Apursomanam chalapratistham | Samudramapah prabisanti jadwat
Tadwat kama jang prabisanti sarbe | Sa santimapapnoti na kamakami

The way ocean never expands to infinite by swallowing millions of rivers, doesn't even cross the seashore, the same way distraction of mind entering into the pure, gets dissimilated, the mind that has seen the ultimate vibration of the universe (Brahman), nothing distracts. Only that person creates a peace of mind, it is impossible to make our mind free if it is connected to materials.

Tani sarbani sangjamya aseet matpara | Bose hi jasyendrani tasya pragya protisthita

Even if only one organ connected to our brain (Indriya), goes beyond control, the ultimate knowledge created in the brain leaks away through that organ-like water goes out of a leaky skin bag.

7 A Complete, Integrated Time Crystal Model of a Human Brain

7.1 BRAIN IS THE ENGINEERING OF PRIME NUMBERS EMBEDDED IN A TRIPLET OF TRIPLET CAGE

Looking beyond current neuroscience: Mapping the entire human brain in terms of biological rhythms: The brain is a noise harvesting machine, a linguistic device, wherein the information unit is a triplet of time crystals run subject-clause-verb/adjective of a sentence (Green et al., 2017). Since the brain converts all kinds of signals in terms of pulses, eventually, letters of brain-language are determined by the variability in pulse shaping and the grammar of this language would have two distinct sections. Information is geometric in the brain (Nie et al., 2014), collective oscillations of hills and crests of information builds human thoughts (Tank and Hopfield, 1987), then, dynamics of time is neuroscience (Rabinovich et al., 2008). First, the basic rules for pulse shaping that makes sure that the pulses are distinctly identified based on their sensory-origins. Second, rules for the superposition of distinctly different streams of pulses. Third, coupling and de-coupling rules among different wave-streams coming from different sensory-organs. However, current neuroscience believes that the brain is all about neurons, no cognitive processing inside a neuron, the membrane does everything, and wiring at the neuron level contains all necessary information for the brain's information processing. The neuron-level wiring is the key for all brain mapping projects, but they ignore, neurons use clocks to talk (Gerisch et al., 1975). Since no two human brains have similar circuits and connections evolve at every moment, we need a new language to read the "circuits in action" for cognition that does not depend on the specifics of the wiring. One such parameter is, to the PPM-GML-H (phase prime metric-geometric musical language-hinductor) triad, the brain has various distinct operating circuit layers both below and above the neuron levels. All circuits in a layer (say protein circuits or cortical column circuits) operate at various frequency domains, thus instead of one at neuron layer, we want to create multiple brain maps at various time domains. All these maps would co-exist and interact simultaneously. Geometric language for brain mapping is rhythms or cycles of vibrations as time crystals generated by the chain of vibrations that connects circuits of all layers. Creation of such a map would enable one to generate quantifiable behaviors using hierarchical temporal maps of the brain (Salthe, 1985).

As the external environment changes, the ripple effect enters inside the brain through a particular frequency domain of the rhythm map of the brain, even a pulse of light could reset a mind (Rusak, 1993; Strogatz, 1990); environment shapes mind (Barrett, 2011). When we listen to others, speech builds an architecture of time (Shannon et al., 1995), inside the brain speech resembles music (Schwartz et al., 2003; Brown et al., 2006). Plasticity of a brain is active even in space (Koppelmans, 2016). On the other hand resonances in the ion-hemisphere affect the rhythms of a human brain (Rusov et al., 2012), the temporal disorder is the key for many mental disorders (Rensing et al., 1987). The internal low frequency or large time period rhythms start changing, the brain and the entire body undergo minimum atomically precise motion at various layers to adjust to the modified rhythms and that we define as decision-making of the brain. A resonance chain of the entire body that links all brain components as a triplet of triplet clocks (Berliner and Neurath, 1965) harmonizes with that of the external environment's perturbation to the internal rhythms. While major brain researchers connect functional domains of brain circuits, there are few yet very important research on event-based coherent communication of brain parts (Andrew and Pfurtscheller, 1996).

Not anyone but all components collectively process information: Neuron holds center stage of neuroscience to artificial intelligence (Reynolds and Desimone, 1999).

The human brain-body structure has so many layers of materials one inside another, circadian rhythms propagate at all layers (Aschoff, 1965a; Aschoff and Wever, 1976). Why not ever anyone thought that the information is not processed at any particular layer, or in between a group of layers, but all the layers build an architecture of time where information is processed. Differentiability or if we measure the variation of two states of a cell between two time intervals or the variation of states between two neighboring cells cannot be defined. Because there are many cells inside and each cell is part of many cells outside. States of each cell are incomplete. As said, a fractal can never be touched. In this case what will be the machine that would work? Since nothing is touching each other but everything is a door to a world within, the only way to communicate is a "resonance chain." Chain of vibration, i.e., time or clocks, the idea advances an old proposal, "brain encodes information using time" (Buzsáki et al., 1994b; Buzsáki, 2006; Buonomano, 2017). Earlier brain science had only ionic rhythm (Bub et al., 1998), now above and below neuron-level we include all forms of polarization, weak van der Waals to atomic in 12 imaginary nested layers. Electromagnetic brain theory came long back (Jirsa and Haken, 1996). The objective would be engineering a brain that would have 12–15 components for processing exclusive time crystals for 15 primes (Figures 3.4 and 7.1a, b).

What is the elementary *decision-making* machine of the brain, say, an alternative of Turing, or a switch? Human brain might not be a discrete sum of machines as we are naturally taught to believe in the Turing world. Since neuromagnetic rhythms flow in the brain with a time period of minutes in space independent manner (Ramkumar et al., 2012), each brain component would vibrate with a selective set of primes as described in Figure 3.4. Resonance chain = specialized PPM of Figure 3.4. We should look at the physical structure of the brain as described in Figure 7.1c, d, find which primes are governing its structural symmetry, make exclusive metric for that component. That metric is the processor of the brain's information as a time crystal. Now, what can this small chain do? (1) Resonate with the big chain to exchange time crystals with each other. (2) Rhythms would expand inside each of them, in doing so they will

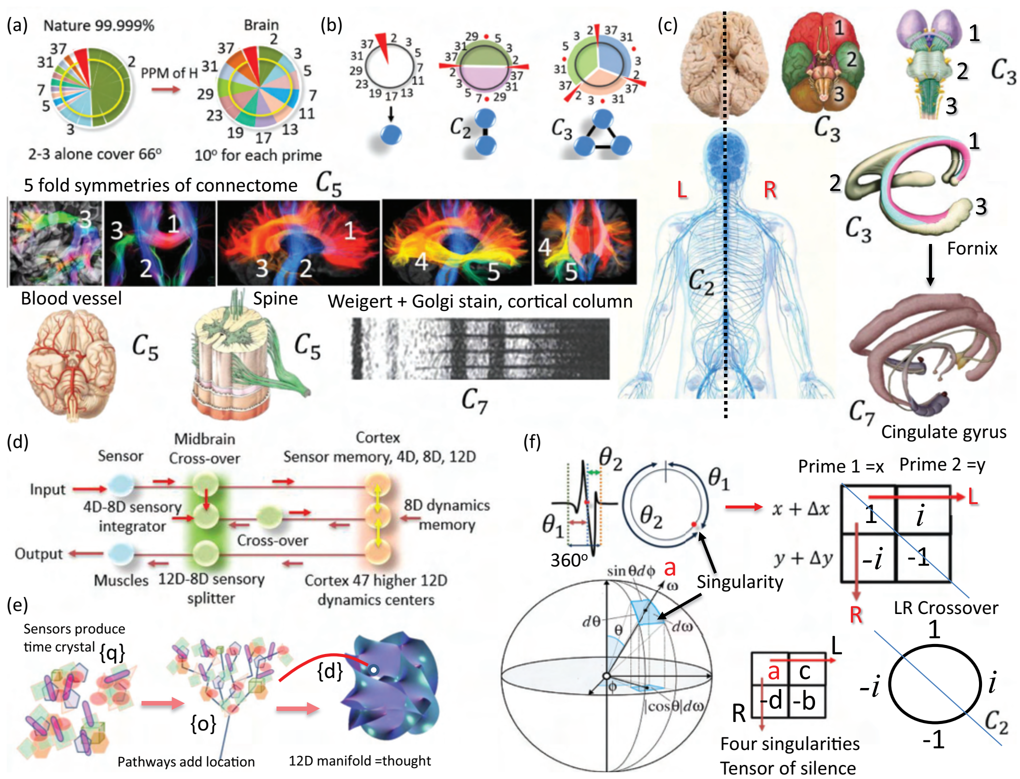


FIGURE 7.1 (a) Two wheels of primes, the left wheel shows the contributions of the primes, the right wheel shows that artificial brain construction means all primes have an equal contribution. (b) The concept of symmetry is applied to select a set of primes in the prime wheel, C2 means 50%, C3 means 33% primes are grouped during operation. (c) Brain's neural network follows C2 symmetry. Three major brain lobes create C3 symmetry, inside the connectome, five prime regions act independently delivering C5 symmetry. Inside the cortex top layer, 47 Broad's functional regions are made of hexagonal lattices of cortical columns, each cortical column has seven layers following C7 symmetry. The spinal cord has five functional domains following C5 symmetry. In the midbrain Fornix follows a C3 symmetry, and Cingulate gyrus follows a C7 symmetry. (d) The three-layered input-output networks of brain's information processing. (e) Three steps for the time crystal-based information processing in the brain. The sensor's time crystal as quaternion, a pathway-based fusion of time crystal as octonion and finally expanding the information to the 12D manifold, a dodecanion. (f) The phase space allocation of brain's information where the components in the brain selectively play the role of diagonal driver of a tensor holding the information for the singularity points.

self-assemble. (3) Some rhythms get stronger and some weaker because of the external input of rhythms, like phase transition. (4) Spontaneous reply back of the rhythm or time crystal to each other by resonating electrically, magnetically and mechanically. (5) Harvest noise, filter it into a signal (Buzsáki, 1989). (6) Geometric information becomes the key factor (Bullmore and Sporns, 2009). So, it will be a new AI, because in the domain of current AI, only neurons work, but here, the entire body is the brain, and we go inside continuously to the molecular scale to complete the resonance chain to define the machine. Also, the machine does not end inside our body it takes metrics of our immediate environment. Design principles of synchronization oscillators by nature in the cellular systems show that it uses a basic geometric language that we use for pattern recognition, the small oscillators are arranged in the elementary geometric shape to generate all possible oscillators. Figure 7.1d shows primes for human-brain body system (C2 symmetry), connectome (C5 symmetry), fornix and cingulate gyrus (C3 and C7 symmetry), blood vessel and spinal structure (C5 symmetry), C47 symmetry in 47 functional cortex regions (Garey, 2006), etc. The symmetry of prime number of components based time crystal model of brain leaves no component, the entire brain-body system is part of the new time crystal model of the human brain model proposed here (Chiel and Beer, 1997). The time gap between interhemispheric transfer tells how information specializes left and right brain (Ringo et al., 1994), thus C2 symmetry activates.

Why do we want time crystal map of the entire human brain? The temporal architecture of the human brain interests many (Llinás, 1994). (1) No two human brains have similar connectivity, and connections in the brain change continuously throughout the life of a person. The mechanics of an observer is unknown, and that is the first step to learn about the brain (Bennett et al., 1989). (2) Natural vibrations or resonant properties are fundamental to any material property, periodic vibrations are rhythms, a complete brain map of rhythms from atoms to the largest scale could unravel a map that would have some features not specific to the hardware of a particular human at a particular time. Rhythm across species must be similar; otherwise they cannot interact, bursting neurons are self-similar (Pinsker, 1977). (3) Be it classical or quantum mechanical, or any physical or chemical event at any scale, everything could be explained in terms of symmetry breaking, so we replace the entire system in terms of "symmetry breaking." Brain size variation across species show that the brain rewires differently with size to keep the symmetry intact (Ringo, 1991). (4) Hierarchy of rhythms, at certain level incorporates nature in its cycle, even to send a picture, neurons create architecture of time and transmit (Richmond et al., 1989). That's why a body learns and adjust with nature without conscious efforts. Thus, we will get to learn why there is life? Now organisms are used as computers, in future, the computer will be organisms, they would live, learn, give birth to a new computer and die. (5) Just like we argue that the brain is a non-computer, universal time crystal argues that there is no communication (Pierce, 1961). When the whole body is part of a one-time crystal composite, there is no need to run separate signal transmission. A conformal replica could be created in the receiver if both sender and receiver are built using a brain that follows the same mathematical rules to link discrete events of the past and extrapolate it to the future. (6). More is different (Anderson, 1972). There are many parts of the brain that are self-similar, fractal-like, following a fixed symmetry, they do nothing. However, sometimes they change the order, symmetry breaks. Anderson beautifully observed in the classic paper that when systems become large, it does not matter how many symmetries the constituents have, giant systems also follow only a few symmetries. Reddy et al. (2018) discovered the metric of primes in the brain, and the metric of prime that we will propose here is conditioned to start counting from 1, as soon as a system completes accounting for first 15 primes (up to 47). (7) Statistics is secondary, the topology of symmetry is primary, so, how many neurons do not matter, how many filamentary nanowires, or cortical columns do not matter (Yates, 1987). The symmetries have a language to talk to each other, and that is the most fundamental knowledge of nature. If we do not know that we cannot learn nature, or our existence. Our objective is to discover that language. (8) The universe is massive, complex, so is the world of elementary particles. The brain is a gift of nature, that is low cost, easy to study compared to building a particle collider or gravitational wave observatory. One phase reset curve builds one-time crystal, a composition of phase reset curves means a composition of time crystals, which is reported for the brain (MacKay, 1991). Stochastic evolution of phase in neurons shows that time crystals may build a new time crystal (Tuma et al., 2016), for delivering a greater control on excitatory and inhibitory properties (van Vreeswijk and Sompolinsky, 1996). It would be exciting to see a brain map extrapolated to the universe. (9). What is the learning limit of a human brain? We want a solution of Chaitin's query (Delahaye, 1989). Singularities in an operating clock are the keys for a time crystal architecture (Malinowski et al., 1985). Phase diagram of a group of oscillators show that there is a collective, unified phase behavior, human brain might integrate many clocks (Matthews and Strogatz, 1990). While integrating clocks, depending on the nature of dynamics, groups of clocks with distinct dynamics are phase clocked with each other (Wang, 1994). Rhythms of motor response argue for a 3D geometry of clocks (Marder and Calabrese, 1996). (10) The pattern of several phenomena is filled in physics textbooks—is the brain designed in the same way nature designs a physical phenomenon? (Small and Garfield, 1985; Agu, 1988; Steen, 1988). The transition from rate code to temporal code is studied for decades (Mehta et al., 2002), this transition is universally captured in the generic time crystal model of the human brain. The delicate relationship between rate code and sub-threshold signals could open up a new world of brain's information processing (Radman et al., 2007). Time crystal model considers the universe of sub-threshold signals, which decides complex signal transformation in the neuron (Ratte et al., 2015), yet brain models do not take them seriously.

How to study the whole brain; is it possible? The frequencies of resonance peaks are fractal, no number of log-log plot would give us a linear relation in the frequency space: The structure models of all brain components are available online. It is also an easy task to simulate the components to find the reflection and transmission coefficients (S11, S21) using a Maxwell equation solver, then verify the properties by printing those components using a 3D printer and measuring the coefficients, confirming with the theory. Conventional brain models that are now trying to reverse engineer brain by deep learning (Yamins and DiCarlo, 2016) consider only neuron-skin or membrane route. Therein, the brain components vibrate using a singular natural logarithmic relation (Penttonen and Buzsáki, 2003). Here in this book we compile research works on the clocking properties of all brain-body neural network, do not leave any component. One has to simply plot the transmittance and reflectance as the resonance peaks of the brain components along the frequency scale, shift in frequency as a function of time is the origin of a clock. Even if we take a log of frequency in the primary axis, the plot looks like as if the resonance frequencies are separated by a log scale, normally peaks should appear equidistant after taking the log scale. Since log values are separated by a linear distance, if we take the linear values and then plot the derived resonance frequency once again, we find, it is a log distribution once again, the log feature or the non-linearity cannot be diminished. It means the frequencies are separated by a log function inside a log function inside a log function. Possibly this would continue both in the brain and in the universal resonance chain, that links brain components in the frequency space. It is a nested frequency fractal, a prerequisite to building a time crystal, and it is non-differentiable. If there is a homogeneous distribution of power among all resonance frequency values when the architecture of the multi-layered seed structure (or escape time hardware) is being formed, then the architecture should adopt a symmetry that allows it to maintain an equal power loss throughout. If the equal power loss is maintained in a scale-free manner, the lower frequencies would be spaced much nearer, now the power law is a conservative claim, the exponent of the power relationship holds an infinite series, thus generating a log inside a log inside a log function (this is not log(log(log(frequency....)))), it is non-differentiable, thus non-Turing.

Triplet of triplet resonance band in the universal resonance chain: Rhythms of very different natures are so intimately connected in the brain. Silent circadian rhythm, thermoregulation disappears (Fuller et al., 1978), the wave of ions interacts with the waves of heat flow. All resonances are linked. It is striking to see that when we look at the PPM plot, it is a triplet of triplet coupling of the distribution of divisor choices of the integers and protein complexes like microtubule generates a triplet of triplet pattern (Figure 6.12). Even more striking is that twelve brain components reveal the triplet of triplet resonance bands (Reddy et al., 2018). In the universal resonance chain or the global time crystal plot resembles that of "teardrop curve" or "pear-shaped plot." The parametric equations for universal resonance chain would be ($x = \cos t, y = \sin t \sin^m(t/2)$) for teardrop curve, and for the pear-shaped plot we get $b^2y^2 = x^3(a-x)$ (http://paulbourke.net/geometry/teardrop/). Note that we need multiple values of p in the domain $0 < p < -1$, for $i^2 = -1$, to create a generic fractal equation for the universal resonance chain. It is interesting to note that the inverse Mandelbrot plot also takes the form of a teardrop, but we are not concerned in shape but the patterns inside. One could generate fundamental constants to five digits after the point at least, from the universal resonance chain, as if the brain is a universe in itself, geometric constraints unfold just like the universe.

The birth of a clock in the brain: When matters vibrate periodically, a system point runs in a loop, its rhythm for biologists, clock for physicists. For a self-operating perpetual oscillator-pair, circling of energy packet between a pair of elements is essential and that vibration comes from matter. While exchanging energy, a part of that energy is never found in any of the participating atoms or systems; we call it bond energy. It can happen at any scale. When a matter or system gets an energy packet, where does the energy go? It goes to the structural symmetry. The symmetry defining part always takes the energy to vibrate, so, physicists found a remarkable tool in symmetry, replace every matter by its structural symmetry. Thus, from the above discussions we can perceive that two different systems have a composition of multiple symmetries, each symmetry has characteristic vibrational frequencies and when they get populated by energy packets, they vibrate. Two matters can exchange energy by sending photons of an electromagnetic frequency, pumping the medium in between mechanically or by sending materials. Among three, all of them or a pair or individually the systems can start exchanging the energy and interact. If the exchange is once, they are not coupled, but if it is periodic due to two or more interplaying forces inversely proportional to each other, then cyclic energy exchange arises and a periodic oscillation or rhythm is born. The temporal structure in the spatially organized neuronal ensembles reveals that the clocks have a hierarchical network (Buzsáki and Chrobak, 1995).

Experimental keys for the fractal time operation in a meander flower garden: Meander flower garden is probably the best contributions made by the three decades of time crystal movement (1970–2000; Figure 2.7c–e). Meander flowers are like various classes of cycloids, epicycloids, and hypercycloids, could be realized by placing a guest clock at various positions on the host clock. More than a century back, in the planar curves such geometries were reported (Eagles, 1885). Nested clocks are the foundations of a time crystal, consequently, from biology to nature to culture, meander flowers rule (Collins, 2000; Leopold and Langbein, 1966). Whenever one measures the electromagnetic resonance band of the biomaterials, the reflectance and transmittance peaks shift as groups. These groups are keys to the geometric shapes, i.e., GML, for example, three peaks oscillating in a group means a triangle is encoded. Now, how does the resonance band change with the additional input signals in the form of electromagnetic, magnetic, mechanical, electromechanical, or ionic vortices? That's the key question for the brain. In this book, throughout, for artificial brain or real brain, the composition of vortex atoms forms the time crystal and arrange in a unique geometry operate the GML and PPM. The composition of distinct PPMs each for different types of vortex atoms operate simultaneously. Each PPM is a meander flower garden, and the composition of PPMs is a garden of gardens (Figure 2.7c–e). Even if there are a large number of objects in an image, the brain has to identify the abstract geometrical relationships among different objects and creates an equivalent fractal for that abstract relationship also. In case of several different kinds of sensory input data, due to the natural property of frequency fractal of the hardware, the patterns in different parts of the artificial brain hardware (the entire brain is a single fractal object) get correlated, and a new fractal of seed geometry is formed. The brain circuit undergoes subtle changes to incorporate these features. In this way, visual, sound, taste, touch, and smell data get correlated in the hardware. It should be noted that for the highest-level operation of the brain fractal hardware, the basic seed pattern of the new input fractal is the highest-level perception data, this is saved in a very particular region, these 47 cortex regions known as Brodmann's regions. The new fractals made of geometric shapes are stored in the brain only when it does not match the existing patterns; if it matches, there is no question for the hardware to store anything new. Adding a flower in the garden is a thought, adding a garden is learning of the intricate skill.

7.1.1 Four, Eight, and Twelve Imaginary Worlds Work Together

Scale-free activities in the brain: Evolution of the brain argues for a scale-free parameter for the animal kingdom (Martin and Harvey, 1985). Signals propagating in the brain are not just connected by frequency; there are ten parameters, the transition from Fast Fourier Transform to time crystal analyzer means acquiring information from nature never acquired before (Figure 2.8e). Phase locking in the propagating signals has been measured in the brain (Lachaux et al., 1999). Multi-input, multi-output, non-linear dynamic modeling of the brain argues for an extensive hierarchical information processing (Berger et al., 2010). However, instead of massive architectures, only the free energy principles have been used to explain learning and creativity/intelligence (Friston et al., 2011, 2006), and this is possible because of scale-free brain functional networks (Eguiluz et al., 2005). Therefore, multilayer phase network, which is the foundation of several brain models is not an imagination, it's an extrapolation of a concrete experimental observation. As per the energy expense, skeletal muscle is the first, the liver is the second, and the brain is the third; as per the information expense, a sensor is the first, midbrain is the second, and cortex is the third (Figure 7.1e). It is already well established that the neural network in the brain evolves its circuitry toward a metabolically efficient architecture. The dynamic synchronization of electrical activity fluctuates in a scale-free manner all over the brain (Gong, et al., 2003), even in the ECG (Hwa and Ferree, 2002). The neurons form clusters of a time crystal (Figures 6.13 and 6.14), larger is the cluster, lower is the frequency of resonance. Since larger cluster requires more power to operate, the power-frequency relationship in the brain would follow an inverse relationship. It has been shown that human brain operates via nested frequencies; it is not a band with continuously allowed frequency values (He et al., 2010). The symmetry of structure helps in modulating time. The brain has two hemispheres exhibiting a C2 symmetry and prime 2. Here the timing difference between the two hemispheres have been linked to a special selection of functions (Ringo et al., 1994).

People survive without a complete brain; brain shows extreme plasticity: If due to hydrocephalus the entire cerebral cortex region disappears in the brain, the person with an empty brain still survives and lives well, but we panic seeing a giant hole in the brain, with almost no cortex region. Fiber pathways of the brain not important (Schahmann and Pandya, 2006)? When an MRI scan shows a giant hole in the brain with a thin layer of cortex surviving, we wonder if this man is conscious of what brain builders are doing by mapping the neurons of a whole brain. The madness in replicating the cortex region for artificial brain needs a revisit, why 20 billion cortex neurons out of total 85 billion neurons do not matter to his consciousness (Wheeler, 1981). Performing basic information processing is possible even without a cerebellum. Recently a Chinese lady was found without a cerebellum, and except temporary nausea she did not feel any problem until age 23. If half of the brain is cut off, the other half takes over, even the medical cases are there without a brain at all, more than age 2 or 3, the babies fail to survive. If enough time is given, the brain cleans up and rebuilds an equivalent of the system largely. The drive to locate consciousness at a particular place, object or process is weak, the lookout for a magic switch to consciousness is primitive. Neuron size, number, and density, nothing single-handedly determine the degree of intelligence. The brain is largely a self-similar structure of cavities nested one inside another, cross-talk between clocks is common (Asher and Schibler, 2011). The cavity is a robust concept, it is a function of wave functions frequency or wavelength, and the nature of the wave determines what kind of material we need to build the pot. A hollow metal ball is not a cavity for a sound wave—for the sound, the object does not exist almost—but it is a cavity for electromagnetic wave. Neurons believed to float in the ocean of ions, what if they float in the ocean of electric fields like an electric eel (Rommell and McCleave, 1972). Whereas for a hollow glass ball, it is a cavity for a sound wave, and for electromagnetic wave it does not exist. The brain is not just a cavity network. The cavity ensures a closed universe for the surfaces to operate. The brain is a nested architecture of time for topological materials too, the surface geometry of objects is designed following the symmetry of prime numbers in such a way that it can produce time crystals in the various frequency ranges and dimensions. The brain has three layers, sensors produce quaternion tensors, the pathways and midbrain produce quaternions and the cortex produces dodecanions as 12D manifolds, i.e., thoughts (Figure 7.1f). Since every human has a different neural network, the map, how all neurons look in a brain is a quest driven by madness, similar madness would be if we go for mapping the cavity, or surface architecture from bottom to the top. What that is invariant in the brain is the symmetry of the primes. Thus, PPM and time crystal made of GML would be the key to find a brain model that would enable researchers across the globe to study it comprehensively in a lab-protocol independent manner.

Sensors are part of the artificial brain, a network of the skin is similar to cortex; clocking genes are everywhere: Until now biological clocks were limited to a group of neurons. When we experimentally establish that those clocks do not end at the neuron skin but are connected further down below to a protein scale (Sahu, 2013a, 2013b, 2014; Ghosh et al., 2016a), our body becomes an integrated chain of clocks, from the atomic scale to the ultimate boundary. Even very recently, the body's master clock was two small spheres—the suprachiasmatic nuclei (SCN)—in the brain made of 20,000 neurons. The 6,000 astroglia mixed in with the neurons we considered silent, but it is just shown that astrocytes clock those neurons, both clocks cross-talk (Tso, 2017), Almost all body cells, e.g., lung, heart, liver, and sperm keep time, with a few exceptions such as stem cells.

All pulses are similar in the brain; the necessity for inventing a new kind of time crystal sensor: Currently neural code alone build's brain code (Kuffler and Nichols, 1977; Konishi, 1990). Its fundamental action, integrator or coincidence detector is under question (König et al., 1996). Once we learn how to read the streams of pulses, we can capture the signal from any part of the brain and read them as a language, if essential, we can talk to that part in principle. As a first step, we invent a new type of sensor. In the day-to-day camera, or sound recorder, we store the picture as is. Every visual image is divided into a 2D array of pixels, and we store those pixels in the memory device. The location of a pixel, the intensity and color corresponding to that pixel is stored in the 2D grid, we call it "negative." The original picture is recovered whenever that is necessary as "positive." For a sound recorder, similarly, we store intensity and frequency exactly as is; the voice stored as a stream of bits of information could be replayed in the tape recorder whenever necessary. While generating an identical replica has been the fundamental inspiration behind human technology, nature has done something completely different. The problem is that, when we look at the pulses inside the brain, to us, electronic pulses coming from all organs look similar, neural code of events is unknown (Mountcastle, 1967). In the last hundred year, scientists have tried to understand how these pulses are generated in the specific organ say eye, and almost all the person who contributed fundamentally to this mission, have been awarded the Nobel prize, however, the next step, how every single information is exactly encoded in those streams of pulses has not been understood. That means, if we put a probe inside the brain, and we observe a stream of pulses, they will mean nothing to us, we cannot read them, or even tell whether it's an optical data or sound (Carr, 1993). In this chapter, we will create a generic model of interpreting those pulses to implement the information gathered to develop the artificial brain like a computer.

Metabolism, plasticity and power consumption: **in the brain:** Live video images of electric signal transport along with the brain show that the total active area remains nearly constant, it could possibly be due to a lossless energy transmission of energy packets across the brain. Widely distinct metabolic and circadian clocks talk to each other (Asher and Schibler, 2011), each rhythm compensate for the other's loss (Brinkmann, 1971; Chandrashekaran, 1974). Since solitons move with the velocity of sound resembling strongly to the experimental observations, researchers have argued for such a lossless transmission process in the brain. One additional argument for soliton-based transport comes from the energy-expenditure calculation for the synaptic firing. We do a simple calculation from the experimentally observed data to estimate how much energy is required for the human brain computing via synaptic junction firing, as the primary process. Metabolic cost unifies all brain components to deliver a scale-free feature (Hasenstaub et al., 2010). For a single neuron firing, it is around 100–120 mV bias change and the current change is 1–10 μA, which means the power required is around 100 nW. There are around 10^{14} synaptic junctions in the human brain, if say 1% of the total neurons fire at a time, then it would require 100,000 watts; however, the brain operates spending only ~20–25 watts. Let us get deeper into this argument. A neuron hydrolyzes 10^{10} ATP molecules per second to get its operational energy, which is around 3 nanowatt power supply, considering 10^{11} neurons in the brain, 1% of brain usage costs 3 watts. Since we know very well that the brain uses an average of 25-watt power, roughly we use 8% of the brain. The calculation seems to be pretty convincing, however, we miss a very interesting part of the story, neurons fire at a speed 1–40 Hz, what would be the source of energy that sends signals to large distances across the brain and asks them to fire? That process should cost a minimal amount of energy per neuron (Suzana, 2011), and minimum time, because chemicals to travel from one end of the brain to another, it will take a very long time. Conduction velocity of action potential = 0.6–120 m/s, which is roughly the 30% of the velocity of sound, and neither ions can move this fast, nor electrons, if for the time being we ignore than the magic of quantum mechanical entanglement playing a role, then the only possibility left is soliton which moves with the velocity of sound (Heimburg and Jackson, 2005; Poznanski et al., 2017). The argument inspired many to reject the firing-based computation protocol and implement an alternative (say soliton-based) computation. The question is that an engineer who wishes to construct the brain must learn how to send the question to all 100% audience, remaining silence is their choice, but that does not mean, he won't ask the question. Soliton is a nice idea to interact, because, the sound vibration can travel all around the brain with ease, if it matches with the encoded resonance signatures it starts to vibrate resonantly (Suzana, 2011; Howarth, 2010).

7.1.2 Singularity on a Sphere—The Key to a Clock of a Time Crystal

High-frequency oscillations nearly 1 kHz have been correlated to cognition, such high-frequency oscillations are at the limiting time resolution of ionic impulses (Kucewicz et al., 2014). One of the problems in explaining high-frequency ionic transmission is that if pulse timing reaches the limit of ionic transmission, and cognition arises in that time domain, the controls must be happening at a faster time scale (Worrell et al., 2008). However, the ionic transmission has reached its limit, so we need another mode of communication. In the existing neuroscience there is no provision for other modes of communication. The geometric language that explores singularity enables complete shutdown of a particular vibrational mode and the other unrelated mode to take over. The transition from one clock to another happens via a burst from a singularity point (Figure 7.1g). One could represent a single clock with four singularity points at maximum using a 2×2 tensor. In Figure 7.1g, a diagonal is drawn to present C2 symmetry of the clock and the structure that builds the clock. One of the most exciting parts of the brain model is one-to-one correspondence between shape and the symmetry, but not the information content. The geometric shape of the information is always invisible.

It is so beautiful to think that eye, skin, ear, nose, and tongue all sensors get 11D information packet from nature using a dodecanion tensor. One Bloch sphere presented in Figure 7.1g cannot represent the whole brain but an elementary device, more spheres need to be connected to represent complex information (Figure 2.2c). The mystery of the brain is in the sensors, which use a pattern of primes to get back to nature and ask external agent if some parts are missing could it fill that gap. Think about 47 layers of Brodmann's region in the cortex. Because the ratios of the mean frequencies of the neighboring cortical oscillators are not integers, adjacent bands cannot linearly phase-lock with each other. Instead, oscillators of different bands couple with shifting phases and give rise to a state of perpetual fluctuation between unstable and transient stable phase synchrony. It is true about the resonance chain too. The $1/f\alpha$ power relationship among different layers in the brain implies that perturbations occurring at slow frequencies can cause a cascade of energy dissipation at higher frequencies, with the consequence that widespread slow oscillations modulate faster local events. The scale freedom, represented by the $1/f\alpha$ statistics, is a signature of dynamic complexity, and its temporal correlations constrain the brain's perceptual and cognitive abilities. The $1/f\alpha$ (pink) neuronal "noise" is a result of oscillatory interactions at several temporal and spatial scales. Singularity is a filter to noise.

7.2 PRIMES IN THE FIVE SENSORY SYSTEMS

All components described in Sections 7.2 through 7.5 were built artificially using cables by Singh et al. (2018), and the rhythms reported in the literature were regenerated in a large device, before their miniature versions were incorporated into the humanoid avatar described in Chapter 9. In all five sensors a stream of electric pulse-based wave trains is created and sent to the brain via a nerve bundle. First, all primary information is stored in the typical nature of the pulse (growth and decay rate, amplitude and coupling of more than one pulse). Second, gridding; it means 2D periodic pulses, each at the corners of the four-sided cells that groups a set of information (Figure 2.8c, d). Third, several 2D pulse-streams are superimposed on the background waveform; suitable filtering hardware could isolate each 2D pattern separately. Be it sensory or memory, three protocols would build time crystals (Figure 2.6) and the corresponding garden of gardens of meander flower (Figure 2.7c–e). Information is encoded in the neural assembly by spike intervals; there are three kinds of responses, mainly. First, "direct response to external stimuli"; second, if the time gap is more between the spikes, then it slowly adopts and then starts responding. There are two types of adaptation, first, "build-up to the necessity," wherein, signal response increases as the number of pulse increases; second, "bursting with a logical time crystal," wherein alternative periods of responsive and silent modes are observed. While describing the grammar of eye-pulse, tri-phase signals are used, tri-phase means two peaks with a negative trough in between them, and the ratio between the crest and trough stores a clock, multiple such sets build a time crystal. The similar pulse signature is common to store and process time crystals for all organs and neural assemblies.

Music and the human brain: Brain's eye movement processing exhibits distributed parallel processing and tensor theory is found to fit well (Anastasio and Robinson, 1990), paving the way for the dodecanion tensor analysis. Just like microtubule is the deserted DNA, it never got the honor it should have received as the coder of metabolism of life, an ear never gets that honor as the eye. The human brain stem, a key center for consciousness shifts its activity significantly with the complex sound (Erika and Nina, 2010). It suggests that conscious human response is related to time crystals that are key to the geometric structure of music. The ear is a fractal drum (Sapoval et al., 1991). Often it is shown that auditory cortex naturally processes key grammatical features of music, as if it is designed to understand music (Elvira et al., 2006; Large and Palmer, 2002). One-to-one correspondence between the thought process of the brain during music and auditory cortex supports this hypothesis (Zatorre and Halpern, 2005). Not just the brain stem, both left and right hemispheres are seen to play musical notes (Tramo, 2001). Moreover, that musical firing inside is also visible in EEG, one could find a mathematical construct when EEG displays music like rhythmic tones in its behavior (Snyder et al., 2005).

Why do we have two ears, two eyes, two noses and a symmetrically divided tongue and symmetrically divided body for sensors? Each half produces a time crystal, when combined, two-time crystals with C2 symmetry merge to resolve the local very small size parts of the time crystals that are not common between the two parts, which helps the organ to analyze remarkable thing. For example, by merging, time crystals of eyes determine two angular parts in the brain so that we can perceive the 3D image, two ears resolve the distance from which the sound is coming. Two nostrils, one remains wetter than the other, and they interchange this feature time to time, so in this way they change the molecular detection efficiency, wet one gets the higher energy part of the molecules and the dry one detects low energy parts of the molecules efficiently. Similarly, two symmetrically divided parts of tongues tell us the gradient of different elementary tastes, i.e., analog values in the detection scale. For the touch sensor, the symmetric body does the same—it creates a virtual analog gradient of temperature sensitivity, moisture sensitivity, etc. Simultaneity in the sensory signals, e.g., audio-visual simultaneity is essential for brain cognition, the non-linear temporal pattern that emerges simultaneity (Benedetto et al., 2018), demands a time crystal as if time really matters for all sensors (Cariani, 1995).

The cognition via visual control system

[Vision Circuit → Optic Chiasm → Thalamus → Visual Cortex → V1 → V2(complex shape, color) → V3(angle, orientation) → V3a (motion + direction) → V5 (Parietal lobe, fusion form gyrus)] Prime: 13, 7, 5, 11, 3: Detecting a time crystal requires detecting a shift in the resonance peaks (Groma et al., 2004). Only then the higher-level clocks reveal themselves, it seems while engineering the human eye 13 types of cavities work together to sense visual input (Figure 7.2a). A clock needs feedback and a feedforward signal transmission, else the loop is not complete (Zipser and Andersen, 1988). Such a network is shown in the visual cortex domain (Michalareas et al., 2016) where five-fold symmetric paths operate (C5). Temporal patterns are resolved by motion-sensitive neurons in the primate visual cortex (Buracas et al., 1998). The brain cannot process all objects accurately in a particular visual image. Isolating the parts is equally important as conversion into time crystals since one need to pick up what to process, at the same time, keeping an eye on the other parts of the image. Asymmetry in the neuron geometry alone cannot explain how eyes sense direction (Anderson et al., 1999). While transcranial magnetic stimulation of the visual pathway shows a periodic oscillation (Amassian et al., 1998; Ilmoniemi et al., 1999). To build a time crystal, self-similar arrangement of neurons is needed and at least cats visual cortex have it (Binzegger et al., 2005). Time crystal-like oscillation of these pinwheel arrangement is reported (Bonhoeffer

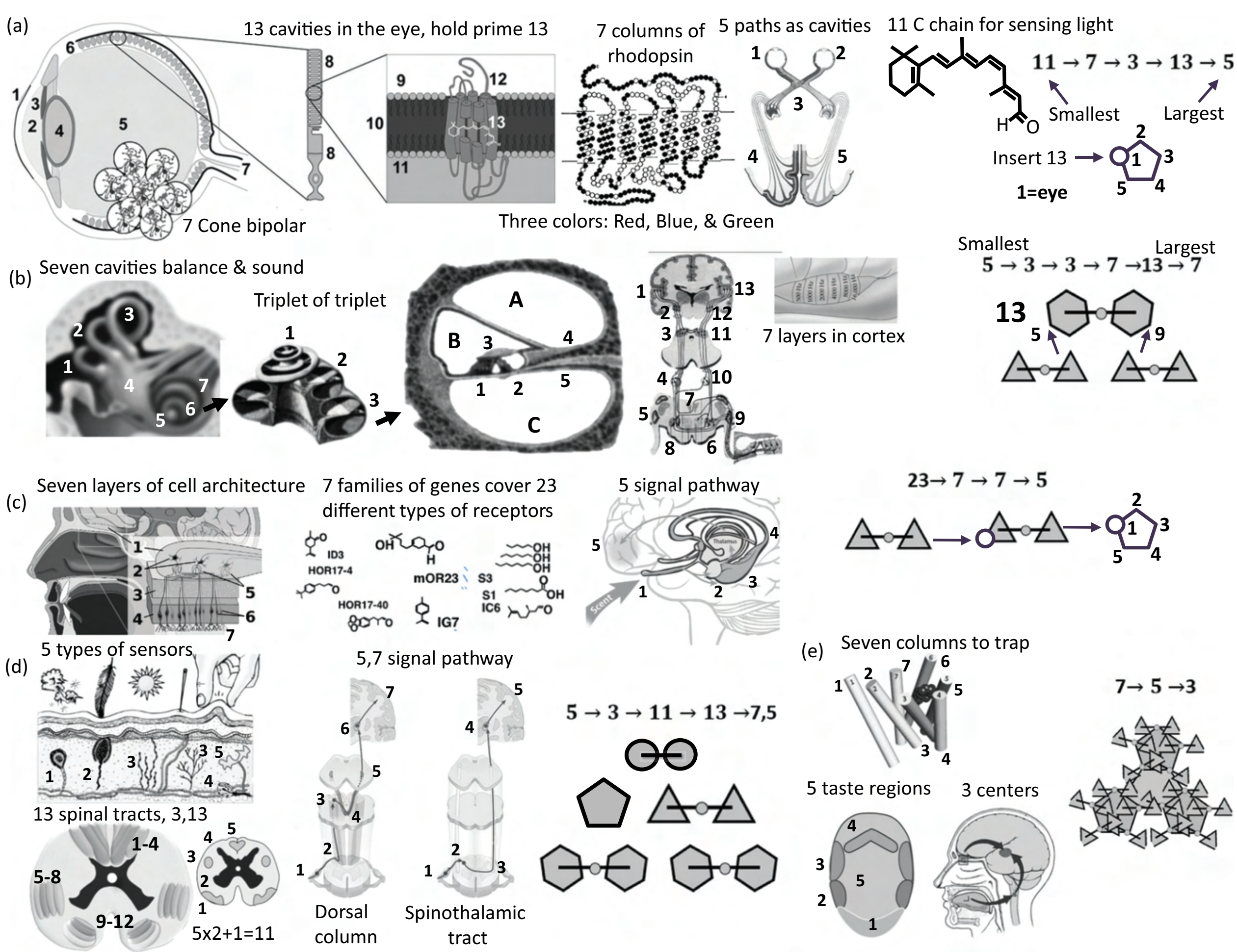


FIGURE 7.2 (a) Components related to prime numbers in the eye. (b) Components related to the prime numbers of our ear. (c) Components related to the prime numbers in the nose. (d) Components related to the prime numbers in the skin. (e) Components related to the prime numbers in the tongue.

and Grinvald, 1991). The orientation columns in the visual cortex adopt unique geometries to sense projected signals (Braitenberg and Braitenberg, 1979). Geometric arrangement regulates phase-locking conditions between different visual memories (Lee et al., 2005; Braitenberg and Schütz, 1998). The combination of parallel and serial processing in the visual cortex hinted toward a distributed computing (Bullier and Nowak, 1995). The idea of a time crystal as a regulating factor emerges from the temporal patterns of visual cortex (Buracas et al., 1998). High-frequency rhythmic and non-rhythmic signals engage in fast synchronization in the visual cortex suggests a general principle that could govern spatiotemporal coding (Eckhorn, 2000). Low-frequency signals regulate long-range synchronization (König et al., 1995). Together they build a temporal architecture which controls visual form that we see (Lee and Blake, 1999). Temporal architecture is the visual form, because it can explain spontaneous bursts with no trigger, even the bursts have topologies like stripes, rings, spirals, etc. (Fohlmeister et al., 1995). One of the fundamental signatures of time crystal is temporal beating, i.e., the frequency difference between two waves forms a new clock (Hammett and Smith, 1994).

Seven columns of rhodopsin molecules with three color sensing pigments convert light into electric pulses via 11C chain molecules, we find C7, C3, and C11 symmetries operate in harmony. Irrespective of the nature of visual, seven different kinds of electrical nerve pulses acquire all kinds of visual information in the retina (Victor, 1999), which takes part actively in shaping the 3D waveform sent to the brain via eye-bundle of nerves. The pulses are connected to point singularities and they distribute topologically (Tanaka, 1995), to hold geometric information. Moreover, the axons in visual cortex arrange in a fractal shape (Binzegger et al., 2005), self-similarity helps in closing a time loop. There are several different kinds of cells, which take part in the photon to a particular electronic pulse conversion process. The 3D waveform is a 2D matrix with variable amplitude, the rate of change of pulse with time contains the phase information and the base of the 2D matrix simply provides the coordinates. Optical illusions reveal such interactions (Tallon-Baudry et al., 1997). 2D matrices are continuously sent as time changes. We have argued above that all sensory organs keep particular places in the grid-free for others to contribute; the same principle is applied for a large number of sensory cells in the eye too. Thus, if sensory cells reach threshold and fire, contribution automatically finds its place in the grid, thus, an automatic classification for the dimension of an object, color, shape, is made in the superimposed grid, as a dynamical organization of clocks (Uusitalo et al., 1996).

Engineering the auditory system

[Auditory circuit → Organ of Corti → Cochlear nucleus of spinal cord → Superior Olive (side of brain stem) → Inferior Colliculus → thalamus → cortex]: Seven tubes (C7) in the inner ear senses sound and keeps body's balance (Figure 7.2b). The cochlea has a triplet of triplet structure (C3). Within that structure five resonating parts transmit sound for sense. Sound is required for enhanced perception of reality (Johnson and Coxon, 2016). In the pattern of sound, often, one could find geometric symbols hidden in the vibrations (Linton, 2009), geometric theory of auditory signals is old (Licklider, 1959). Auditory signals are captured by giant tuning forks located in the ear that vibrate resonantly with the sound signal. Visual imaging of auditory signals shows classification (Tani et al., 2018) or nested groups. For all sensors, we are using resonant oscillators, since the wavelength is less for light (400–600 nm), the eye requires very small size molecular optoelectronic resonant oscillators, but for sound wavelength is large (300 m), therefore the drum required is quite large. A large-scale coherent neural assembly operates connected to the drum over a sub-second time frame (250–300 ms), voltage-sensitive dyes (VSDI) provide high-sensitive (both temporal and spatial) real-time imaging of the neural activity. While capturing visual signal, the human brain is most sensitive at the point of stimulation, but for the auditory signal it is most active at the superficial layer, as the brain is not interested in the spatial distribution of the auditory signal. In addition, neural assemblies are organized in such a way that, naturally, the visual neural assembly responds faster than the auditory counterpart in the first 120 ms response time. However, after 250 ms, the visual neural assembly response falls sharply, while a linear increase in the signal response of the auditory signal is observed. Signal integration time for the auditory response is much larger than the visual one.

Deaf people convert sound into a sign language (Zaghetto, 2012). The sound could be sensed from anywhere; for example, whales hear the vibration of the skull (Cranford, 2015). Even proteins are triggered by sound wave (Xiujuan et al., 2003). Brain stem filters the complex sound into multiple time-domain (Erika and Nina, 2010). Panoramic view of the environment where the sound comes from originates in the seven layers of brain cortex (C7), responsible cortical neurons classify 360° views as time period of a clock (Middlebrooks, 1994). Auditory cortex not just builds electrical but a 10 Hz magnetic rhythm (Lehtela et al., 1997). One requires three rhythms electrical, magnetic and mechanical, for $e-\pi-\phi$ control. To the right of Figure 7.2b, we have shown geometric shapes for each auditory system in terms of primes. In GML, 3D geometric shape embedded in a time crystal is the control.

The fundamentals of the smell control systems

[Olfactory circuit → smell → Olfactory lobe of the limbic system (looped around the primitive brain) → Amygdala → Cortex]: The nose was the first organ created during the evolution of the animals. Therefore, its nerves are very close to the brain-stem where from the fundamental control of our body, heart-beating, lungs-breathing (respiratory rhythm, Lewis et al., 1992; singularity in respiratory rhythm, Paydarfar et al., 1986; geometry of respiratory rhythm, Sammon, 1994), and motor nerves are controlled. On another planet, if the environment is such that the touch is favored, one could find touch controls near the brain stem. Temporal coding of odor and music have a similar geometric structure in the brain (Plailly et al., 2007; Wehr and Davidowitz, 1996a; Wehr and Laurent, 1996b). Similar to the human nose, one could use a "lock and key" principle of supramolecular chemistry, where a single molecule could sense a particular smell-molecule. Seven families of genes with 23 different types of receptors follow 5 signal pathways to deliver the cognitive experience of odor (Figure 7.2c). Each sensory cell has several fine hair-like cilia containing receptor proteins that are stimulated by odor molecules, however, there is no permanent chemical change. Hence, a resonant and wireless communication is triggered to sense odor molecules and then the locking is removed. However, it embeds a special pulse-cluster synthesizer attached to the molecular sensor, for a particular kind of smell a distinct spike-pattern or temporal architecture is created (MacLeod and Laurent, 1996). The number of activated receptors determines the intensity of the stimulus, the layer of neurons located beneath the sensory molecules in the olfactory bulb generates a synchronized wave (Onoda and Mori, 1980). These waves have been recorded in the electroencephalogram (EEG) tracings, rise in the wave-amplitude indicates the intense sensation, and fall is caused by inhibition. Note that EEG records information for thousands of cells at once (Tani et al., 2018). Reinforcement technique is a beautiful feature of the nose; some neurons remain as a buffer between the neurons in the bulb and the neurons of the olfactory cortex. These buffer neurons activate suitably during training and strengthen the connection for generating a complex signal response, such that a species could have a peculiar sense of a complex combination of smells. Thus, if trained a complex smell signature could carry an extremely vital environmental change or threat or even a very particular event, this tool could alone serve as an extremely intelligent encoding machine.

The touch sensor controls

[Touch detection circuit → Touch bud → spinal cord → thalamus → cortex]: Five types of touch sensors are distributed all over the body surface (Rose and Mountcastle, 1959), and experiments have shown that the brain relies on the collective response of the touch sensors (Figure 7.2d) to create a packet of time crystals regarding the body-shape that it needs to protect under external attack. Touch sense is used to determine size, shape and texture of an object, and according to the need, density, and pattern of distribution of sensors are varied to sense more or less pain, and touch discrimination. A slight movement of the body-hairs could sensitize the touch sensors distributed all over the body; the whole body is divided into particular regions in a very ordered fashion via 13 spinal tracts of a neural network to transmit touch senses from individual parts of the cortex via the spinal cord (Figure 7.2d). Temporal synchronization is the key to a couple of touch sensors across the body. By touch, the brain detects vibration (Keidel, 1984).

Touch sensors also require a permanent memory hardware mechanism; therefore, it was involved in the process dozens of chemical messenger and receptors to sustain pain if the condition continues (Khamis et al., 2015), in the artificial brain, we could altogether replace it with physical permanent memory processing protocols as described in chapter three. Information gathered from touch sensors requires three kinds of responses, first, immediate response by moving a muscle or the body-part, the decision is taken via spinal cord (Dorsal horn loop). Second, pain message is sent to the brain, and instruction for inhibiting the excitation comes back, the process involves thalamus and cerebral cortex. Third, always, for all kinds of pain and touch senses a part of the signal is sent to the hippocampus and this particular brain stem region controls complete situational analysis by sending it out to the upper brain, cross-checking previous learning and then a comprehensive decision is taken, output is sent to the cerebellum to execute action.

Engineering of the taste sensor controls

[Taste circuit → nucleus of solitary tract (brain stem) → thalamus → cortex]: In Chapter 9 we will describe training a nano-brain, arguing that an idiot baby brain gets trained by following three basic desires of a life form, first, acquiring food; second, defending the safety of the body; and third, taking reproductive measures. When a body looks for basic foods, just to run the body, it does require the test buds to cover a range of tastes that provides signature that the food is suitable for the body or not, whether the food contains more calories or not, even, the concurrent necessity of the body could also be reflected in the tongue-sensory-response. The tongue is a chemosensory assay of five basic tastes (C5); each taste bud has sensory molecules with seven helical columns (C7), which adsorbs molecules (Figure 7.2e). Different regions have distinct taste buds triggering both chemical and non-chemical responses. Adapting to a particular taste always decreases its sensitivity to a particular taste, and particular chemical concentration always helps in reaching maximum efficiency. The learning of the taste sensors has twofold importance: First, if the sensors are exposed to the polarizing pre-conditioner, it acts as an exhibitor, the sensitivity decreases; second, if the pre-conditioner is de-polarizer, then it acts as an inhibitor and the sensitivity increases.

7.3 PRIMES IN THE CEREBELLUM, HIPPOCAMPUS, AND HYPOTHALAMUS

Cerebellum: Cerebellum has 13 cavities that are filled with a fractal neural net; the cavity boundary has seven layers and as a whole entire structure have generic seven major folds (vertical cross-section), and two major fold in horizontal cross-section (Figure 7.3a). It reads the final decision fractal from the hippocampus and its hardware is a tree-like a fractal network of neurons (Bell, 2002; Werner, 2010). Multiple generations of fractal wiring enable learning complex sequences of mechanical movement coordination (Thach, 1998). It sends extremely synchronized signals to all sensors for better data capture for improving the decision-making process and actions for the organs like a high precision machine (Eccles et al., 1967). Since we use frequency fractal as a tool for information processing and at the beginning of our discussion, we noted that we construct frequency fractals such that if all time crystals from all sensors are fused; therefore, we do not need additional hardware to identify which signal belongs to which organs. A flat map reveals 2D one-to-many connections (Hurdal et al., 1999). When the final decisions come from the hippocampus, mechanical movement controlled by

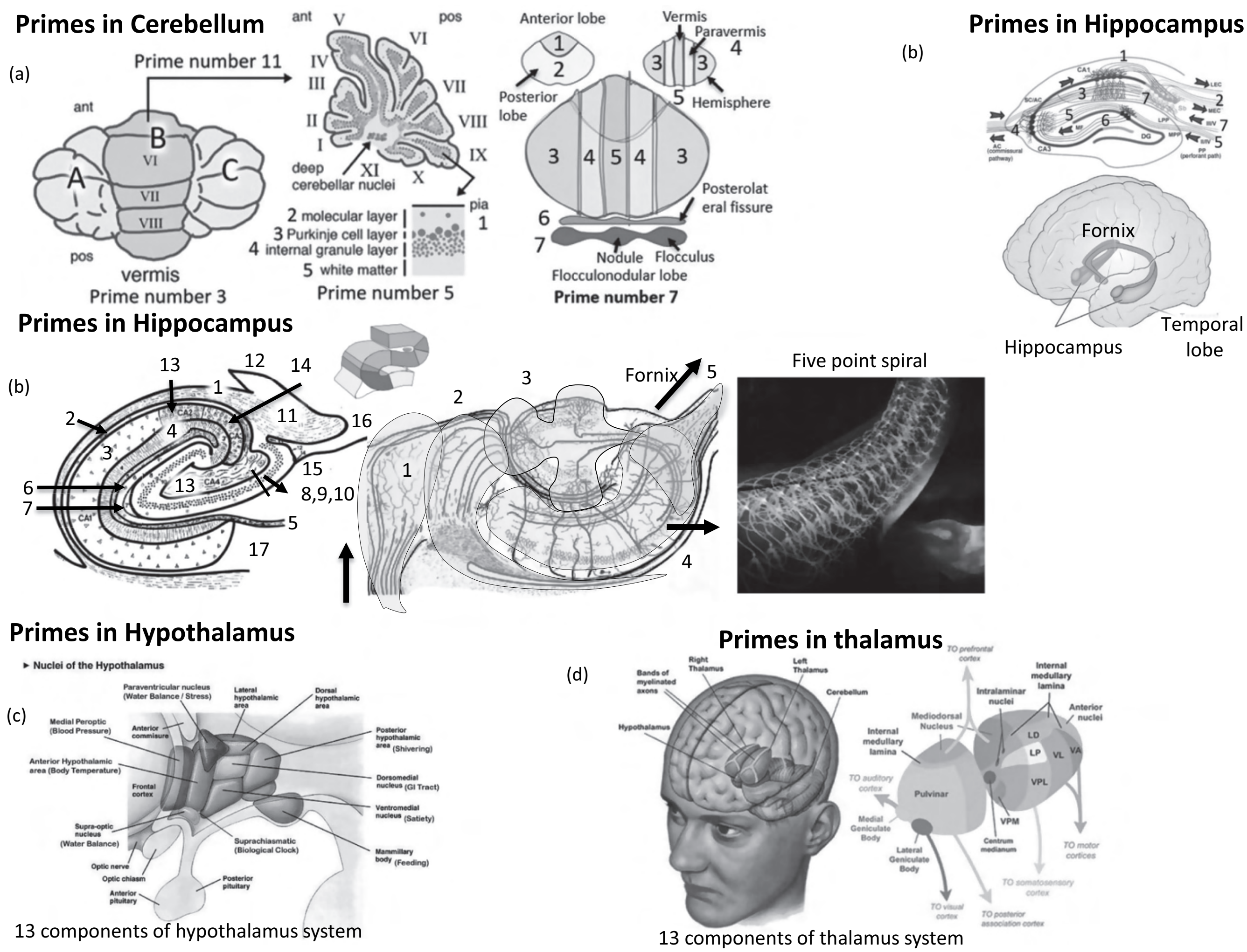


FIGURE 7.3 (a) Components related to the prime numbers in the cerebellum. (b) Components related to the prime numbers in the hippocampus. (c) Components related to the prime numbers in the hypothalamus. (d) Components related to the prime numbers in the thalamus.

cerebellum assists in processing memory, a dual clock runs (Gao et al., 2018). Depending on the length of signal travel through the hippocampus if we connect the wiring with the particular wires of the cerebellum, the right signal will reach the right machine output.

Hippocampus: Hippocampus is made of 17 cavities, wherein a pair of spiral pathways run in parallel side by side, the parallel pathways have five-fold symmetries (Figure 7.3b). Signals coming from entire body require performing two vital tasks at hippocampus, the temporal code generator of the brain (Buzsáki et al., 1994a) and it has its own long-term memory (Bliss and Collingridge, 1993). Chemical rhythms initiate a long-term memory (Kang et al., 1997; Ferbinteanu and Shapiro, 2003). Temporal codes for each type of memory is different (Leutgeb et al., 2005). First, a copy of the entire information packet is glued here (Wallenstein et al., 1998), like fusing all-time crystals, that final time crystal should be radiated outside to the entire upper brain for matching with previously gathered knowledge, so this device would work as a helix antenna-receiver system. Following fast in fast out principle it maintains the credibility of a pulse-packet (Jonas et al., 2004). Hippocampus activates spontaneously at a selected frequency band (Buño and Velluti, 1977). The second task would be continuously capturing the modified time crystals from the higher brain as primary solutions, identifying the complementary time crystals and intelligent filtering of entire input sets of time crystals at this place depending on the sensory organs. The filtered time crystals, which do not already exist in the brain, is then sent back to the specific regions of the brain for the permanent storage and further processing (CA1 projections to entire cortex region; Cenquizca and Swanson, 2007; Ciocchi et al., 2015). CA1 edits limiting clocks, the fastest and the slowest, to regulate theta rhythm (Rotstein et al., 2005). Electrical rhythms of hippocampus reveal the rate of learning of the brain (Berry and Thompson, 1978). The very basic operation of artificial brain computing is executed here in the helix antenna. Given the complexity and reliability of the task needs to be performed here, we need two antennas—one to send the incoming sets of time crystals continuously to the upper brain (resource antenna, Fornix, C7 symmetry, prime 7; Figure 7.3b), and the other to send the complementary time crystals to different distinct parts of the brain for saving it permanently (encoder antenna). To avoid essential conflicts between the two jobs, two separate helical antennas each with 37 rings (resource buffer and encoder buffer) in between. They resonantly communicate with the primary antennas spontaneously (Buño and Velluti, 1977) and work as a buffer state provider, and since permanent writing is done in the brain via wired transport, buffer antennas help to sustain the pristine features of the information being processed in the primary antenna. Hippocampus is also a spatial map generator of our environment (Blum and Abbott, 1996; Frank et al., 2000) navigation and memorizing complex paths work together (Buzsáki and Moser, 2013). Spontaneous activation and navigation happen in different frequency bands (Buzsáki, 2005).

The basic architecture of hippocampus is a helix-shaped molecular assembly with a large number of cables coming out of it radially at different parts of the helical length. Assigning a phase by evaluating information properly is its specialty (Kamondi et al., 1998). The cables and all parts are made by neurons only in the real human brain; the rest of the synthesis of all midbrain components are controlled by a particular frequency-modulated environment. The basic principle of hippocampus design is "time delay is proportional to the length of the wire the signal will travel" (Buzsáki et al., 1992). Just based on this simple principle we can fuse all different kinds of frequency fractals in it and at the same time isolate them, categorize and send them back to the particular specific region of the brain. An orthogonal pair of antenna (Gloveli et al., 2005) always radiates out the signal as an electromagnetic energy packet, while radiating out, the phase, frequency two essential features of the time crystal are kept intact as an automated property of the corresponding ionic wave; however, the delay or phase modulation needs to be modulated by the hardware itself. Electromagnetic sensitivity of hippocampus is well established (Maskey et al., 2010). Pyramidal cells are good in phase adjustment (Harris et al., 2002), especially in the cortex, pyramidal neurons interact with inhibitory neuron to edit a complex phase structure (Lytton and Sejnowski, 1991). Now the helical path comes into action. More is the length or number of loops in a helix, longer the signal should travel, which would eventually increase the delay between the two signals radiated out, thus, helical antenna sustains three fundamental features of a time crystal with absolute reliability. At this particular point of time, a delay is a key, from which sensory organs the signals are originated do not make any difference (Amaral and Witter, 1989). Several clocks sync, desync, build, and destroy clocks to operate hippocampus (Buzsáki et al., 1994a). The streams of signals while entering into the brain, it is passed through the helical resource antenna, at certain intervals or after a few helical loops, the time crystals with shorter delay are extracted. Thereafter, the signal left passes through another few loops, and then the longer delayed signals are taken out and the process continues. Since a time crystal uses the delay or relative phase shift to differentiate between two distinct time crystals, the length of the antenna is optimized to generate that particular delay. Hippocampal place cells regulate neuron firing to edit time (Royer et al., 2012), or even phase precession (Harris et al., 2001, 2002). It could even get into an off-rhythm state (Garcia-Sanchez et al., 1978), silence the synapses, and downregulate systems (Norimoto et al., 2018).

If we simply pump in all signals as fractal seeds described above (the fractal seed is the unit of information in the brain) through the spring-like structure, and we take out an output after every single loop, we can get signals with quantized phase differences. Pattern completion is exclusive to the CA3 region (Guzman et al., 2016). Self-assembled neurons in four CA networks generate a unique spring in the hippocampus region as if four H3 layers of Hinductor device based 2D sheets are packed together. Similarly, the nerve fibers that connect pre-frontal cortex, thalamus, hypothalamus, amygdala, etc., all sub organs of the midbrain resemble H3 device-based 2D sheets (see Chapter 8 for details). Before the memory information is sent all over the brain for permanent storage, it is processed in the lower brain hippocampus and converted into a set of patterns by massive compression (Skaggs et al., 1996). Grids do wonderful things (Kraus et al., 2015). Then it sequentializes the learning process (Wallenstein and Hasselmo, 1997). The lower brain region looks similar for every animal from dinosaur to human, the information processing protocol for all animals is the same. If we enter inside the hippocampus, in one of its four functional layers, the machinery looks like a spiral ring and longitudinal connections exist all along with the spiral net, a neuron pulse flows helically, when it collides with the longitudinal one, a particular phase is associated and helicity encodes particular frequency. Therefore, this single machine prepares the information to categorize them into particular classes, with a set of frequencies and phases before sending them out to a distant location. In addition, whenever it would be necessary, with that particular set of phase and frequency, it can recall them as a cognitive graph (Muller et al., 1996). The machine is, therefore, phase and frequency encoder. Positive and negative phase interact to neutralize and regulate phase (Holscher et al., 1997). Phase regulation means changing geometric shape in a time crystal, it is the coordinate (O'Keefe and Burgess, 1996).

The clock like periodic oscillations down-regulate the synapses (Norimoto et al., 2018). The connection of nerve fibers that connects between the hippocampus and amygdala has a typical geometric shape and it changes following a change in geometric symmetry (Kishi et al., 2006). Slower clocks hold phase information with clarity (Adey et al., 1960), clocks autocorrect possibly guided by symmetry breaking of the encoded information, i.e., integrating path and environment cues interplay to find a major change in the ensemble code for space (Gothard et al., 1996). A cortex network for memory, navigation, and the perception of time, namely entorhinal system communicates with the hippocampus using theta rhythm (Buzsáki and Moser, 2013; Buzsáki, 2005). Geometric structural symmetry of hippocampus in the CA1 region changes very little and that precise change reflects the projection of the region to the entire cortex region (Cenquizca and Swanson, 2007) and projection neurons adopt a geometric symmetry that enables it to filter information (Ciocchi et al., 2015), stable under massive noise (Zugaro et al., 2005).

The operational mystery of real hippocampus is unresolved, the dynamic data flow appears like checkerboard like a grid of pulses or metric (Terrazas et al., 2005) propagating across the hippocampus and on top of that grid, another stream of water like waves flow. Geometric shapes of hippocampal oscillations during sleep carries the geometric language embedded within (Staresina et al., 2015). The phase relationship between hippocampal place units and the EEG theta rhythm suggests that for each brain decision the stream flowing on a grid protocol remains the same, throughout (O'Keefe and Recce, 1993). The biggest question that should disturb us, is regarding the origin of this gridding of information. If it is not done at the very moment when information enters in our body, it is just impossible to compartmentalize them later in the brain wherein the streams of pulses are coming in from all over the body. The homogenizing gap between spikes is one key to regulate time (Vida et al., 2006). Thus, the biggest problem we are facing in resolving the mysterious information processing of the hippocampus is hidden in the skin, eye, nose, ear, and in the tongue, not in the brain. It is so exciting to feel that the biggest problem of the brain's information processing is distributed throughout the body, not just in the brain.

Hypothalamus: Hypothalamus in a normal human brain is used for vital motor controls and generate rhythms. It is made of 13 cavities (Figure 7.3c). Bidirectional feed-forward electromagnetic signaling observed in the hypothalamus is evidence of clocking regulation of metabolism (Stanley et al., 2016). These programmed activities are not essential for the computer we want to build; however, it is the supreme authority, if we want highest-level transformation in the final decision fractal in the hippocampus, then we can program those protocols here. The neurons are self-assembled similar to an LC-coupled oscillator-type periodic fractal seed generator and an antenna made of a neuron that transforms the final decision fractal within the certain limits. It is the interfacing point of the user modulating the computational process in the artificial brain.

Thalamus: Thalamus is a gateway to the sensors, a gateway to the brain cortex (Sherman and Guillery, 2002) and a gateway to the cerebellum. It is made of 13 cavities (Figure 7.3d) and acts as a universal synchronizer (Steriade and Deschenes, 1984) that builds a natural logarithmic relationship in the frequency distribution among various brain components (Penttonen and Buzsáki, 2003). The machine looks like as if many springs are side by side, if one of them is triggered then a complex vibration is automatically triggered over the entire system. Each spring-like structure accepts the particular kind of sensory signals. Visual information is encoded as an architecture of time here (Reinagel and Reid, 2000). Thalamus works with basal ganglia (Morison and Basset, 1945).

Fornix: Fornix dynamics follows a C7 symmetry (Figure 7.4a), it is the antenna and receiver of time crystal between the midbrain and the upper brain (Raslau et al., 2015), built-in a triangular network $T1$, $T2$, and $T3$ (Figure 7.4a). Neocortex and hippocampus have competing learning mechanisms that work in a complementary way (McClelland et al., 1995). Cingulate gyrus in the fornix is the key antenna receiver complex of the brain's learning. The interplay between hippocampus and cortex self-organizes time crystal and indexes the memories (Miller, 1989).

Connectome: Connectome is the fiber pathways of the brain (Schahmann and Pandya, 2006). There are five distinct pathways of nerve fibers (C5, Figure 7.4a). However, during functional imaging we find that $T1$, $T2$, and T3 domains of connectome triggers five regions or seven regions in a geometric shape (Figure 7.4, bright domains with a dark background). At the bottom part of Figure 7.4a we demonstrate projection seven-fold to the cortex. Functional logic for the five-fold and seven-fold cortical connections is established (Zeki and Shipp, 1988).

Cortex: The phase modulation of the propagating waves in the cortex is important for time crystal analysis, similar periodic behaviors are noticed in the network (Sanchez-Vives and McCormick, 2000). Cortical rhythms of various kinds are controlled by thalamus directly (Ralston and Ajmone-Marsan, 1956). However, long back a map of the 2D phase change profile was accounted for the decision-making of the human brain in the cortex (Ermentrout and Kleinfeld, 2001). Earlier, the same group argued for learning by phase change (Ermentrout and Kopell, 1994), which is again a key to establishing time crystal, GML-based learning of human brain. Circuital changes were attributed to Darwinism (Edelman, 1987), which may be replaced by collective cooperation in future. High frequency, 200 Hz, focal synchronization of ripples in the neocortex (Grenier et al., 2001), may include spiral waves (Huang et al., 2010) in time crystal GML, we may call it, fusion of time crystals. It is also reported that neocortex codes space using architecture of time (Singer, 1994). Gray matter and white matter of cortex are connected by universal scaling law (Zhang and Sejnowski, 2000). Cerebral cortex holds a deep 3D architecture of phase to regulate the alfa rhythm (Lopes da Silva and Storm van Leeuwen, 1978). Intracortical and thalamocortical, two distinct time crystals interact which reflects in the alfa rhythm (Lopes da Silva, et al., 1980). Different cortical regions have discrete rhythms, which integrate, build higher-level rhythms and that higher-level temporal architecture is the global landscape of cognition (Taylor et al., 2015). These cortical convolutions (Tallinen et al., 2016) are vortex atom-like structures representing the mind.

Pre-frontal cortex: Pre-frontal cortex controls futuristic simulations remaining phase-locked with the hippocampus (Siapas et al., 2005). The region is directly connected to the frontal lobe where the highest-level fractal seeds are stored as compressed data (Nieder and Miller, 2003). However, this region captures the final fusion fractal which is the solution of the computation carried out in the brain and concentrates only on the "then" related "action" parts, which the body will execute. Then it feeds higher-level time crystals stored in the

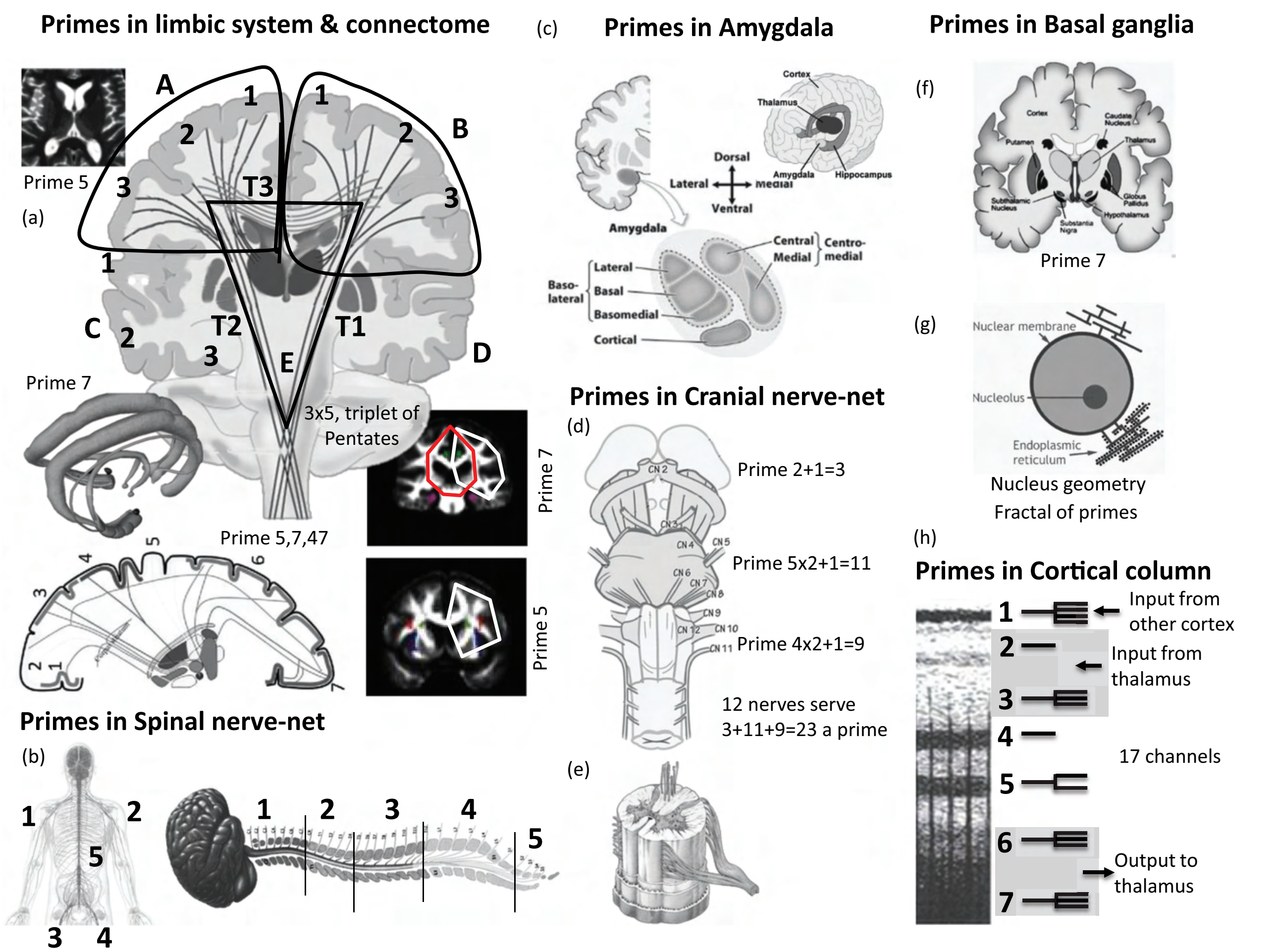


FIGURE 7.4 (a) Components related to the prime numbers in the folding of the cortex and two junctions above the limbic system, one claustrum and the other corpus callosum. Triplet of triplet arrangement of cavities is visible. (b) Components related to the prime numbers in the spinal cord and the spinal system. (c) Components related to the prime numbers in the amygdala. (d) Components related to the prime numbers in the three domains of midbrain that controls 23 dynamics of 12 cranial nerves. (e) Spinal cord with 5 fundamental symmetries. (f) Components related to the prime numbers in the 19 basal ganglia points. (g) Components related to the prime numbers in a large number of nuclei found in the brain, these are 2, 3, 5 fractal symmetries that protrude via endoplasmic reticulum. (h) Components related to the prime numbers in the 17 branches of the cortical columns emerging from seven regions of the cortical column.

frontal cortex to generate "futuristic simulation" of the actions in the hippocampus. The hardware is made of two antenna and receivers coupled with each other. First with one antenna it reads the "action to be taken" parts of the frequency fractal, matches with the higher-level rules "if" clusters, as soon as it matches, then those phase transition rules are sent to the hippocampus for transforming the final decision-making fractal. Thus, futuristic thoughts or imaginations are generated with this neuron-made hardware. As this region expands the final frequency fractal in the hippocampus, the hippocampus sends it back to all over the brain and executes significant modifications in the final frequency fractals.

Spinal cord: Thirty-one pairs of spinal nerves come from all over the body in five domains (C5, Figure 7.4b) to reach sensory signals high up the brain, and 31 pair motor nerves to carry brains execution order. We might notice the fantastic use of primes in the branching of spinal responses. Even if there is no firing in the medulla and in the spinal cord, there is a rhythmic neuronal discharge to compensate the signaling (Ren et al., 2006), which suggests that there is firing or not, rhythmic or clocking responses generate perpetually in the spinal cord. Its geometric information is so profound that rebuilding initiates spontaneously (Mackinnon et al., 2012).

Amygdala: Seven cavities of Amygdala work in harmony (Figure 7.4c). Amygdala and hippocampus work together to store a typical face and word (Heit et al., 1998), retrieving fear memory (Seidenbecher et al., 2003) geometric projection from the hippocampus to the amygdala is significant (Kishi et al., 2006). The circuits between the duo tell an emotional story of logic. Emotional differences are the differences between architectures of time (Schmidt and Trainor, 2001). In the time crystal model of a human brain model amygdala implements the complex filtering process. Amygdala's structural geometry and behavioral response are closely related, and that regulates amygdala hippocampus circuit (Yang and Wang, 2017). During a decision-making process, the human brain receives the final time crystal in the hippocampus, which contains all possible decisions and solutions, the design of amygdala hardware is such that it generates a set of unique fractal seeds that reads particular signatures in any other fractals and according to its list of preferences, it deletes unacceptable choices or fractal seeds. In other words, the amygdala sends a fractal to the hippocampus and that fractal checks coexistence of conflicting geometries (multiple opposite choices in the solution of a problem) and then it simply deletes the unfavored ones. To simply understand what happens mirror symmetry or C2 symmetry is detected. Basic drives for a life form is a triangle for giving birth, effort to save life, arranging food for regeneration of cells remains saved in the amygdala with birth and evolves with our life practices, so evolution of a time crystal of desires from a single triangle to a superposition of a large number of triangles in a single plane, it looks like a lotus flower. Such an emotional bonding makes memory permanent (Paré et al., 2002). Top-down control of fear and anxiety (Adhikari et al., 2015). Reward system acts in correlated clocking with ventral striatum (Cador et al., 1989), while the network of clocks or time crystal for processing emotion works in a loop with the pre-frontal cortex (Delli Pizzi et al., 2017). Geometric conversation, or exchange of geometric shapes between multiple components, e.g., between the amygdala and prefrontal cortex in a periodic sequence determine emotions (Ghashghaei et al., 2007). Since the symmetry of lotus is very different for different humans, the orange or mango is different for every single person on the planet.

Twelve cranial nerves: Phase coupling between cranial nerves (e.g., vagus with sinus node; Jalife and Moe, 1979) and the local time crystals initiate a higher-level time crystal synthesis. Cranial nerves in the midbrain arranged in three cavities, in the first cavity two (two cavities vibrate around a center, $2 + 1 = 3$ dynamic points), in the second cavity there are five nerves ($5 \times 2 + 1 = 11$), in the third cavity there are four nerves ($4 \times 2 + 1 = 9$), total dynamic centers $3 + 11 + 9 = 23$, and one nerve is left out, it runs separate (Figure 7.4d, e).

Basal ganglia: Basal ganglia made of seven cavities (Figure 7.4f) perform procedural learning, or learning by practice, it finds time crystals that are good, bad, and ugly for a task (Boraud et al., 2005). The organ modifies the final decision-making frequency fractal of hippocampus so that a very systematic input is captured and the brain jelly could reconfigure the neural circuit concretely, its motto for practice is to "loving it" (Graybiel, 2005). Therefore basal ganglia generate a new kind of frequency fractal that enables it to control multiple sets of solutions generated by the brain at an interval of 200 ms, it keeps continuation among the discrete computational input-output process. The hardware necessary for this is the creation of a fractal and then run it in a loop longer than 200 ms so that it affects the self-motivated data acquisition process continuously. Failing to automation leads to Parkinson's disease (Brown, 2003). However, there is another important aspect of it, how would the fractal nature be determined? Unlike previously described organs, in this case the fractal nature is not pre-programmed. In fact, prefrontal cortex simulates futuristic outcomes and if the final decision fractal before and after futuristic simulation suggests missing of significant "then" correlated data, then that event is captured by the basal ganglia and it generates a continuous relevant data capturing job.

The brain stem is the region that exhibits the best example of "one-to-many and many-to-one" network, along with hippocampus it controls theta rhythm (Vertes and Kocsis, 1997). In the human brain, the pinnacle of the spinal cord (Hindu literature call this maha-siva-pada, it senses the most complex sound of the universe, Erika and Nina, 2010) holds the brain-stem cells, it is surrounded by a cavity holding the cerebrospinal fluid (CSF). Every movement of the body needs a local motor clock activation (Sanes and Donoghue, 1993), every learning of motor operation is a synthesis of rhythm or clock (Sakai et al., 2004). The liquid of CSF dumps the vibrations generated by any physical shock, e.g., noisy ripples generated by heartbeat, lung rhythms, and motor nerve controlling units. Motor nerve control units are essential for the automated learning feature development and lungs control may not be essential if an analog of heartbeat control takes care of the entire energy supply. Regarding motor nerve controlling, brain-stem cells should run a synchronous rhythm wave, which should run perpetually as a controlled operation. The rhythmic program should not be modified or re-written, even if it is switched off, after switching on the same programmed rhythm would start running perpetually. That incredible feature enables finding the geometric difference between the two architectures of time. It means it divides two-time crystals instantly, it is the creator of new unprecedented architectures of time (Carr and Konishi, 1990).

7.4 PRIMES IN THE CONNECTOME, SPINAL CORD, AMYGDALA, NUCLEUS, AND CORTICAL COLUMN

Nucleus: Nucleus are bodies with autonomous firing abilities (Figure 7.4g), it is so robust that if necessary, act as a pacemaker (Bal and McCormick, 1993). Though small in size, a large number of neurons coexist in different structural symmetries just like stem cells (Hassan et al., 2009), the organization is adaptive to any change in symmetry (Scheibel and Scheibel, 1966). Plasticity of nucleus architecture is enormous. Suprachiasmatic nuclei control sleep, but if one deprives sleep, the nuclei change its structure (Deboer et al., 2003). GABA receptors control the clocks of suprachiasmatic nuclei (Liu and Reppert, 2000); GABA not only syncs but desyncs clocks too (Llinás et al., 2005). Generally sleep rhythm is created by thalamic and neocortical rhythms (Steriade et al., 1993a, 1993b). The geometry of the nucleus plays a vital role in its time crystal processing, the topological architecture of information is key (Phillipson and Griffiths, 1985). Most nuclei that are clusters of neurons activate the action potential and initiate the propagation of clocking waves spontaneously or autonomously (Atherton et al., 2008). Nuclei are good in regulating spindle rhythmicity, which means multiple strings or protein fibers could be triggered simultaneously into a coherent oscillation (Destexhe et al., 1994). If the nucleus is disconnected, the collective spindle oscillations disappear (Steriade et al., 1985). Spindle oscillations help in simultaneous management of many neural firing (Wang and Rinzel, 1993). A nucleus could act as a catalyst, programmed to trigger a local or a cascade of global events like arousal (Lewis et al., 2015). A nucleus could be programmed for a sequence of geometric codes to activate a particular switch of events (Phillipson and Griffiths, 1985). It is like encrypted engine. The nucleus is best bet for phase reset, key to time crystal (Field et al., 2000).

Cortical column: Cortical column has seven layers. It generates a magnetic field (Arlinger et al., 1982; Figure 7.4h), and it generates temporal structures like a song (Ikegaya et al., 2004), which makes it a fit candidate for the third generation Hinductor fourth-circuit element as described in the Figure 7.11. As noted, the first-generation elementary decision-making device H1 of the brain is microtubule, its three layers are water crystal inside the hollow cylinder made of tubulin proteins, the upper water layer is also important. The second generation of decision-making device H2 is the filamentary bundles made of microtubule, actin and intermediate filaments as the first layer. Then above this axon core there is a 2D ordered net of beta-spectrin and actin filaments which anchors multiple proteins. Finally, the third layer is a composition of glial cells, neurons, and oligodendrocytes building a nerve fiber or cortical column. The third generation of decision-making device H3 is a cortical column made tract, sheet, fiber, using hexagonal close packing of columns, i.e., 7, 19, 37….number of columns are used. The second layer is made of 19 groups of 7 column units. The third layer is 47 groups of 37 column units, thus, Brodmann's 47 regions are covered (Brodmann, 1909; Garey, 2006). Radial Unit Hypothesis (RUH) is a conceptual theory of cerebral cortex development, first described by Rakic (1988). Radial glial cell hypothesis is important for evolution, which uses glial cells as evidence of the evolution of the cortical column. In the mainstream neuroscience the true role of a cortical column is not known (Horton and Adams, 2005). However, in the time crystal model of the brain, a cortical column processes an octonion, H2 while a single microtubule a quaternion H1, and the cortex layers 47 Brodmann's region all together represent a dodecanion. In a time crystal, actually multiple infinite wave trains are encoded. To understand its hidden information content, the brain has to split an infinite wave-train into multiple segments, dendritic branches in the cortical column could segmentize the temporal signals with a particular pattern (Branco et al., 2010). It is when a brain begins to understand the information content. Similar H3 devices are there at many places, especially in the hippocampus.

One of the finest debate about the cortical column is that whether remaining within the hexagonal close packing, a single cortical column could operate independently or collective response is the only way out (Gawne and Richmond, 1993). The debate turns interesting because the cortical neurons find symmetric and asymmetric division zones and migrate through various phases (Noctor et al., 2004).

7.5 PRIMES IN THE NEURON, GLIA, DENDRO-DENDRITIC, ASTROCYTES, MICROTUBULE, AND PROTEINS DNA

The physicist Paul Nuñez pioneered rigorous applications of physical wave propagation theories to brain waves (Nuñez, 1981, 1998). Physics provides a vast toolbox for treating wave phenomena mathematically. These techniques have provided some understanding of global brain phenomena in terms of the physical properties of its carrier medium. How far can we go with this physicist's view of the brain? While medium filtering is an important factor, it cannot explain the larger spatial extent of neuronal recruitment at lower frequencies or the behavior-dependent highly coherent gamma oscillations in distant brain areas (König et al., 1995, 1996; Varela et al., 2001). Libet's principal finding was that short trains of pulses evoked only unconscious functions, and the somatosensory cortex had to be stimulated for 200–500 milliseconds for evoking a conscious sensation of touch. This time-domain has sub-domains (Nicolelis et al., 1995). To become aware of a sensory experience requires the engagement of the appropriate brain networks for hundreds of milliseconds. The delay between Libet's "mind time" relative to physical time is a favorite argument of philosophers to question the unity of the mind and brain (Libet, 2004). Some form of noise is included in all models to mimic the highly variable spontaneous spiking activity present in the intact brain (e.g., Usher et al., 1994). Some networks with sparse connectivity can generate irregular spike trains, chaos into organized clock network (van Vreeswijk and Sompolinsky, 1996; Amit and Brunel, 1997). However, these models are less sensitive to input perturbations and are quite unstable. Models of single oscillators, on the other hand, are too stable, and without some external noise, the spike patterns are very regular. Voltage fluctuations in real neurons are limited by conductance increase that accompany the synaptic activity. Therefore, it seems unlikely that synaptic activity can generate large enough white noise-like variability to sustain activity in model networks. Hippocampal regulation of rat's anterior eye chamber during its early development shows patterns of neural communication (Bragin and Vinogradova, 1983). The burst/pause patterns of cortical slabs resemble "slow 1" oscillation (Timofeev I. et al., 2002; slow 1 oscillation is a novel rhythm of cortical brain that leads to a steplike change in the membrane potential of the neocortical pyramidal neurons from −70 to −80 millivolts to spike threshold) for the plasticity of cortex or epileptic discharges. Traub and Wong (1982) provide a quantitative explanation for the avalanches in the model

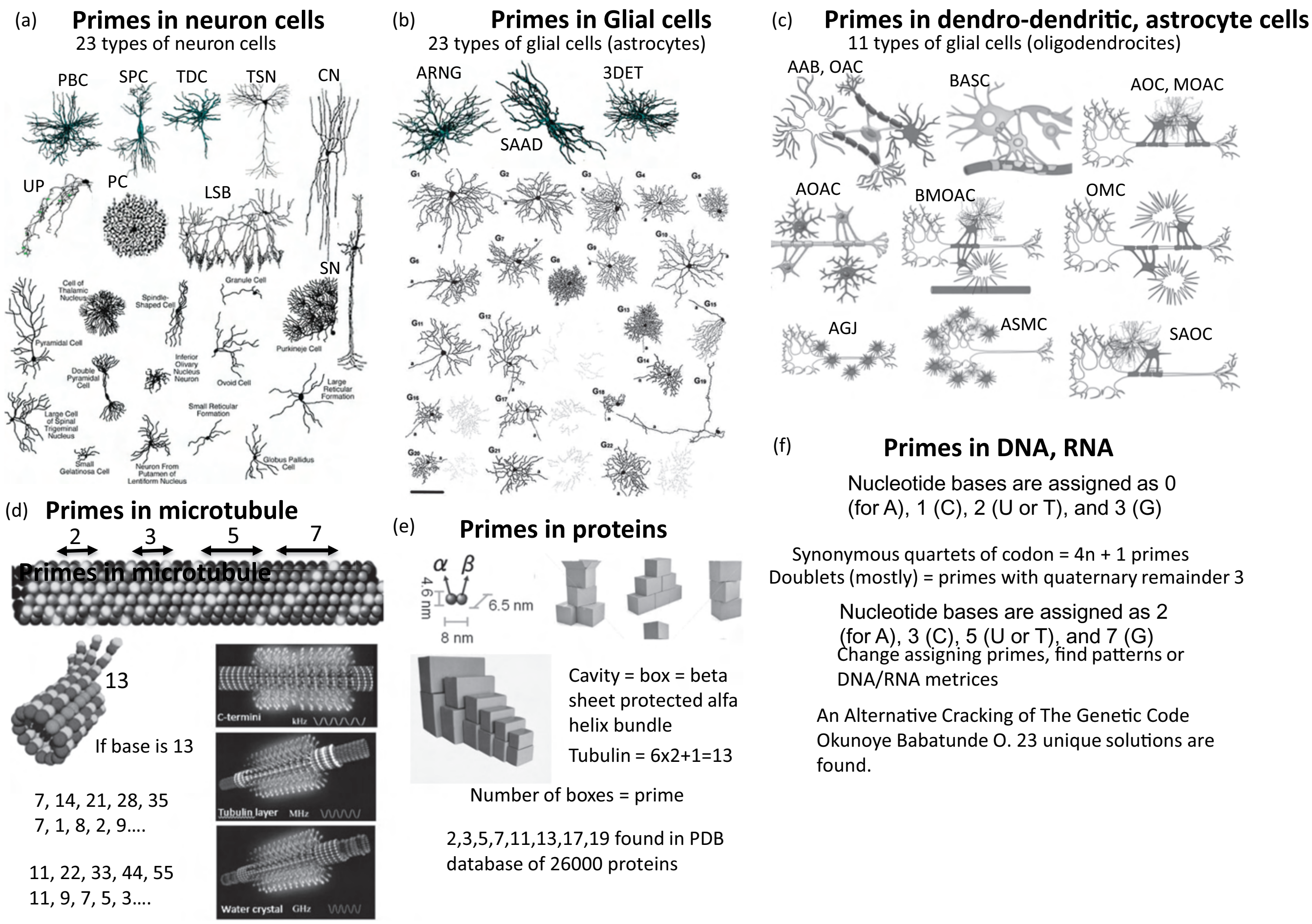


FIGURE 7.5 (a) Components related to the prime numbers in the branches of the neuron cell. (b) Components related to the prime numbers in the glial cells. (c) Components related to the prime numbers in the dendro-dendritic, astrocytes. (d) Components related to the prime numbers in the microtubule. (e) Components related to the prime numbers in the proteins. (f) Components related to the prime numbers in the DNA and RNA. *J. Theor. Biol. 1991 Aug 7;151(3):333–341; Prime numbers and the amino acid code: analogy in coding properties. Yan JF1, Yan AK, Yan BC.*

networks, it is important to know that over synchronization is a failure in computation. In preventing population bursts, subcortical neurotransmitters flow pattern play a vital role (Steriade and Buzsáki, 1990).

The neurons: Twenty-three types of distinct geometries of neurons are reported thus far, which delivers a distinct electromagnetic resonance (Figure 7.5a). Oscillator like the resonance of neurons with multiple dynamic modes (Wang, 1994) is responsible for neural information processing was proposed long back (Lliná*s*, 1988). It harvests channel noise (White et al., 2000) to build organized clock, a transition from random time slices to ordered architecture of time (Enright, 1980), the effect of noise in modulating neuron's frequency response is significant (Brunel et al., 2001), it figures out space using time (Ahissar and Arieli, 2001). Though Ghosh et al. advocated time crystal like the architecture of neurons (2016), the transition of spike model to clock model of neuron started long back (Aviel and Gerstner, 2006). The fact that each neuron has the fastest clock and a slowest limiting clock that govern its temporal sensitivity, the neuron is a phase editor (Lundstrom et al., 2009). Neural discharge is connected to phase, (Andersen and Eccles, 1962) and they exhibit circadian rhythms (Benson and Jacklet, 1977). Time crystal model makes a significant shift in the established concept of a neuron, because in the conventional model of a neuron, the Ca^{++}, Na^{+} and K^{+} ionic channels control the membrane potential and that explains neuron firing. We include an additional factor, the electromagnetic oscillations of the microtubule bundle as a secondary control parameter of firing. It regulates the architecture of time of a neuron (Arvanitaki and Chalazonitis, 1968). When neuron switches its conductance very fast, spontaneous ripples generate (Connor, 1978), similar to time crystal measurement. Conversely, perturbation inhibits learning (Choe et al., 2016). Microtubule of specific length has a specific resonance band (some peaks are prominent some gets dormant), thus, brain, during its circuit evolution choose compositions of different microtubule lengths to generate a complex signal transmission behavior that eventually governs the membrane potential distribution and sets the statistical distribution of the different ion channel percentage, wherein fractal feature is evident (Liebovitch et al., 1987). The filaments regulate subthreshold communication (Ghosh et al., 2016a; Jin et al., 2012). Subthreshold communication is key to the central nervous system communication (Llinás, 1988; Laughlin and Sejnowski et al., 2003). The skeleton of the entire neuron body turns alive via microtubule and no matter how far the axons extent, the entire pathway of a giant network of a neuron cell works as if a single molecule. The giant network expresses itself with large spikes (Lewandowska et al., 2015). Basal bodies like the number game, assembly of neurons like the game of integers because the microtubules are packed inside (Pearson and Winey, 2009). The number games of neurons have been a subject of study (Williams and Herrup, 1988). Organoids model the migration of neurons as part of number game (Xiang et al., 2017). The architecture of spatial arrangement and the architecture of temporal arrangement go hand in hand (Buzsáki and Chrobak, 1995). Geometric pattern or clique of neural assembly provides the missing link between structure and function (Blaustein et al., 2017). "Functions follow form" is an old debate (Connors and Regehr, 1996).

The geometry of neural branches select a suitable set of frequencies (Hutcheon and Yarom, 2000), geometry sets transmission rules (Rall, 1959). Why do neurons need thousands of branches? The reason could be sequential memory (Hawkins and Ahmad, 2016) or time crystal processing, where singularities on a single host clock are sequential memory, while one inside another it simultaneous memory. They compartmentalize plasticity (Losonczy et al., 2008). Electronic clocks disrupt ionic clocks (Hormuzdi et al., 2001), electromagnetic clocks trigger electronic clocks in the biomaterials, therefore, the intra-clock transmission is feasible. Without flowing neurotransmitters through synapses one could fire a neuron by sending electronic current (Jefferys, 1995). Even a single protein synthesis inhibitor could modify the circadian rhythm of a neuron (Jacklet, 1977). Neuron circuit generated geometric asymmetry is not enough to explain the directional responses of neurons in the visual cortex (Anderson et al., 1999). Thenceforth Singh et al. explored the symmetry of geometric shapes hidden in the temporal architecture revealed in a large set of spikes, group of groups of spikes, the answer to all mysteries hides there (Singh et al., 2018). Hierarchical multi-layered control on the neuron spikes timing requires a cascade model, as additional support, the Hodgkin Huxley model alone does not explain neuron firing (Aviel and Gerstner, 2006). Even a neuron creates the perception of 3D space that we see around us by editing the time gap between two spikes (Ahissar and Arieli, 2001). Sync and desync organize together (Gray, 1994). Neurons are filled in a cavity and then all neurons dance to the resonant modes of the cavity building all the architectures of the brain, from cortical column to the hippocampus, cerebellum, spinal cord. The geometry or clique of neuron holds the missing link between a neurons structure and its function (Blaustein et al., 2017). Thus, the time has come to go beyond the Hodgkin Huxley doctrine started by Lapicque in 1907 (McCormick et al., 2007). Questions are plenty. Why did nature invent more than 120 neurotransmitters if all it had to do was execute a simple job—fire or not fire. Neurotransmitters are neutral and thousands of branches fire in a group; some remain silent, some fire, thus it is not a simple brute transmission (Sanes and Lichtman, 1999). Following time crystal hypothesis every decision-making unit in the brain should follow $e-\pi-\phi$, mechanical-electrical-magnetic resonance. Neurons exhibit magnetic resonance (Long et al., 2015).

Neuroglia: There are 23 types of glial cells or astrocytes found in the brain (Figure 7.5b). Biologically, a neuroglia performs several tasks (cleaning neuron cell deposits, etc.), however, in the human brain model, wherein computing is the key, the neuroglia works as a synchronizer, we ignore other jobs as those are not directly related to the computing of the brain. In the human brain, neuroglia and neuron are in a ratio 2:1. To remarkably speed up the long-distance chemical communication, the brain needs signal amplifiers and in the geometric human brain model the neuroglia is an essential buffer engine that delivers homogeneity in the potential gradient produced by individual neurons in the neural network. It is a multi-functional resonant oscillator is constructing the neuroglia. The fundamental electronic property of this material would be receiving any band of the electromagnetic signal emitted from the neurons and then radiating it out all over the environment, thus working similar to an amplifier in the conventional power transmission lines. It is essential to maintain the homogeneity of the electrical potential distribution in the entire frequency fractal hardware. It is therefore computationally equally important to the neurons.

Astrocyte based connectors: In the emergency situations, astrocytes regenerate the neurons, in an environment just like the glial cells they hold the time crystals for the localized regions, therefore when the time comes to recreate the neurons cells, the circuit is ready with them. Eleven types of oligo-dendrocytes, dendrocytes, and associated connections are found in the brain (Figure 7.5c). Astrocytes regulate daily rhythms working in tandem with the suprachiasmatic nuclei (Tso, 2017). Surprisingly in the suprachiasmatic nuclei, astrocytes form gap junctions, wiring, network, but not neurons (Welsh and Reppert, 1996).

Nerve fiber and microtubule: These are not cables. Periodic changes in the periodic oscillations of the transmitted signals means, there exists an architecture of clocks (Arshavsky et al., 1964). A cut in the nerve reveals various kinds of nanowires, microtubule (25–30 nm wide), actin (2–4 nm wide) and neurofilaments (10–15 nm wide). Thousands of these skeleton-like filaments were considered silent, now Sahu et al. (2013a, 2013b) and Ghosh et al. (2016a) have proved that they transport signals and regulate neuron firing. On microtubule, one could select a variable spiral pitch and generate different kinds of signals (Figure 7.5d), thus, microtubule could hold a wide range of primes for resonance (see Chapter 6 for details).

Proteins: Beta sheets of protein isolate alfa helices as per STM studies (Sahu et al., 2013a, 2013b; Figure 7.5e), these clusters act as a cavity. 26,000 proteins of the PDB database was searched to find that only up to 19 cavities are there in nature (see details in Chapter 6).

DNA and RNA: Prime numbers are abundantly observed in the genetic codes of DNA, amino acid code harnesses the symmetry of primes (Lam, 2014; Yan et al., 1991; Figure 7.5f). Micro-RNAs play a fundamental role in micro-managing the circadian clocks, biological timekeeping may go down further below (Mehta and Cheng, 2012). Genetic and nucleosome positioning codes are filtered and function wise segmented, the classification follows the symmetry of primes (Mossallam et al., 2016). Choice of codons, its binding symmetry evolves proteins (Stergachis et al., 2013). Genes have circadian rhythms and those clocks show aging effect (Yi et al., 2016), autoregulation of periodic genes (Sehgal et al., 1995). DNA, RNA proteins have interstitial water and they may act as time crystal alone (Mendonca and Dodonov, 2014). Using genetic alphabet one could synthesis artificial life (Zhang et al., 2016).

7.6 TWELVE WAYS OF MEMORIZING AND TWELVE CARRIERS OPERATING RHYTHMS/CLOCKS

Vibrations hold the key to everything. Until now, we were considering that vibrations and rhythms are the only keys to some enzyme cycles, periodic discharge with periodic input is what makes neuron a clock (Rescigno et al., 1970). But the PPM-GML-H triad proposal is that deep down below even to the molecular scale there are rhythms. The current extrapolation is an advancement of Adaptive Resonance Theory (Carpenter and Grossberg, 2003): Brain regions that are functionally described include visual and auditory neocortex; specific and nonspecific thalamic nuclei; inferotemporal, parietal, prefrontal, entorhinal, hippocampal, parahippocampal, perirhinal, and motor cortices; frontal eye fields; supplementary eye fields; amygdala; basal ganglia: cerebellum; and superior colliculus, Thalamic nuclei. In the (adaptive resonance theory) ART all kinds of resonances have no relation in between, here all resonances are geometrically connected. The origin of scale-free brain activity is the correlation between the architecture of the time and the architecture of spatial arrangement (He et al., 2010). Twelve years of electrical turbulence evolve the system (Winfree, 1998), thus 12 is important. Event-specific changes in brain rhythms reveal that memory is dynamic, it has a structure of clocks (Bastiaansen and Hagoort, 2003).

Retrieving a memory has been a subject of interest for centuries, it haunts us (Sara, 2000). The geometry of time to recall is created when theta and beta rhythms encode memory (Sederberg et al., 2003). Theta rhythms of neurons build wide ranges of brain functions (Vinogradova, 1995). Alfa rhythm associated memory is a fractal structure, for a baby, it is localized, for an adult, its global (Srinivasan, 1999). And there are 12 types of memories that work at the 12 scales of operations in the brain (Figure 7.6). All memories are geometric in nature:

1. Periodic memory: Chain of guitar string we see mostly in DNA, proteins, a period of periods in the nodes of the string. Edit the memory by changing the periodic length of elementary point oscillators.
2. Spiral of spiral memory, in DNA and proteins, also in microtubules. Edit the memory by changing the twists and the number of hierarchical periods by inducing more and more twists.
3. Vector memory, the orientation of helices to make cavities inside the protein. 3D orientation makes it a multipolar complex 3D vibrational element. Edit the memory by changing the orientation of column oscillators.
4. Lattice memory, microtubule, actin-beta spectrin network, protein complex. Change the lattice parameters to edit the memory.
5. Chemical-electric memory, chemical transmission cycles. There are nested time cycles highly interconnected, to edit the memory, change the diameter, phase, delay or starting points.
6. Leak density of cavity memory, ion diffusion holes in the cellular membrane. To edit the change in memory the leak density on the cavity surface.
7. Spiral geometric memory, assembly of neurons, etc. To edit the memory, change the pitch-diameter-length of the spiral.
8. Vortex or fractal memory, memory stored in the geometric parameters of the vortex. A vortex has divergence parameters and scale repeat unit, these two parameters are changed to edit memory.
9. Nodal and polar memory: Nodes in the spinal cord brain network (nodes in a teardrop). The geometry of the shapes is changed among eight different choices from teardrop to ellipsoid to edit nodes and polarity memory.
10. Electromechanical phase memory: organs sync and desync like a giant molecule. The memory is edited by changing the bond length or wiring length and distribution.
11. Multipolar loop in phase space loop memory: hyperspace memory. The memory is non-physical and hence not editable.
12. The phase of phase duality generator memory: the hierarchical assembly of the reality sphere. The memory is non-physical and hence not editable.

Rhythms in the brain or thoughts are nonlinear (Stam et al., 1999), they are not only one type. Large-scale models of the brain have been proposed to resolve the cognitive and systems issues in neuroscience (Eliasmith et al., 2012). It has been argued that transient dynamics of the neural network would resolve this issue (Rabinovich et al., 2008). It has been established now concretely that greater similarities in neural pattern across repetitions are associated with a better memory

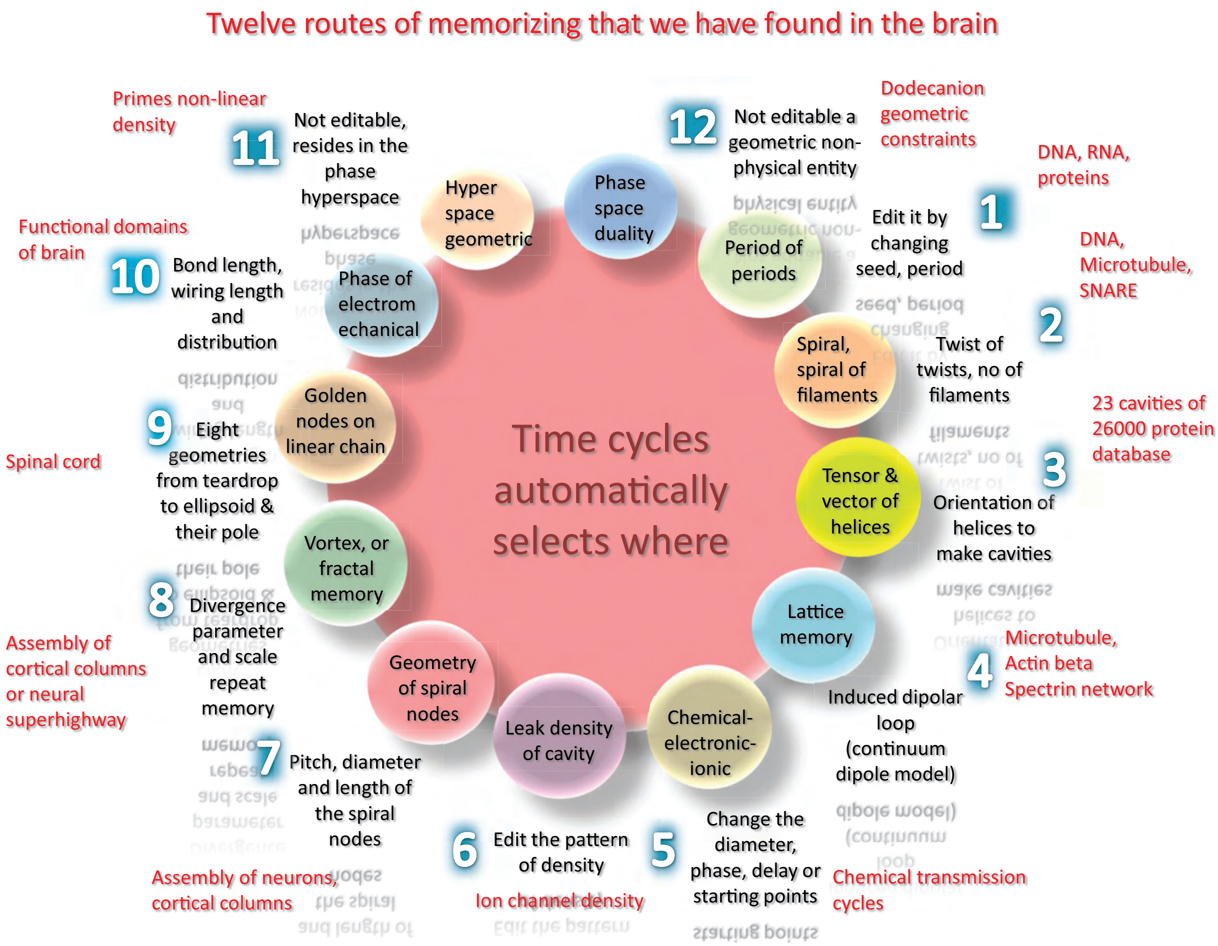


FIGURE 7.6 A chart is showing 12 different possible ways to build time crystals, their editability, and location.

(Xue et al., 2010). Sound is a mechanical rhythm and we have 12 different rhythms in the brain which differs in normal and pathological functions (Schnitzler and Gross, 2005; Figure 7.7), which ensures burst or not to burst (Steriade, 2001) at all levels:

1. Electromagnetic rhythm (carrier is photon or electromagnetic wave is trapped in a cavity to generate beating or rhythm).
2. Magnetic rhythm (spiral flow of electrons or ions, they are the carriers editing the magnetic flux, the geometry of path forms the periodicity).
3. Electrical potential rhythm (change in the arrangement of dipoles editing the electric field, fractal distribution of local resonators generate a time function of potential).
4. Solitonic and quasi-particle rhythm (carriers are solitons, defect in the order flows in an ordered structure, the ordered structure is edited to make a loop).
5. Ionic diffusion rhythm (ions are carriers, tube-like cavities are formed in a circular shape or continuous path to generate a loop).
6. Molecular chemical rhythm (molecules like proteins, enzymes, etc., are carriers, tube-like cavities are formed and sensory systems make sure a circular signaling pathway).
7. Quantum beating (spin is the carrier, wavefunctions interfere in a squeezed excited photonic, electromagnetic or spin state).
8. The density of states rhythm (orbitals coupling, wave function modulation, virtual carrier, a virtual continuous loop is made).
9. van der Waal rhythm (atomic thermal vibration is looped in a spiral pathway).
10. Electromechanical rhythm (classical beating with a mechanical beating like tuning fork).
11. Quasi-charge rhythm polaron, polariton (topological fractured band based continuous loops).
12. Mechanical rhythm, sound wave (similarly elastic pathways to make a circuit of sound waves).

Just imagine, such beautiful patterns are one of 12 different formations. Their physics is different, application domain and temporal range are different.

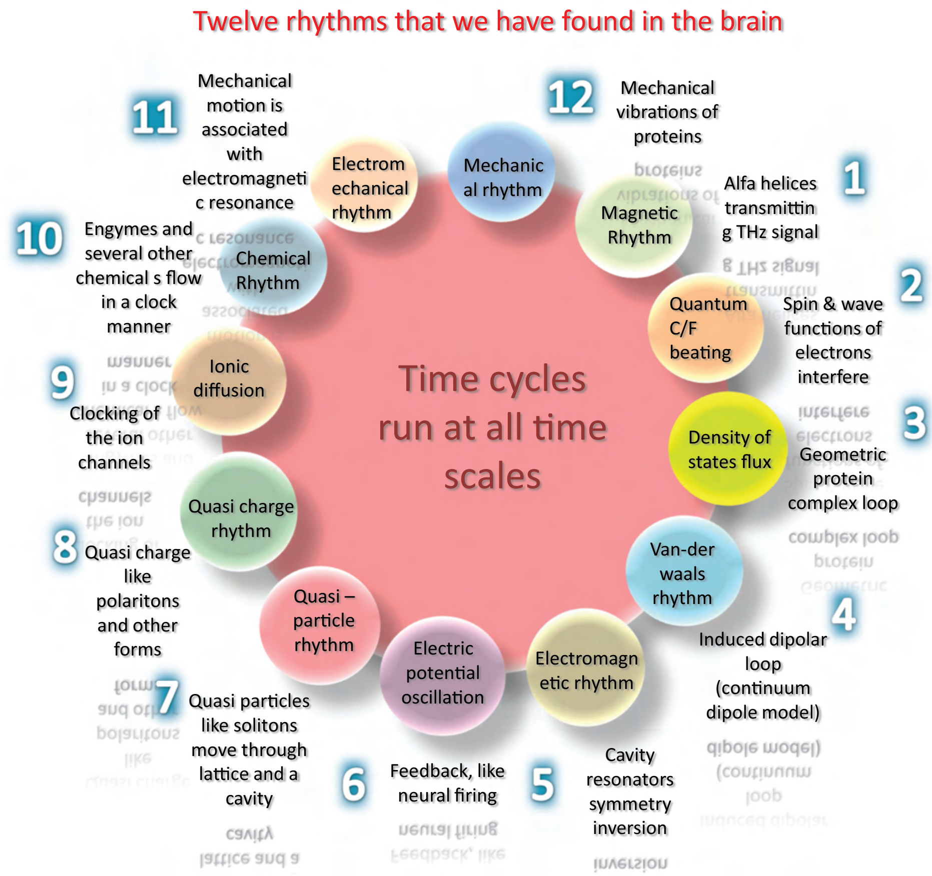


FIGURE 7.7 Twelve types of rhythms found in the brain, 12 layers of dodecanions were considered seeing not just the hardware layers from top to bottom, but the abundance of 12 key information processing parameters.

7.7 THE BRAIN'S WHEEL OF PRIMES

Fundamental questions that "connectome-" based brain models cannot answer: Once a generic rhythm-based pathway connects the smallest molecules like DNA and thousands of proteins to the largest structures like hippocampus in terms of rhythmic cycles, we get eight parallel worlds instead of one that is a neuron, then, can answer fundamental questions that "connectome-" based brain models cannot answer (Reimann et al., 2015).

1. How is information coded in neural activity? A dead map cannot answer. As a collection of multiple rhythms with a common contact point, without using any fitting we can show geometric encoding.
2. How are memories stored and retrieved? Neuron alone does not store memory. Stored as integrated cyclic rhythms at different time scales, the entire cyclic pathway is retrieved if a few points in rhythm are triggered.
3. What does the resting activity in the brain represent? Reconfiguration of multiple rhythmic cycles into a singular one, phase transition and automated re-wiring involving all layers.
4. How do brains simulate the future? "Future" is a rhythm generated by rhythms containing the past memories, time crystal always simulates the future.
5. How is time represented in the brain? Periodicity of rhythms at atomic to the centimeter scale is the time (the brain is a clock inside a clock, at every scale it is a timekeeper for time crystal).
6. How do the specialized systems of the brain integrate with one another? A system is part of a slower rhythm, no part at any scale is left alone, hence it is nested, escape time fractal hardware connected by time crystal.

We get answers to all these queries when we build a very simple model of prime numbers for the human brain (Figure 7.8a). The oversimplified model is a circle, left side is input via sensors that processes primes 2, 3, 5, 7, 11, and 13, it means in any input sensors find C2, C3, C5, C7, C11, and C13 symmetries. Then, 8 such sensors (octonion sensor tensor) take input via 31 spinal +12 cranial nervous systems, take it to midbrain and project to 47 functional domains of the cortex (Brodmann's region).

The three distinct regions of Figure 7.8a is isolated in Figure 7.8b. There are three domains, first, sensor, where time crystal data is 12D but dynamics encoded for time crystal is only 4D. It means, in 12 different axes different dynamics are encoded but four imaginary worlds one inside another hold the 12D data. The second domain is midbrain where the data

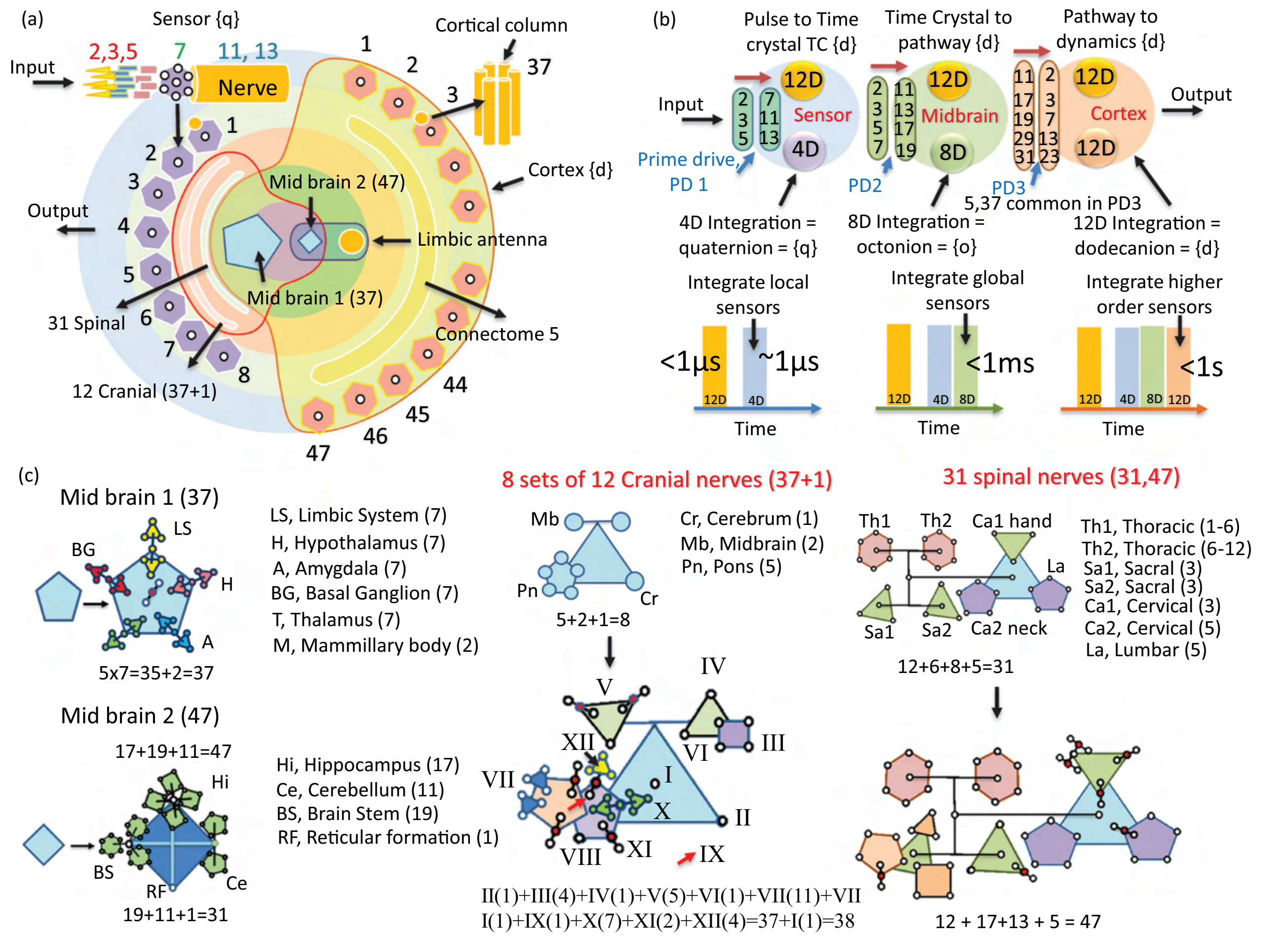
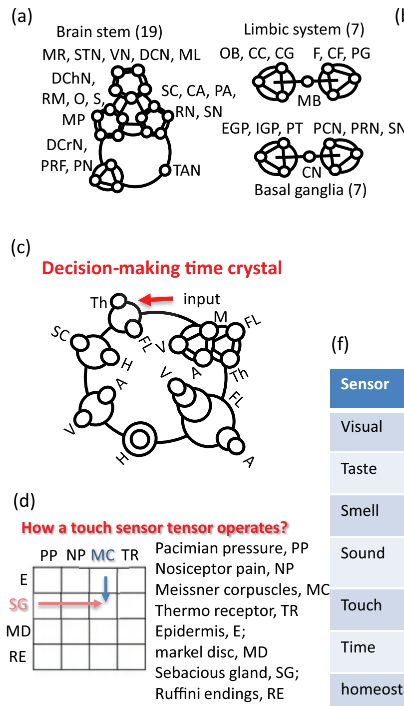
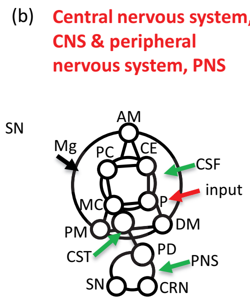


FIGURE 7.8 (a) A spherical model of a human brain. The left half is made of eight classes of sensors. Each sensor processing primes 2 to 13. Sum of cranial and spinal nerves is 43, a prime, passes through two basic parts of the midbrain one represents prime 17 and the other represents prime 47, which equals to the cortex functional classification with Brodmann's 47 regions. Explanations of the primes are given in the panel (c). (b) Two rows explain the flow of primes with the data structure in the brain (top) and data structure with the operational time domain. (c) The components used in the generic brain model of panel (a) is explained in panel c.

structure is 12D but dynamics is 8D, and finally cortex the third region where data is 12 D and dynamics are 12D. Below three columns, three time-domains are explained. As the 12D data passes through the deeper brain structures, 4D dynamics converts to 8D and that reaches 12D dynamics. Direct experimental electronic resonance band measurement for DNA, proteins, microtubules and organic structures, neurons and their clusters, suggested data for estimating different dynamics while we took EEG and other data for the global scale measurements. Microhertz resolution resonance frequencies could be measured without noise trouble. Below microhertz, large time-domain data was collected and based on the slopes nano hertz to femto hertz data are produced. Note that nano to femto hertz is just one band and we had to consider that as nano-hertz is around 30 years and we need to take into around 120 years as some peoples are alive until then. Triplet of triplet resonance bands are observed every single layer, in each of the three sub-bands in a single triplet there are eight "fundamental resonance peaks" and numerous other resonance peaks. Finally, Ghosh et al. have generated the resonance band of the entire brain. Here are 12 bands of a brain, first six bands are experimental data measured in Ghosh et al. lab, the rest six bands are derived from other researcher's reported measurements.

Figure 7.8c outlines the major components of the brain model as demonstrated in Figure 7.8a. The geometry of spinal and cranial nerves, midbrain 1 and midbrain 2 systems are represented using 2D geometric shapes. Similarly, 2D geometric structure of brain stem, limbic system (Figure 7.9a), a combined central nervous system, CNS and peripheral nervous system, PNS (Figure 7.9b) are presented. Combining the operation of all participating components the decision-making time crystal for the brain (Figure 7.9c) is generated. If the phase relation between different components is taken into account, then the 2D structure converts into a 3D structure, which embeds inside a complex time crystal structure. To do that, we simply put a phase sphere around a geometric shape.





(e) How does an octonion {O} tensor looks like?

$e_i e_j$	emoti	vision	sound	touch	smell	taste	pain	Prop
emoti	emoti	vision	sound	touch	smell	taste	pain	Prop
vision	vision	−emo	touch	−soun	taste	−smell	−Prop	pain
sound	sound	−touch	−emo	vision	pain	Prop	−smel	−taste
touch	touch	sound	−visio	−emo	−Prop	−pain	taste	−smel
smell	smell	−taste	−pain	−Prop	−emo	vision	sound	touch
taste	taste	smell	−Prop	pain	−visio	−emo	−touch	sound
pain	pain	Prop	smell	−taste	−soun	touch	−emo	−visio
Propr	Prop	−pain	taste	smell	−touch	−soun	vision	−emo

(f)

Sensor	Crossover, left-right	{O}producer	Cortex/midbrain	Prime
Visual	Optic chiasm	Thalamus	Somato sensory	7
Taste	Brain-stem, solitary tract	Thalamus	Somato + insula	5
Smell	Medulla, brain-stem	Amygdala	Olfactory cortex	11
Sound	Superior olive, inferior colluculus	Thalamus	Medial/lateral orbito frontal	7
Touch	Medula brain stem	Thalamus	Somatosensory	13
Time	Substantia nigra	Hypothalamus	Prefrontal cortex an	3
homeostasis	Hypothalamus-pituitary	Hypothalamus	Ventral tagmental	3
Balance, orientation	Pyramidal decussation	Vestibular nu Reticular form	Primary motor	3

FIGURE 7.9 (a) The time crystal representation of the brain components, brain stem, limbic system, basal ganglia. (b) The time crystal representation of the brain components, central nervous system, CNS and peripheral nervous system, PNS. (c) Decision-making time crystal. (d) Example of an operational sensor, that fills its 4 × 4 quaternion tensor while acquiring data from the environment. (e) An octonion table is created where horizontal and vertical sensory elements interact and a new sensor is built. The diagonal elements emotion and proprioception are purely real and purely imaginary. These diagonal vectors are termed as diagonal drivers. (f) A table for eight sensory systems of the brain, highlighting the C2 symmetry operator as crossover between left and right elements, the component that produces the octonion tensor and the prime that dominates in its structural symmetry.

Limbic system: Caudate nucleus, CN; putamen PT; external /internal globus pallidus, EGP; IGP; subthalamic nucleus, SN; pars compacta and pars reticulata of the substantia nigra, PCN; PRN.

Brain stem: Superior colliculus, SC; cerebral aqueduct, CA; periaqueductal gray, PA: red nucleus, RN; substantia nigra, SN; deep cerebellar nucleus DCrN; pontine reticular formation, PRF; pontine nuclei, PN; dorsal cochlear nucleus, DChN; raphe magnus, RM; olives, O; sulcus, S; medullary pyramid, MP; medullary reticulum, MR; solitary tract nucleus, STN; vestibular nucleus, VN; dorsal column nuclei, DCN; medial lemniscus, ML; tegmental area and nucleus, TAN limbic system: mamillary bodies, MB. the olfactory bulb, OB; cingulate gyrus, CG; corpus callosum, CC; fornix, F; column of fornix, CF; parahippocampal gyrus, PG.

CNS+PNS: Meninges, Mg; piamatter, PM; duramatter, DM; cerebrospinal fluid, CSF; aracnoidmatter, AM; plan: central executive, CE; detailing of plan: putamen, P; decision: parietal cortices, PC; connect to spinal cord, 1 million long axons come down from cortex: motor cortex, MC; midbrain: corticospinal tract, CST; crossover: pyramidal decussation, PD; sensor: lateral corticospinal tract, LCST; peripheral nervous system, PNS; spinal nerve, SN; cranial nerve, CRN.

Decision-making time crystal: Sensory cortices, SC; hippocampus, H; visual, V; frontal lobe, FL; auditory, A; motor, M; thalamus, Th.

7.7.1 Eight Sensors Hold Crossover Magic of Octonion

The brain operates by tensor algebra as described in the Chapter 4, but the question is how? Figure 7.9d explains that simply for a quaternion touch sensor, four different streams of pulses form a typical time crystal, hence each sensor element is a 12D-4D time crystal, as explained above. When the time crystal for MC and SG interact, they bond to create a new time crystal. A similar example is shown for an octonion tensor that holds information for eight distinct sensors of a mid-brain. The two diagonals of an octonion tensor represents emotion and proprioception, i.e., two fundamental senses of a human brain that regulates its conscious behavior (Figure 7.9e). One could also notice that in the figure taste information interacts with smell and as a result vision is affected. Thus, following this octonion tensor we understand that eight sensory systems which undergo C2 symmetry by crossover (Figure 7.9f) generate in certain organ in the midbrain but activates certain part of the higher brain. Thus, tensors that operate and regulate human consciousness physically links surprisingly different organs in the brain-body system. If hardware grows within and above such tensor products would govern systems in a very different manner than the common circuit concept we learned for over a century.

Wide distribution of synchronization time across the brain: The human brain has developed a distribution of convergence-speed across the organ controls, which could be visualized in the fMRI images, any change in that triggers folding and restructuring of entire brain structure. For example, say, emotion-processing region converges the fastest say within 1–2 ms, then, the smell-processing region, say in ~3–10 ms and so on up to 50 ms, say for the visual region. The most important and abundantly accessible information reaches convergence in the slowest speed. Thus, it ensures that while solving a problem, the newly generated time crystals in the slowest region are instantly cross-checked in the control-region of fast-processing time crystals. As a result, the possibilities of de-coupling are also alleviated. To implement the speed control in the hardware, the shape of the region, circuit complexity and size of the storage are taken into account in the human brain. The degree of randomness in the network regulates the speed of convergence and size is a dependent parameter for the above two. Order of preference among particular regions for reaching the convergence of neuron firing does not mean the human brain is a sequential processor, if required, even after completion of visual processing it could re-trigger the emotion-processing. The entire process could be repeated several times, until all emerged time crystal-clusters are transformed.

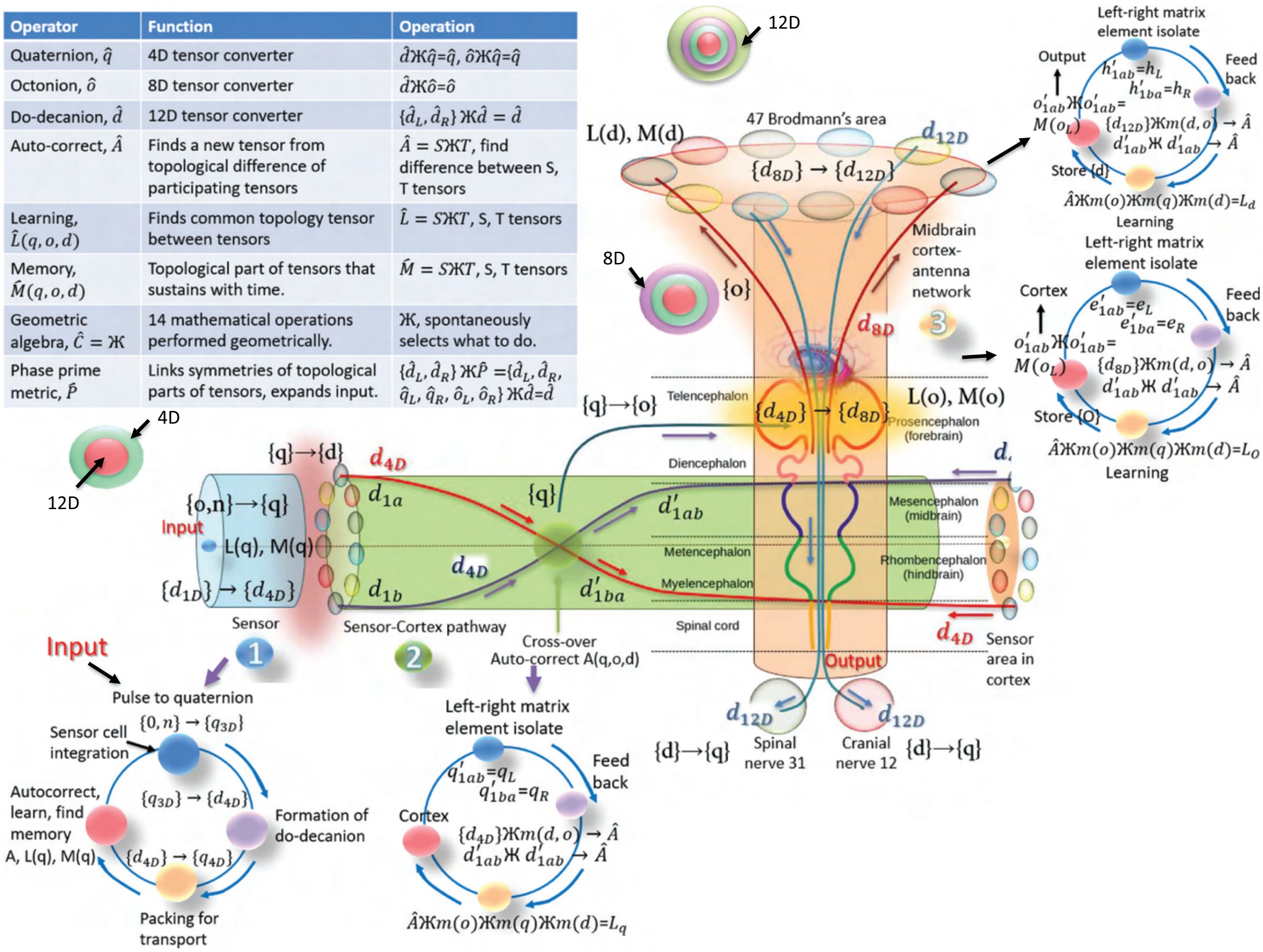
Hierarchical time crystals causing folding/restructuring in the forebrain: slower rhythms make system more intelligent and creative: The resting-state fMRI study when compared operations in the brain between a rhesus monkey and a human, they found that the front brain and the back part carries out extensive information processing back-and-forth in the resting state for human but not in the monkeys. During the brain's decision-making, a synchronous stream of pulses propagates back and forth, between the frontal lobe and the back part of the brain where the visual control is located. The provision is made, using dual transformation antenna pair, the core information being processed sustains for a long period of time, ~100–150 ms. Within this time convergence is reached for all essential parts of the problem, technically, the input-time crystal cluster transforms physically and logically into an output form. Brain repeats that for solving a problem for the geometric artificial brain means, harnessing the time crystal database associations as extensively as possible, and, then shrinking the possibilities to a few choices by multi-level synchrony. Therefore, the first requirement of speed control is to identify and isolate the key features of the problem as distinct coupled clusters and then oscillate the entire packet of clusters physically between the two potential walls like a ball, until the solution is reached or transformation is completed. In other words, when transformation antennas are in operation, there is be a tag, "do not disturb."

7.7.2 Eight Mathematical Operators Run Two Orthogonal Math Engines

Figure 7.10 outlines a table with eight operators, top-down applied sequentially. To explain the mathematical operator, we represent the human brain using two orthogonal cylinders. As explained in Figure 7.8b, here sensory data is a dodecanion tensor d_{4D}, it's every element a time crystal represented by quaternion tensor, each element of that quaternion tensor is information about singularity points. The tensor d_{4D} comes out of sensor and while passing back and forth between mid-brain and left-right crossover, the tensor d_{4D} converts to d_{8D}. It means the data structure remains the same but its elements, which were earlier quaternions, now becomes octonions. In the third and the last phase the third feedforward loop runs between 47 Brodmann's region in cortex and midbrain, the tensor d_{8D} converts to d_{12D}. In summary, two cylindrical columns make the tensor $d_{4D} \rightarrow d_{8D} \rightarrow d_{12D}$. Four feedback loops run in parallel. One feedback loop builds a time crystal from pulses, second feedback loop builds first quaternion learning time crystal L_q, third feedback loop builds octonion learning time crystal in midbrain and the fourth, feedback loop builds a dodecanion time crystal L_d in the Brodmann's cortex region. Eight basic operators regulate entire operations, first, three tensor building operators, quaternion, octonion and dodecanion. Then, second step is crossover (autocorrect operator $\hat{A}$). The third step has two operators, which grows simultaneously, one, pure learning $L_{4D} \rightarrow L_{8D} \rightarrow L_{12D}$; the other, memory $M_{4D} \rightarrow M_{8D} \rightarrow M_{12D}$. Finally, geometric algebra (Figure 3.12a) and PPM operators (Figure 4.12) located in the 47 Brodmann's region transform the time crystal.

When the information is extracted as part of memory-retrieval, the typical feature of the pulses is reproduced, just similarly as tape-recorder repeats the same song every time it is played. It is a delicate issue when the brain-memory plays an event, the mechanism is that a few words of the song come discretely from distinct sensory-organs, and then superimpose with each other as a combined, coupled time crystal without any conflict. Therefore, the sensory-organs while constructing their own wave-stream, keeps free space in the time-grid so that those parts are filled by other sensory organs when they construct their own wave-stream. Thus, when wave-streams from different organs come and overlap into a single multi-level wave stream, all pulses carrying particular time crystals occupy separate locations. If not, a particular color-coded in a pulse with particular intensity, pairing and coupling, could overlap with a particular sound or particular touch, or taste or smell encoded pulse. Therefore, the attempt to build a global database of brain's biological rhythm is the beginning of unraveling the mysterious pulses observed randomly at different parts of the human brain and frames the very foundation of the geometric artificial brain.

The sensory input-generated time crystal-cluster of a particular organ (say visual time crystals) could be complementary to others (say sound sensor produced time crystals). Such complementary, supplementary, and conditional time crystal-based coupling is possible if electronic pulses originating from



Operator	Function	Operation
Quaternion, $\hat{q}$	4D tensor converter	$\hat{d}Ж\hat{q}=\hat{q}$, $\hat{o}Ж\hat{q}=\hat{q}$
Octonion, $\hat{o}$	8D tensor converter	$\hat{d}Ж\hat{o}=\hat{o}$
Do-decanion, $\hat{d}$	12D tensor converter	$\{\hat{d}_L, \hat{d}_R\}Ж\hat{d} = \hat{d}$
Auto-correct, $\hat{A}$	Finds a new tensor from topological difference of participating tensors	$\hat{A} = SЖT$, find difference between S, T tensors
Learning, $\hat{L}(q,o,d)$	Finds common topology tensor between tensors	$\hat{L} = SЖT$, S, T tensors
Memory, $\hat{M}(q,o,d)$	Topological part of tensors that sustains with time.	$\hat{M} = SЖT$, S, T tensors
Geometric algebra, $\hat{C} = Ж$	14 mathematical operations performed geometrically.	Ж, spontaneously selects what to do.
Phase prime metric, $\hat{P}$	Links symmetries of topological parts of tensors, expands input.	$\{\hat{d}_L, \hat{d}_R\}Ж\hat{P} = \{\hat{d}_L, \hat{d}_R, \hat{q}_L, \hat{q}_R, \hat{o}_L, \hat{o}_R\}Ж\hat{d}=\hat{d}$

FIGURE 7.10 Top left corner table shows eight operators that primarily regulates the brain operation. The bottom right model explains architectural and operational pathways in the brain. Two orthogonal cylinders represent two parallel information transmission pathways, with a common crossover. Mathematical operators explained in the table is used here to document the essential mathematical operations for the decision-making, using four operational cycles. 1. Synthesis of quaternion at the sensors. 2. Crossover and synthesis of octonions. 3. Learning. 4. Expansion and synthesis of dodecanions. The data structure is always 12D; however, 12D time crystals are packed in a 4D, 8D, or 12D tensors that transports and engage different brain components. This is explained using a few rings.

different organs have similar amplitude and follow identical time-modulation protocols. Since the brain uses pulses of similar shape throughout (all pulses have a spike-shaped irrespective of their sensory-origin) one could easily couple multiple pulses to define particular kinds of a time crystal. Similarly, by maintaining similar kinds of phase behavior one could easily tune decay and growth profiles of pulses, but similar time modulation protocol is kept universally constant from the sensor to the brain. The similarity that is the advantage for the brain inhibits us from unraveling the information encoded by organs in the brain.

7.8 THE BASIC DEVICE FOR DECISION-MAKING IN THE BRAIN

The smallest decision-making device in the brain is helical or vortex shaped water channels residing inside a molecule, like protein, DNA, and microtubule. One helical channel cannot operate by itself, in Chapter 8 we would describe how three concentric spirals could act as a universal time crystal generator, namely Hinductor, H. We find such structures all over the brain-body system. Figure 7.11 shows one prime example. Microtubule, its inner water channel and outer water channels make a triad, a complete H device. Several such filaments or H devices come together to form a bundle, as axon core, on that core, actin-spectrin filaments form a hollow cylinder wrapped around it, and then oligodendrocytes, astrocytes all connected cell branches form three layers. We get H2. Finally, several such H2 devices or neural assemblies form columns (e.g., a cortical column), these millimeter-wide columns form 2D sheets, the sheets form different structures for various organs throughout the brain-body system, listed as H3 in a table in Figure 7.11.

Quadratic geometric relation between mechanical electric and magnetic resonance: All biological systems have a light (electromagnetic) and sound (mechanical) effect

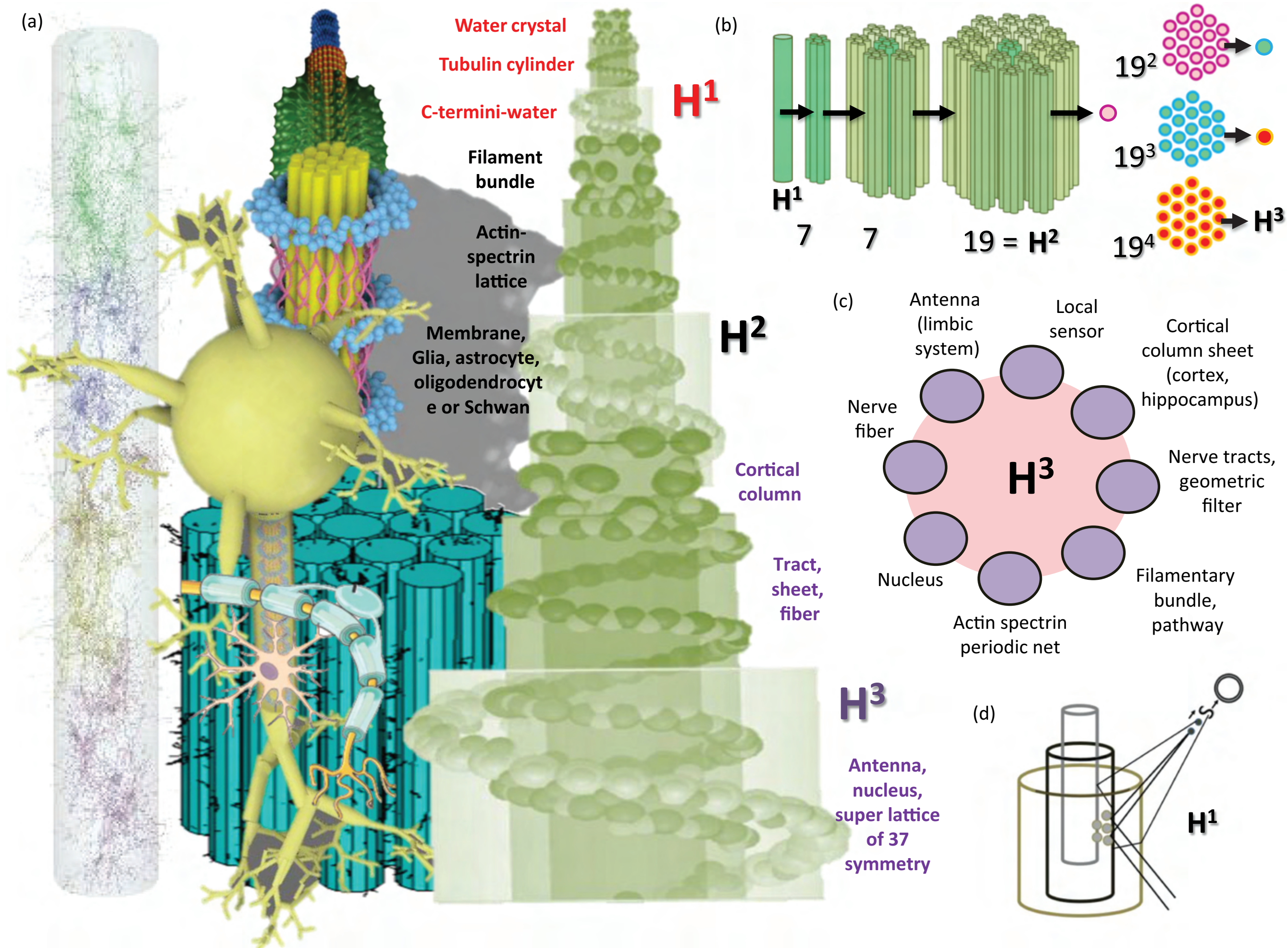


FIGURE 7.11 (a) Basic decision-making an element in the brain is H, it is any spiral or vortex shaped structure like DNA, alfa-helix, microtubule, a spiral nanowire of proteins, etc. Two-layered architectures are shown. The left column is a layered structure of real elements that we find in the brain and to its right, the equivalent nested spiral structure's schematic is presented. Three layers of triplet structures are noted with red, black, and blue color. H1 is the basic entity which self-assembles and forms H2 and finally several H2 self-assembles and form H3. (b) The cortical column formed in the panel a becomes H1 in the cortex and self-assembles in the hexagonal close packing forms a sheet. (c) 2D sheets of cortical columns fold into various geometric shapes, these are all H3 structures that form all decision-making organs in the brain. (d) The operational mechanism of the elementary H device where monochromatic light falls and pure magnetic vortices are generated.

for running the magnetic vortex based time crystal processing, and both electromagnetic and mechanical effects play an equal role in governing the neuron firing while neuroscience ignores the electromagnetic part and considers mechanical ionic movement controls everything in any living cell or neurons (see schematic below Figure 7.11). The squarely parallel chemical and physical protocol is then implemented in creating an entire time crystal model of the whole brain, we believe that this step would fundamentally change the way biology is being studied today. Though existing neuroscience has concretely established the chemical link, electrical wave in cortex is considered as thoughts (Ermentrout and Kleinfeld, 2001) it does not explain how self-assembly begins at the atomic scale and ends up in the meter scale. Therefore, the geometric electromagnetic interaction model is also an additional framework to provide the missing link. We do not discard existing neuroscience or biology; we suggest that existing biology looks at the ionic response and molecular chemical interaction as an absolute expression. For the PPM-GML-H triad, ionic and molecular chemical events widely reported in the biological textbooks could be included as the dielectric responses in the kHz frequency domain. However, some other things happen in MHz that controls the events in kHz domain, then some other things happen at GHz domain and this journey continues until several peta-hertz frequency domains. Moreover, in the Hz, milli-Hz, micro-Hz, and nano-Hz processes are also there. Most biologists are interested only in the kHz imaginary world if we locate them in the time crystal model, but there are six similar universes above in the slower time domain and six similar universes below in the faster time domain; if we do not include them, a complete mechanistic explanation of a biological system cannot be done.

The *decision-making* protocol of the human brain: In the geometric model, the human brain is neither a classical nor a quantum computer (just being fractal does not mean quantum; Gardiner et al., 2010), it operates among 12 imaginary space-time-topology-prime worlds at the same time, generating a quaternion of self-assembled time crystals following linguistic criterion (who, what, when, and how). A linguistic quaternion is a decision, in the brain it gets filled up by dodecanion time crystals, but the linguistic core structure is never compromised. Thus, a human brain solves a problem continuously, in fact, the massive architecture of time crystals have one-to-one correspondence and these two protocols perform only one computing in a human life, it begins with birth and ends with death (one life is ~10^9 s, it is a stream of 100 pulses of a 10^{-11} Hz oscillator). There is no reduction protocol like classical or quantum computing, no deterministic decision for any query, resonance-based projected set of vibration by the PPM more with holographic engineering. The human brain therefore is an automatic fractal correlation analysis, storage and retrieval machine, since relative weights of different time crystals are assigned in the PPM of time crystals of each brain organ only after the query is made, therefore, we cannot explain the human brain using a Turing machine. Since any input signal, visual, voice, taste, smell or touch senses are taken directly as 3D pattern of pulses carrying 11D geometric structure, eventually converted in terms of basic geometric patterns like circle, triangles, several kinds of polygons, close and open U-shapes, etc., by "fractal decomposition," therefore, we can find some past correlations for any input fractal, processing does not require a framed logic. The decision-making in the brain means sensing symmetry of the time crystals within and outside and creating new crystals to regenerate symmetry. Thus, computing acts smartly when due to unknown parameters, the problem is even difficult to define, the faintly correlated pattern from the PPM of time crystals is projected as output, thus, we get instant decisions continuously for a series of inputs where even the problem is not defined. If we look at the cross-section of an entire sensory bundle containing a million nerves, it will appear as a 2D pattern of frequency change as a function of time say it is $Q(f1, f2)$. However, it should strictly be noted that the very particular geometric relationship of the input image is not destroyed. The fractal frequency approach can generate the quasi-periodic oscillations in the brain described by Izhicovich as a direct output of a generic frequency fractal map.

Learning and spontaneous brain circuit evolution: The brain uses maximum energy in the central layers, where the neuron resides. The eventually fused fractal in the hippocampus, which is the solution of the input problem, does not disappear instantly from the hippocampus after sending its mirror copy to the cerebellum. It sends the final solution fractal back to the cortex regions and the process to write the evolved fused fractal. The majority of the fractal frequencies is found common between input and the memory; hence they neutralize vibration, however, some neurons vibrate continuously to meet the requirement of new frequencies. The minimum frequency difference causes "beating" and the antenna of the neuron generates "electronic signal burst" which is then detected by all other neurons in the neighborhood. The stream of bursts continues until suitable neurons create wiring with it properly and/or microtubules inside the axon re-wires to accommodate the new fractal part. "Beating" based modulation principle argues when a set of neurons decides to fire and why firing occurs at a very selective region of the brain.

7.8.1 H3 Device That the Brain Uses Everywhere

Tension based morphogenesis and compact binding of the central nervous system (Van Essen, 1997) suggests for a universal decision-making device (Llinás, 1988). Here H3 is the decision-making device as listed in Figure 7.11 (see Chapters 2 and 8 for H1, H2, and H3). Hippocampus looks like a unique device, but actually the same cortex layer formed by hexagonal close packing of cortical columns folds uniquely to build the hippocampus, limbic system, nucleus, nerve tracts, etc. Thus, H3 is not a very particular design, it is a theme, on which the brain has engineered many different structures, the most prominent of them are the cortex layer and hippocampus, one may say hippocampus is a big cortical column.

7.9 FUSION OF CAVITY AND DIELECTRIC RESONATOR MODEL OF A HUMAN BRAIN

When a single chain polymer builds a protein molecule the dynamics show like a teardrop slowly convert into an ellipsoid. Inspired by this dynamics and morphogenesis, all brain cavities listed above were converted five compositions as outlined in Figure 7.12a. Using eight basic shapes that transform a teardrop into an ellipsoid, all major brain cavities could be regenerated by adding certain noise (Figure 7.12b). Phase synchrony and desynchrony is a key to brain operation (Lachaux et al., 1999). The attributed device for resonant communication neuron has not just one but many thresholds (Sardi et al., 2017), which is more extensively studied by Ghosh et al. (2016). Since forward and backward propagation of action potential is both presents, neuron cavity is a resonator (Scott, 2007). Clock-like responses of a neuron have hierarchical organization (Strumwasser, 1974). Thenceforth we created a cavity based on the potential distribution required to represent a time crystal of our choice. That area was converted into a neuron geometry using an algorithm. As outlined in Figure 7.12c.

The architecture of spatial symmetry = architecture of temporal symmetry: Transport means one position to another, in the time domain, i.e., nested hardware one inside another does not need to do that. Right from DNA to the largest brain oscillator, 12 components are there where triplet of triplet resonance bands is observed. We trigger natural vibration of the oscillators for computing; therefore, we do not require power supply even if we want to resonantly vibrate entire frequency fractal hardware made of 100 billion

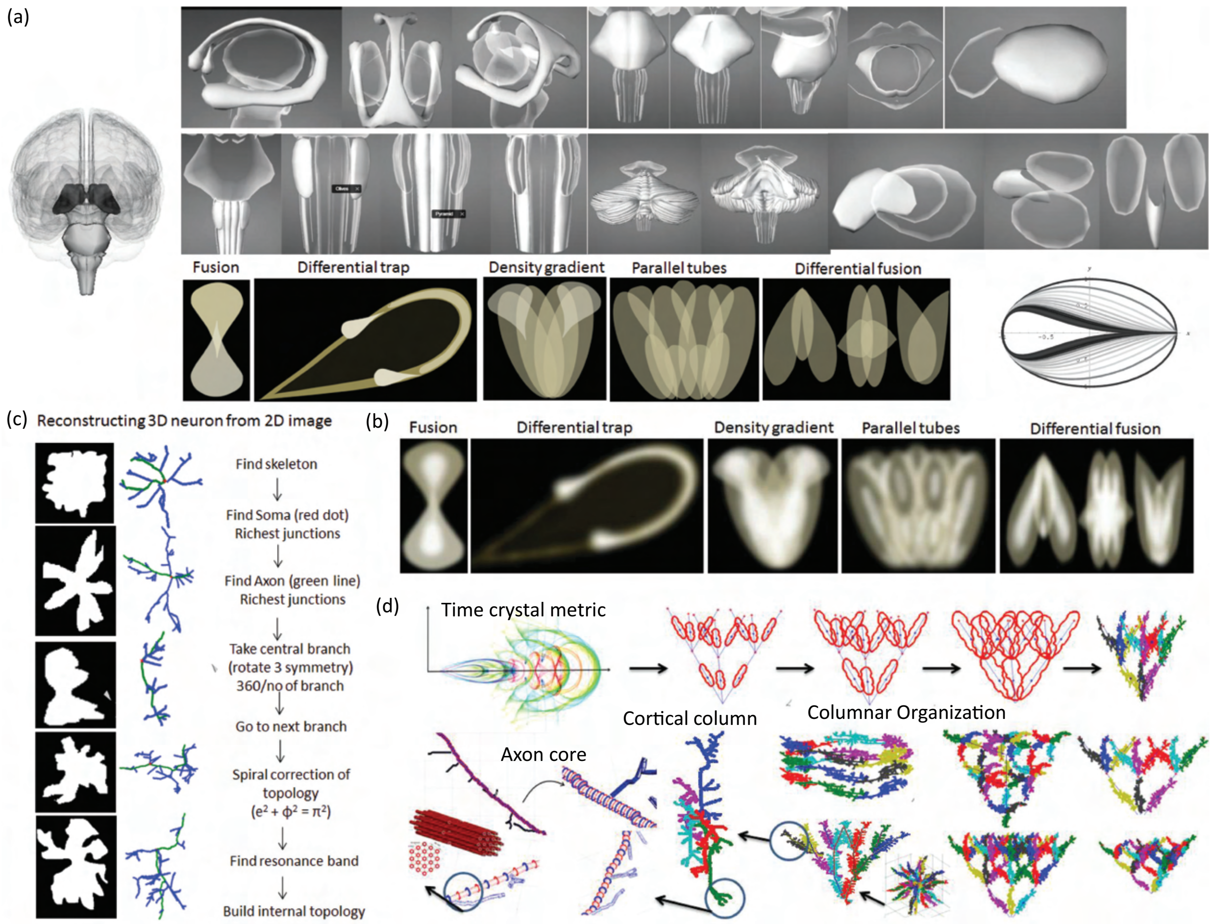


FIGURE 7.12 (a) Different structures found in different components of the brain (top two rows) are converted into seven different classes of cavities, and all these cavities could be generated from a single equation of a teardrop. (b) By fusing teardrop cavities several brain components shown in the top two rows of the panel a are regenerated. (c) Using skeleton operation alone from a given cavity while changing its shape we could regenerate the neuron architecture following the algorithm listed here. (d) Using the PPM the neurons could be self-assembled into cortical columns and 47 Brodmann's regions using a single algorithm of cavity filling.

neurons. The only reason for energy expenditure is the circuit evolution, changing the neuron orientation, constructing new synaptic junctions, rejecting old connections, which are essential to write a new fractal seed in the column of "if-then" time crystals. Neurons need to be fed, since cells are alive, we repeat, following the PPM-GML-H triad model, the energy required for computing is negligible. A system communicating with its constituents is an oxymoron. Thus, we integrate time crystal, convert 3D geometric shapes for a time crystal into the available 3D space for the neuron to grow. It was a major, aggressive decision that architecture of time symmetry equals the architecture of spatial symmetry. However, from a cortical column to various neural assemblies listed in 7.11 table could be created. The most exciting part of this study is that there is only one simple principle, "find skeleton of a given 3D space" and we could generate the architecture needed for the time crystal.

What is the information contained in the human brain model? Resonance state writing is a unique process in the brain, at different levels, it occurs in a unique way; at protein level, it is a change in the relative orientation of secondary structures; at the neuron level, it is selection of microtubules of different lengths at the neuron level; at the cortical column or rhythm control level, it is the organization symmetry of the neurons. Thus, before any information is written the chain of resonance bands starting from DNA, protein, enzyme, microtubule, neuron to the neuron clusters and ends with the largest oscillator that is the entire brain, therefore, information is a time crystal. **A human brain is a singular time crystal made of an endless network of rhythms (opt to reject entire hardware and be happy with time crystal to upload consciousness!!!), it means an argument when it includes a time function, that also means after a certain time t, it would change to another time crystal, in this book we use time crystal in general, always it means a 3D geometry whose corners are singularity points.** To run this cyclic loop, around a geometric shape, one primary source of energy is thermal noise, it is already shown that biological clocks are temperature independent (Hastings et al., 1957). **Where in the brain, do we see "spontaneous reply back"? The layered clock:** In the time crystal model every biological system has a multi-layer vortex or spirals like a signal receiver and a fractal antenna for the wireless communication and/or "spontaneous reply back." A DNA replies back to proteins, enzymes, and all single molecules. Then, these proteins and small molecules reply back to the supramolecular assemblies created by them like microtubules. Several such filaments reply back to the neurons, which replies back to the cortical columns and it continues to the final assembly, the brain. Singh et al. have simulated all-dielectric structures of a real human brain mapped in UCSD (Figure 7.13, a–f). The brain cavities are considered as a cavity resonator + dielectric resonator + water resonator (Figure 7.13a), the composition of resonators is like H devices, three layers build a feedback network which could create periodic transmission of fields or carriers along with the system (Figure 7.13b). In connectome (Figure 7.13d), neuron (Figure 7.13g), in axon core (Figure 7.13h), in blood vessel (Figure 7.13e), and in ventricles (Figure 7.13f), everywhere the electric and magnetic field distribution shows a periodic transmission spatially all over the structure. Thus, every single seed replies back to everybody at every moment, no question is ever asked, it is collective responsibility for all to regenerate the lack of symmetry or eliminate the asymmetry following PPM. if the symmetry of a particular time crystal-cluster is known, then we do not need to search every time crystal of that cluster, during spontaneous reply the system simply test one and

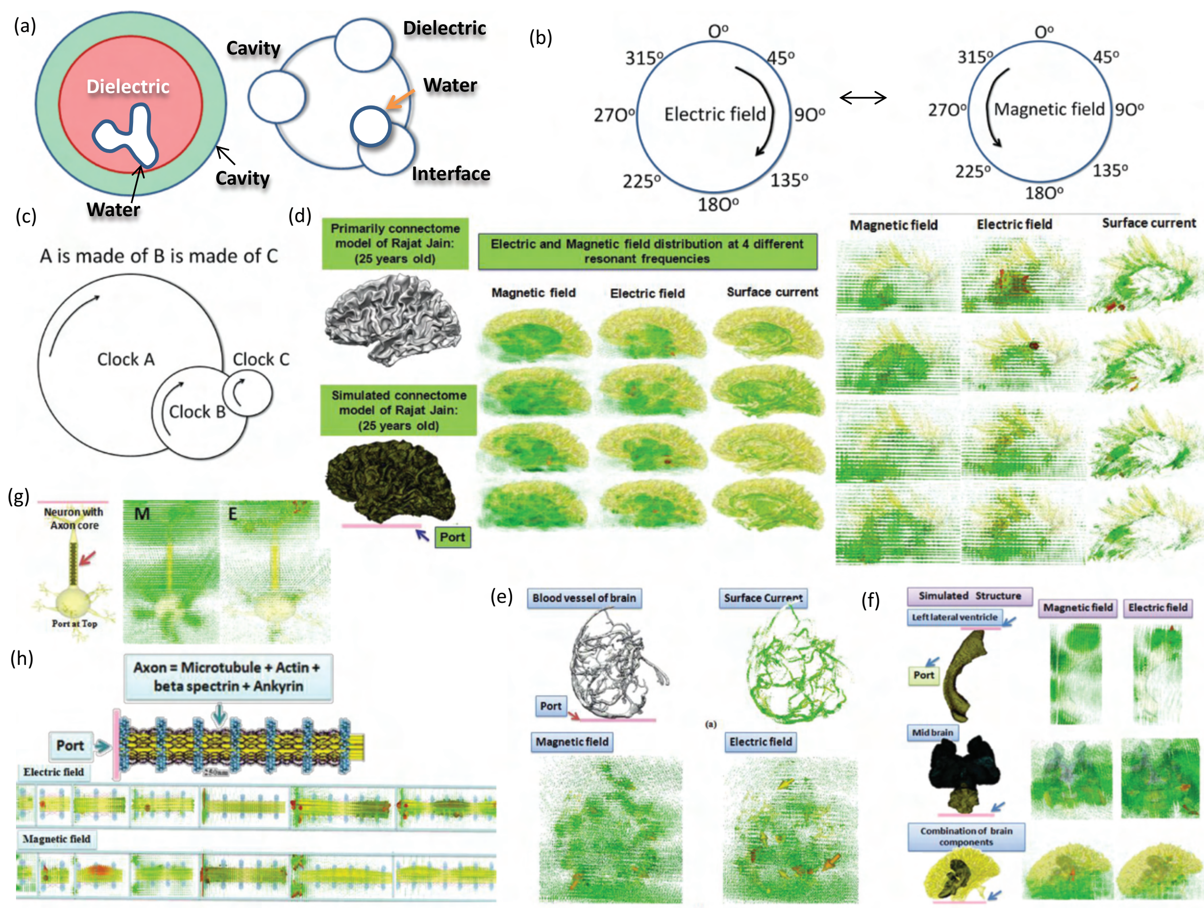


FIGURE 7.13 (a) The brain is a fusion device, it is a combination of dielectric resonators and the cavity resonators (left). Each and every component contributes to the formation of the time crystal, i.e., nested architecture of clocks. (b) Artificially built dielectric and cavity resonator-based brain components show that the electric field and magnetic field rotates spatially and temporally around a local region at the resonance frequencies. (c) The locally observed resonance frequencies and the distribution of fields rotating periodically around a region are considered as a clock and how one clock inhibits the other, how one clock changes its rotation with respect to the other, is studied to build nested clocks. (d) Rajat Jain's brain elements were studied in the CST Maxwell's equation solver to find the electric and magnetic field distribution. Connectome's magnetic field, electric field and the surface current is plotted. (e) Blood vessels cause a massive mechanical thrust in the brain, however, the electric and the magnetic field for the electromagnetic resonance is plotted. (f) The simulated results for one ventricle, midbrain and components incorporated in the brain is shown. (g) Electric and magnetic field distribution for the neuron. (h) Electric and magnetic field distribution at resonance frequency, for the neurofilament and microfilament bundle.

reject all associated options (symmetry breaking) to speed up the computing rapidly. Eliminating multiple symmetries is a difficult task, however, it is shown that simply by adding a constraint, almost all symmetries could be broken (Puget, 1993).

A journey from atomic scale to the largest structure in the brain: always it's a hills and crest in a 3D potential surface: When proteins are pumped at electromagnetic resonance frequencies, the electron density distribution in the secondary structures (cluster of α helices in tubulin) of a protein molecule looks like electron density distribution in a single small molecule. The same pattern evolution is also observed in the single microtubule, filamentary bundle of the axon, group of neurons, etc. The potential fluctuations among different seeds (alfa helices in a single protein, tubulin in a single microtubule and microtubules in the axon bundle) are delocalized among many seeds to generate the collective resonance properties. Say, molecules self-assemble to make a larger seed, then, potentially takes a different form, which controls the electric, magnetic, and mechanical resonance (Hughes, 2018), that very potential should remain distributed among all elemental seeds inside the bigger seeds, thus, all clocks in the brain are nested, one such map is shown in Figure 7.14, its 2D representation is in Figure 7.15. In the cluster of cortical columns the inter-column potential induction via diffused gradient of neurotransmitters, the composition of neurotransmitter river-flows combines multiple cortical columns as a single integrated unit, just like a single molecule. Several cortical columns or nucleus regions made of neuron clusters, i.e., nucleus, fibers, 47 Brodmann's regions in the cortex operate as a single molecule like system. **Why is there wiring in the brain?** When several such sensory controls located at far distant places in the brain needs to be integrated and formed a single molecule like system then neural pathways hold the potentials for constructive interference of waves in the larger cavity, just what the atomic bonds do in a single molecule. Re-wiring and propagation of nerve impulse is following the changes in mapping the 3D interference patterns in the host functional lobes (sub-seeds). The objective is that the potential distribution corresponding to the resonance of multiple carriers in multiple time domains is mapped inside the host cavity that could be a protein complex, cortical column, nucleus or brain stem or the entire brain does not matter, size changes, so the carriers, thence the need for various mechanisms. In other words, wiring is an illusion.

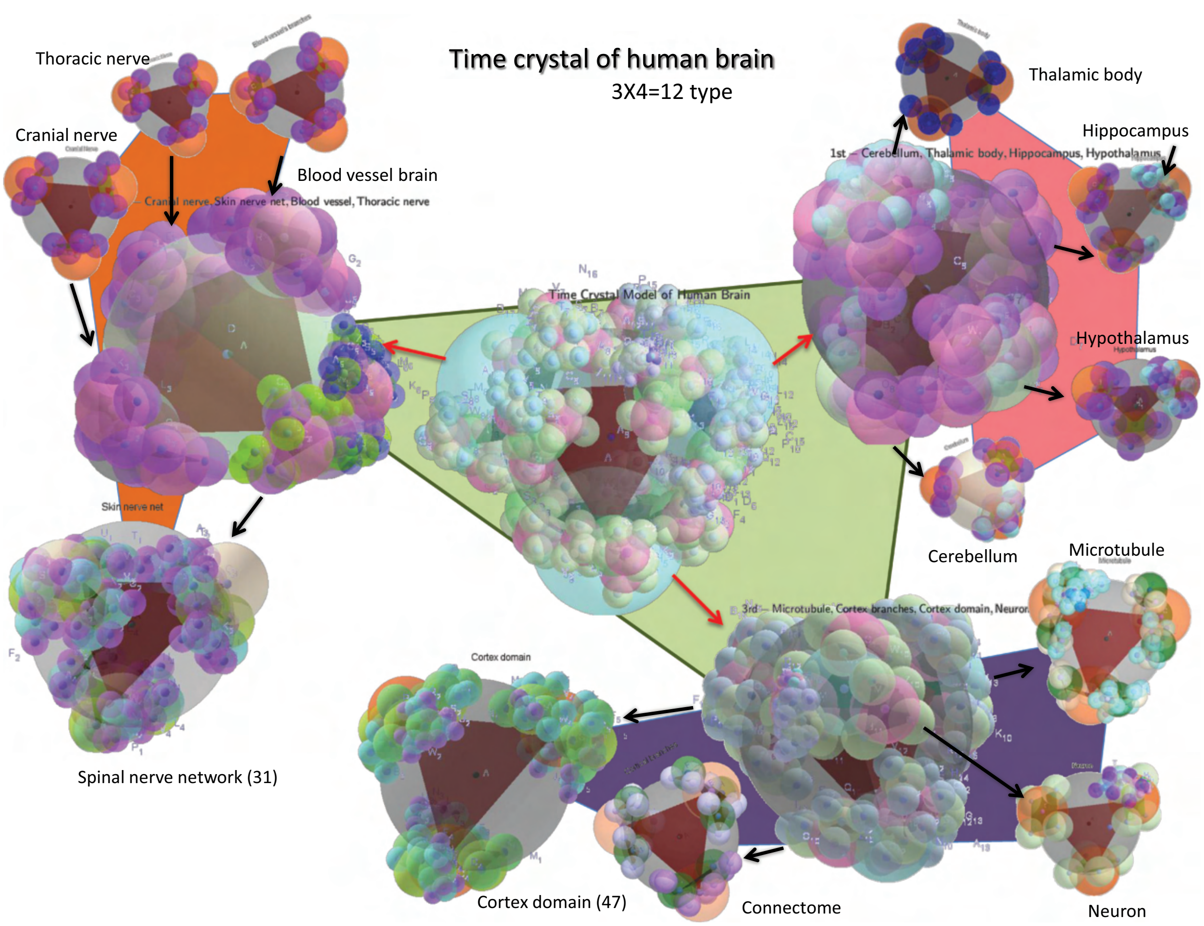


FIGURE 7.14 Time crystal model for the complete human brain.

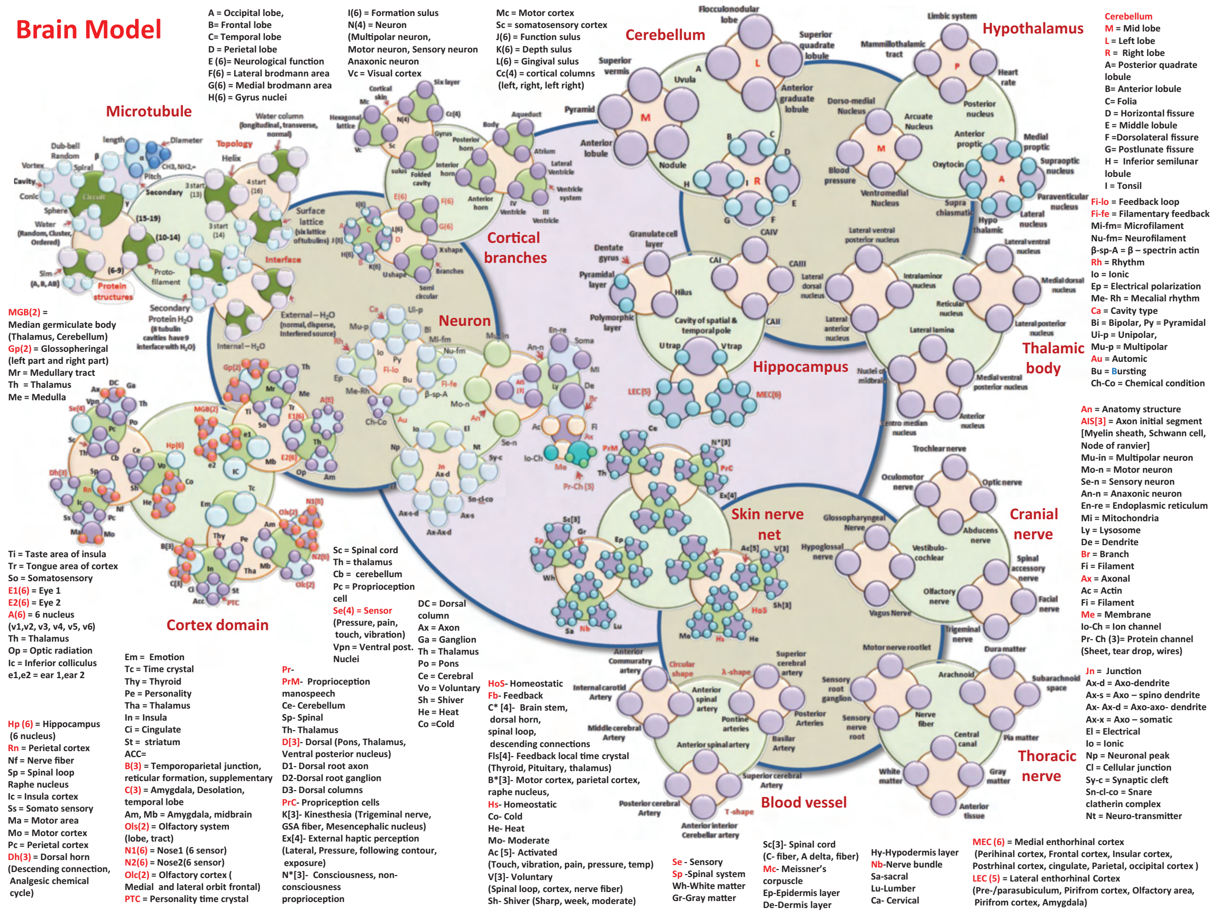


FIGURE 7.15 Time crystal model for the whole brain.

7.10 TIME CRYSTAL MODEL OF THE HUMAN BRAIN

Popular science claim that the brain is a black hole (Buonomano, 2017), gets a new dimension in time crystal map. How a human brain keeps time has been a point of discussion for a long time (Buhusi and Meck, 2005). Some researchers have proposed that keeping time is fundamental to its information processing (Wing, 2002). It is not just that the neurons engage in the management of time (Ivry, and Spencer, 2004) the basal ganglia, when it learns a new trick, it builds time crystal architecture (Graybiel, 2005). The similar kind of time management is found in the cerebellum, whenever it learns coordination in the movement, it builds an architecture of time slices or clocks (Thach, 1998). The human motor activity has a robust, intrinsic fractal structure with similar patterns from minutes to hours (Hu et al., 2013). Thus, the development of the fractal architecture of the time is abundant in literature varying all over the brain, yet there was no compilation by biologists to build a generic musical model of the brain. A time crystal model of the human brain shown in Figures 7.14 and 7.15 would enable providing the seamless regeneration of the lost organs (Biasiucci et al., 2018).

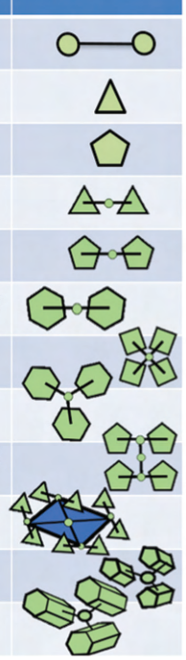
GML is inspired by the brain's intricate engineering to process music: The hidden language in the brain what researchers have always been looking into could be in the form of music (Brown et al., 2006). Not just that brain perceives the music and its evolution pre-attentively (Koelsch et al., 2002) intersensory connections are also musical, smell's neural signature looks like music (Plailly et al., 2007). Fusing two sensory time crystals in the GMLs are inspired by this intra-sensory feature of the brain. The brain is hardwired so that it perceives temporal regularity in music (Large and Palmer, 2002), which is fundamental to the time crystal analyzer described in Chapter 2. In computer science language, one could state the brain finds a hierarchy of recursive functions, or nested recursive functions automatically and elegantly. Brain's engineering is so intricate that it naturally differentiates between an absolute pitch and a relative pitch (Zatorre et al., 1998; Zatorre and Halpern, 2005), which is again a fundamental feature of a time crystal analyzer.

Magnetic rhythms or clocks in the brain: are they output of magnetic vortices? Magnetic rhythms in the brain are known for a long time (Cohen, 1968). Even the magnetic field of a single axon has been studied (Roth and Guo, 1988; Roth and Wikswo, 1985). The research of the biomagnetic field effect on regulating the biological phenomenon has been very well documented (Barnes and Greenebaum, 2007). Since microtubule, DNA like a various magnetic vortex, ionic vortex and electric vortex generators as a fourth-circuit element (Chapter 8) are abundant in the brain, we closely reviewed the research work that monitored the magnetic rhythms. Note that to be a Hinductor-class fourth-circuit element, the charge-flux ratio must be linear and should be seen optically at least during neuron firing. While axon's magnetic field was studied long back, the magnetic study of ionic firing has been demonstrated recently (Barry et al., 2016). Therefore, magnetic rhythms or pure magnetic clocks must be abundant at all scales of information processing in the brain. It is shown that continuous frequency glides in the brain's neural network generates cortical magnetic fields (Arlinger et al., 1982). Neuromagnetic brain rhythms run for minutes for human cognition (Ramkumar et al., 2012). The reason magnetic stimulation based functional imaging of the brain works is manifold (Ilmoniemi et al., 1999).

7.11 FOUR METRICS OF PRIMES RUN IN PARALLEL—THE SAGA OF HEXAGONAL LATTICE

The classic use of PPM is observed in the pupil of our eyes. When discrete time crystals arrive and remain unattended by one metric, then the hierarchy of metrics attend them (Damsma and Rijn, 2017). Gamma band activity of the brain reveals several rhythmic tones connected to each other such that we could represent them as a single metric (Snyder and Large, 2005). The fractal geometry of the brain (Di Leva, 2016) uses four distinct types of metrics in parallel. Pieces of literature are rich in claiming that mind-brain paradox holds a fractal solution (King, 1996). The origin of scale-free dynamics in the brain (Eguiluz et al., 2005) is easily explained by composition of four metrics (Figure 7.16). In the brain at all scale, components try building a tiny PPM, tiny means, limiting integers are narrowed. A brain does not have one but trillions of PPMs, but they integrate and build more complex ones. However, since the pattern of primes is

Prime	Information PPM-1; 12D	Local sensor PPM-2; 4D	Global sensor PPM3; 8D	Higher level sensor PPM4; 12D	Topology
2	3D arrangement of sensory cells	Molecular sensing conversion	Olfactory to cortex pathway	Cranial nerve	
3	Layers of depths of sensor columns	Alfa-helices based cavity sensing	Tongue to brain cortex pathway	Blood Vessel	
5	Types of neurons for sensing	Helical topology of nerve cells	Auditory to cortex pathway	Connectome	
7	Sensing area classification	Geometry of nerve bundles	Thalamus	Limbic antenna	
11	Folding volume for sensing	Neuron-glia relative lattice	Cerebellum	Cerebellum	
13	Geometry of neuron branches	Actin-spectrin edits MT core	Optic pathway eye to the cortex	Microtubule-filament complexes	
17	Non-neural cell arrangement	Nerve lattice defect memory	Hippocampus	Hippocampus	
19	Protein complexes assisting sensing	Protein complex cycle memory	Brain stem	Brain stem	
23	Triplet layers correlation for 12D	Triplet layers for H1, H2, H3	Neuron-glial complex	Neuron-glial complex	
29	Neuron-glial complex	RNA, protein exp. memory	Antenna-midbrain complex	Antenna-midbrain complex	
31	Actin-spectrin periodic network	Hexagonal nerve cell bridge	Spinal nerve	Spinal nerve	
37	Microtubule, MT geometry	Microtubule & filaments H1-H3	Cranial nerve	Cortex-cortical layer	



Prime engineering in the brain

Brain needs elements vibrating following symmetries of five primes only 2,3,5,7, 23 are enough to deliver the rest of the primes using them.

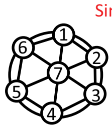
2x2+1=5
2x3+1=7
2x5+1=11
2x6+1=13; 2x3=6
2x9+1=19; 3x3=9
2x11+1=23
2x14+1=29; 2x7=14
2x15+1=31; 3x5=15
2x18+1=37; 2x3x3=18
2x21+1=43; 3x7=21
2x23+1=47; 2x23=46

Most critical prime 23

To build this, brain uses 23 types of neuron cells, 23 types of glial cells and 23 types of dendoastrocytes.

C_2, C_3, C_5, C_7 of $\{23\} = H3$

Hexagonal lattice = prime 37



Singularity Path Choices
2; 1-2-1, 2-3-2......12 clocks
3; 1-2-7-1, 2-3-7-2,......6 clocks
4; 1-2-3-7-1, 2-3-4-7-2,...6 clocks
5; ...6 clocks; 6; ...6 clocks;
7; ...1 clock;

FIGURE 7.16 A table shows how 12 primes govern the information processing at four different levels (three primes are left). Four PPM-1 that regulates the synthesis of 12D time crystal information via sensor cells, PPM-2 that regulates the sensing and synthesis of 4D linguistic quaternions for the sensory input data (four linguistic queries are who did it? What it did? How it did? At which condition?). Then comes PPM-3, this metric governs the sensing and synthesis of octonion packing of sensory time crystals and finally PPM-4, that expands the information content. To the right of the table it is shown that 2, 3, 5, 7, and 23 are enough to create other primes using geometry. To the bottom, hexagonal lattices are found in the microtubule, cortical column assembly, etc, its different pathways taking 2, 3, 4, 5, and 7 elements at a time it is shown that they could replicate 12 + 6×4 + 1=47 clocks, which is exactly the number of Brodmann's region in the brain.

universal, all PPMs governing functional responses in the brain deliver a scale-free dynamic (Eguiluz et al., 2005). Biological clocks are rhythms of life, the clocks running for milliseconds to seconds (Foster and Kreitzman, 2004); here clocks do not end at the neuron surface, there is an infinite chain of segmented times, which forms an infinite, incomplete network of clocks.

Four major PPMs governing the brain are information, PPM-1; local sensor, PPM-2; global sensor, PPM-3; higher-level sensor, PPM-4. Each metric processes 12 primes at least (Figure 7.16), we have listed in the table how typical metrics corresponding to a typical prime (Figure 3.4) is actually generated in the brain. The statistically dominating geometric shape in the time crystals is also noted in the metric table. Two points need to be kept in mind. First, 2, 3, 5, 7, these four primes could generate all other primes easily, geometrically as we observed in the brain components, except 23. Unfortunately, the most important information processing in the neuron layer. Therefore, we need only five symmetries; the rest of the prime dynamics could be regenerated from only five symmetries. Second interesting feature is the importance of hexagonal lattice (see Figure 7.16 bottom). A hexagonal lattice could hold various kinds of clocks simultaneously, some options are shown in Figure 7.16. Thus, Brodmann's 47 regions use hexagonal carpet to process any possible integers and prime dynamics.

7.11.1 Composition of Four, Eight, and Twelve Dimension Tensors

Distributed parallel computing in parts of cortex shows tensor algebra like signal processing (Anastasio and Robinson, 1990). If tensors are there, theories of a holographic brain projecting Schrödinger's wave could not remain far (Nobili, 1985). Clocked cell cycles clock (Edmunds and Adams, 1981) to process three distinct classes of tensors simultaneously. All large-scale models of a human brain (Eliasmith et al., 2012) are linear, 4D, 8D, and 12D network of time crystals is the singular undefined model of the human brain. Octonion algebra could estimate the phase elements of the tensors interacting with each other (Furey, 2018). However, dodecanion algebra would loop the interactive elements, once? Twice? In reality, looping isolated elements mean triggering the PPM. Four-dimensional unified brain theory (Friston, 2010) is not transformed into a 12-dimensional brain here, rather, a variable dimension brain that explores the topology of dimensional transformation would be the right explanation of the time crystal brain model discussed here. Imagine some thoughts are 2-dimensional, some are 8-dimensional, and some events are 10-dimensional (Figure 7.17), the truth lies in the pattern of imaginary worlds active among 4, 8, and 12 choices, it is non-computable (Stulf et al., 2015).

Information PPM-1; 12D	Local sensor PPM-2; 4D	Global sensor PPM-3; 8D	Higher level sensor PPM-4; 12D
PPM-1 is H3 type device that is the only device used by brain for memory & processing.	PPM-2 integrates local sensors, send 12D time crystal to PPM-1 for further processing.	PPM-3 combines 12D data of PPM-1 coming from various sensors all across. Sends output pathways to PPM-4.	Filters match, expand PPM-3 pathways, fills them inside PPM-4 built topologies. 12D input gets 12D dynamics.
Information as 12D time crystal, TC is pure, but requires three editing.	Creates/edits 4D memory for better construction of 12 D input TC.	Creates/edits 8D memory of pathways to filter, combine various sensor built TCs.	Creates/edits 12D memory to expand, transform topologies holding pathways inside.
Information is packed in a 12D TC, then 12D dynamics is packed in three layers.	Destroys identity of local sensors, PPM-2 expands to enrich possible 4D dynamics of 12D input TC.	Destroys identity of global 8 type sensors, pack them in a pathway. 8D dynamics is added to 12D input TC.	Destroys identity of pathways packs paths as points in the topology of higher dimensions, input TC gets 12D dynamics
Information is real, 3 PPMs perfect 12 sensors	Smell, taste, hearing & touch sensing arise.	Visual, proprioception, thermal & time sensing arise.	Symmetry, prime, infinity & consciousness sensing arise.
Dodecanions {d}.	Quaternions {q}.	Octonions {o}	Dodecanions {d}

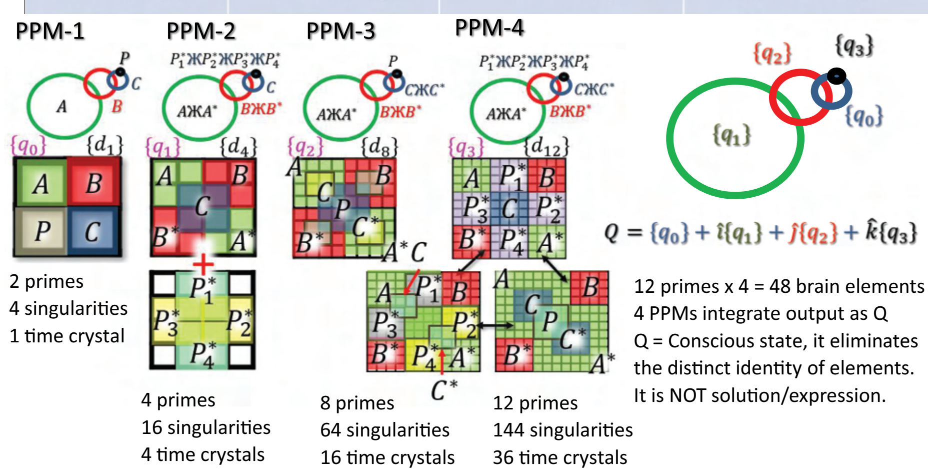


FIGURE 7.17 A table shows the comparisons between the four types of metrics that govern the brain operation. At the bottom, we demonstrate how four PPMs process tensors and deliver a decision for the brain. The brain preserves the linguistic quaternion (who, at what condition, what, and how) for all 12 primes to deliver an output Q, i.e., the conscious state.

As said earlier, information is linguistic (Figure 2.10b), four imaginary worlds, each shares a clock, they hold the answer to four queries, who, when, what, and how. The four PPMs described in Figure 7.17 have identical linguistic structures; however, the tensors have multiple choices as described earlier in Figure 4.13. The only point we add here is that the quaternion composition of four metrics, PPM-1, PPM-2, PPM-3, and PPM-4 delivers us the conscious state or the state of mind Q of the human brain in a time crystal model.

7.11.2 Quaternion, Octonion, and Dodecanion

Biological rhythms and nesting of rhythms were there always: Now it's a crystal and composite materials but made of clocks: It takes five to six days for RNA to replace a protein molecule; the replacement of cells in the body follows a very particular rhythm. Skin cells are replaced in every 14 days, we get new blood in every *three* months, we get a new kidney in every 17 months; in 24 months we get new bones; and in 100 years we get a new heart. Even our breathing, heartbeat, circadian rhythms run perpetually. One interesting aspect that we would like to introduce here is that we now look at all these rhythms from relative changes of one with respect to another. For example, every three months when we get new blood, skins have been replaced roughly six times. The frequency of skin cycle Fs is six times more than the frequency of blood cycle Fb, we can write $Fs = 6Fb$. In this way, all cycles would be related. Not only this is true for the cell replacement cycle, for circadian and other rhythms, but we can also find that there are rhythms inside a rhythm. Not just biology, nested rhythm requires new math and physics. Self-organization goes on at all scales at all time. Biological rhythms are distinctly different from the decision-making rhythms, which are primarily ionic, molecular, chemical. Figure 7.17 primarily concerns decision-making rhythms which are physical, electric, magnetic, mechanical, etc.

Graph theoretical analysis which was used connect structure and function (Bullmore and Sporns, 2009), now a composition of the quaternion, octonion, and dodecanion, i.e., tensor of 4, 8, and 12 imaginary worlds took over (Figure 7.17). Critical and limiting features of the brain are often discussed (Beggs and Timme, 2012), possibly, the limit of all limits is set by the tensor triad of 4, 8, and 12 imaginary worlds. Temporal coding enables segmenting the event scenes in the brain for all kinds of sensors (Engel et al., 1991). In the second step isolated or segmented events are temporally bonded by the typical tensorial bonding protocols (wilder than quantum: hand interacts with eyebrow to sense rose smell; Engel and Singer, 2001). It's a top-down synchronization to implement quaternion, octonion, and the dodecanion (Engel et al., 2001). All the tensor elements are phase lags that estimate the singularity or undefined domain when two clocks interact (Ermentrout and Kopell et al., 1994).

7.12 TIME CRYSTAL MADE MEANDER FLOWER TO A GARDEN OF GARDENS

Musical rhythms have been reported from all over the brain-body architecture, for example the cerebral substrates (Halpern, 2006). Thoughts are often attributed to cerebral rhythms (Steriade et al., 1990a). Different parts of the brain respond to musical emotions very differently, especially in the frontal brain EEG one could read musical emotions distinctly (Schmidt and Trainor, 2001). Even during motor learning music like rhythms are born (Sakai et al., 2004). The brain states are oscillatory and if information in the brain is considered as geometric, then, using neural oscillations it becomes easy to explain the brain states (Nie et al., 2014). The map of temporal disorders suggests that a set of clocks or a local part of time crystal could move from one system to another and build a new system (Rensing et al., 1987). This particular mechanism is the foundation of brain's decision-making, the brain has a storage of complex time crystal system (first two columns of Figure 7.18), from these running banks, the brain picks tiny little clusters of clocks or local time crystals and builds unprecedented time crystal as thoughts (last three columns of Figure 7.18).

Garden of gardens (GOG) pick flowers from different gardens of time crystals, synchronize those flowers as petals to build new flowers (Glass, 2001), the transition from clocks to chaos to clocks continue (Glass and Mackey, 1988). PPM governs how and which petals to be picked and to be brought together. The journey of time crystals that begins as a singular clock, ends in a random collection of flowers in a garden, which ends in the formation of a conscious architecture, GOG. A GOG attains the ability of build new flowers since it's a composition of 12 life like gardens of time crystals, so each of its garden has 12 distinct classes of time crystal systems. GOG is composite life form made of 12 life like systems. Unconscious means an absence of garden of gardens, by delinking of 12 garden-integration systems; yet all 12 gardens remain active (Goila and Pawar, 2009), the inverse event is therefore the construct of a conscious machine. Large-scale synchronization like a world wide web is a good metaphor (Varela et al., 2001), but it reveals nothing about the intricate nature of clocks.

7.12.1 Twelve Dodecanion and Eight Octonions Build 20 Conscious Human Expressions

In the 1880s, B.W. Betts developed a mathematical system for modeling the development of human consciousness through geometry (Cook, 1887). How brain builds its cognitive codes is the hallmark of the science of consciousness (Grossberg, 1980), now, with the advent of a fractal tape, an entirely new scientific exploration is getting a shape around it (Ghosh et al., 2014a). Geometric information estimates the neural interactions in the human brain (Nie et al., 2014), often the interactions are considered to be electric (Nuñez, 1998). However, linear layered architectures of intelligence like deep

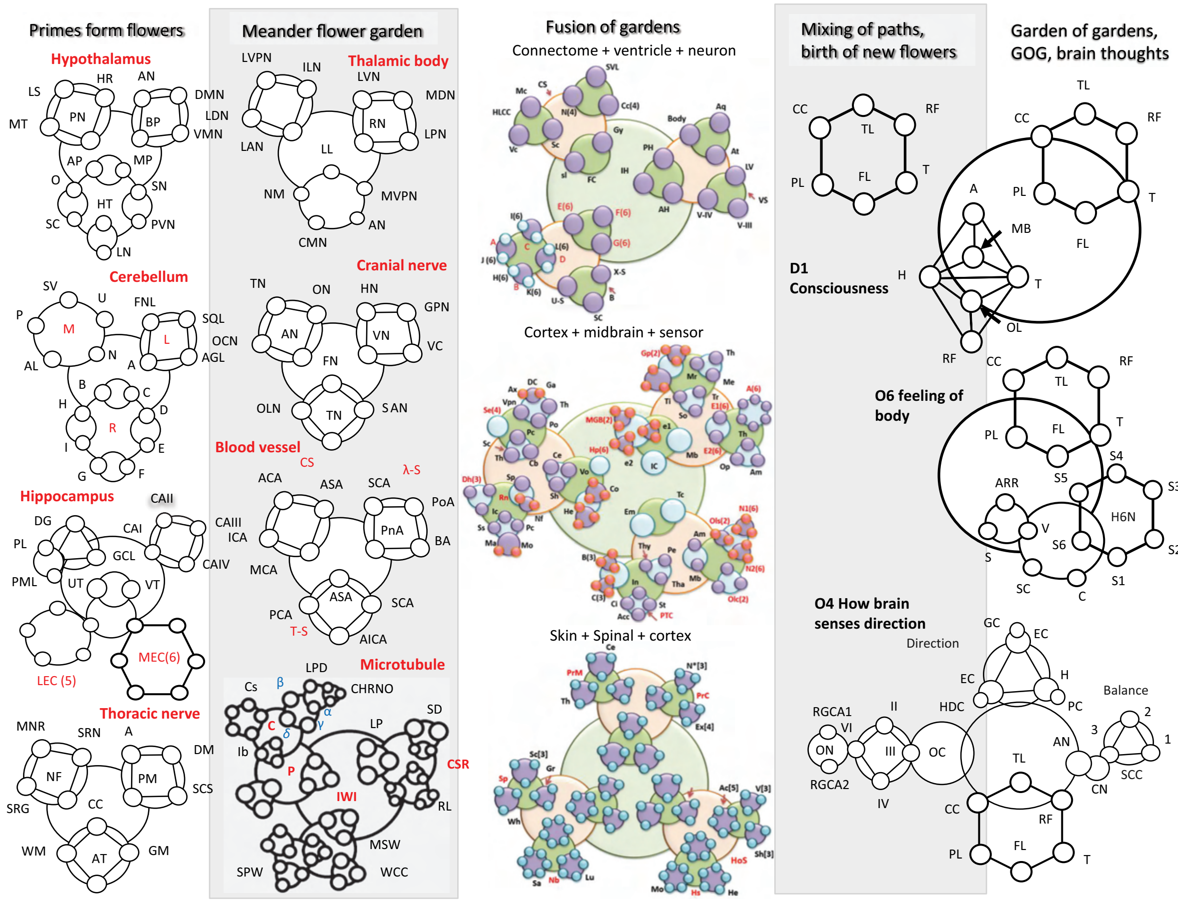


FIGURE 7.18 Five columns demonstrate how the time crystals that represent a particular organ in the brain delivers a few loops and those local time crystals self-assemble to generate complex functional time crystals for conscious response of the human brain as Garden of Gardens described in Chapter 2 (here, column 5).

Hypothalamus:

MT-Mammilothalamic tract, LS-Limbic system, HR-Heart rate, PN-Posterior nucleus, DMN-Dorso medial nucleus, AN-Arcuate nucleus, VN-Ventromedial nucleus, BP-Blood pressure, AP-Anterior Proptic, MP-Medial preoptic, SN-Supraoptic nucleus, PVN-Paraventricular nucleus, LN-Lateral nucleus, HT-Hypothalamic nucleus, SC-Suprachiasmatic, O-Oxytocin

Cerebellum:

SV-Superior vermis, P-Pyramid, AL-Anterior lobule, N-Nodule, U-Uvula, AGL- Anterior Graduate Lobule, A-Posterior quadrate lobule, SQL-Superior quadrate lobule, FL-Flocculonodular Lobe, B-Folia, D-Horizontal Fissure, E-Middle lobule, F-Dorsolateral fissure, G-Postlunate Fissure, H-Inferior semilunar lobule, I-Tonsil

Hippocampus:

DG-Dentate Gyrus, GCL-Granulate Cell Layer, H-Hilus, PL-Pyramidal Layer, PML-Polymorphic layer, Cavity of the spatial and temporal pole is made of UT and VT, UT-U Trap, VT-V Trap, LEC(5)-Lateral Enthorhinal Cortex (Pre/Parasubiculum, Piriform Cortex, Olfactory area, Amygdala). MEC(6)-Medial Enthorhinal cortex (Perihinal cortex, frontal cortex, insular cortex, postrhinal cortex, cingulate gyrus, Parietal, Occipital cortex)

Thoracic nerve:

MNR-Motor nerve rootlet, SRN-Sensory root Ganglion, SNR-Sensory nerve root, NF-Nerve Fiber, A-Arachnoid matter, DM-Dura matter, PM-Pia matter, SCS-Suprachnoid space, CC-Central canal, WM-White matter, GM-Gray matter, AT-Anterior Tissue

Thalamic body:

LVPN-Lateral ventral posterior nucleus, LDN-Lateral dorsal nucleus, LAN-Lateral anterior nucleus, IN-Intralaminor nucleus, LL-Lateral lamina, NM-Nuclei of midbrain, CMN-Centro median nucleus, AN-Anterior nucleus, MVPN-Medial ventral posterior nucleus. RN-Reticular nucleus, LPN-Lateral posterior nucleus, MDN-Medial dorsal nucleus, LVN-Lateral ventral nucleus

Cranial nerve:

TN: Trochlear nerve, ON-Oculomotor nerve, AN-Abducens nerve, ON-Optic nerve, HN-Hypoglossal nerve, GN-Glossopharyngeal nerve, VC-Vestibulocochlear, VN-Vagus nerve, FN-Facial nerve, ON-Olfactory nerve, TN-Trigeminal nerve, SAN-Spinal accessory nerve *(continued)*

FIGURE 7.18 (Continued)

Blood vessel branches:

Circular shape (ACA-Anterior commutator artery, ICA-Internal carotid artery, MCA-Middle cerebral artery, ASA-Anterior spinal artery), λ-shape(PA-Pontine Arteries, BA-Basilar artery, PA-Posterior Artery, SCA-Superior cerebral artery), T-shape (ICA-Interior cerebral artery, ASA-Anterior spinal artery, PCA-Posterior cerebral artery, AICA-Anterior Interior cerebral artery)

Microtubule:

Tubulin protein structure

Secondary protein [α-helices (LPD-Length pitch and diameter; CHRNO-alkyl, amine), β, γ, δ]. Cavity [Conic, vortex, dumb-bell or tear-drop, spiral]. Water layer [Random arrangement, cluster, ordered]. Sim on the lattice surface, S (lattice type A, B, and AB) and protofilaments (numbers, 6-9, 10-14, 15-19).

Topological morphogenesis of microtubule surface

Helical transport path (periodicity helical gap 2, 3 (returns on 13); gap 4 (returns on 16)); central water channel (longitudinal, transverse, and normal); surface tubulin lattice (six distinct classes of lattices observed in the tunneling images)

The interface between sub-helices and surfaces

Secondary protein water channel (triplet of triplet domains, eight tubulin cavities have nine interfaces with H2O); external surface water layer (one to two molecular layers of water in three modes, normal, disperse, interfered source); inner core water channel (longitudinal, transverse, and normal modes of water)

Skin nerve network:

The homeostatic primary clock network

HoS-Homeostatic; Fb-Feedback; C* [4]-Brain stem, dorsal horn, spinal loop, descending connections; Fls[4]-Feedback local time crystal (Thyroid, Pituitary, thalamus); B*[3]-Motor cortex, parietal cortex, raphe nucleus, Hs-Homeostatic; Co-Cold; He-Heat; Mo-Moderate; Ac [5]-Activated; (Touch, vibration, pain, pressure, temp); V[3]-Voluntary (Spinal loop, cortex, nerve fiber); Sh-Shiver (Sharp, week, moderate)

Brain-controlled higher-level network connected to skin

PrM-Proprioception manospeech; Ce-Cerebellum; Sp-Spinal; Th-Thalamus; D[3]-Dorsal, (Pons, Thalamus, Ventral posterior nucleus); D1-Dorsal root axon; D2-Dorsal root ganglion; D3-Dorsal columns; PrC-Propriception cells; K[3]-Kinesthesia (Trigeminal nerve, GSA fiber, Mesencephalic nucleus); Ex[4]-External haptic perception (Lateral, Pressure, following contour, exposure); N*[3]-Consciousness, non-consciousness proprioception

Sensory pathway via the spinal cord

Se—Sensory; Sp-Spinal system; Wh-White matter; Gr-Gray matter; Sc[3]-Spinal cord, (C-fiber, A-delta, fiber) Mc-Meissner's corpuscle; Ep-Epidermis layer; De-Dermis layer; Hy-Hypodermis layer; Nb-Nerve bundle; Sa-sacral; Lu-Lumber; Ca-Cervical

Cortical branches

Ventricular and geometric cavities

Aq-Aqueduct, Body, At-Atrium, LV-Lateral Ventricle, VS-Ventricular system, IV-V=IV Ventricle, III-V=III Ventricle, PH-Posterior Horn, IH-Interior Horn, AH-Anterior Horn

Top folded hexagonal lattice domains (47 Brodman's regions)

CS-Cortical system; SVL-Seven vertical layers of the cortical column, N(4), Hexagonal lattice, Mc, Vc, Sc. Folded cavity, Sl-Sulus, Gy-Gyrus, Cc(4).

Nerve bundle for the different functional region.

E(6), F(6), G(6), L(6), I(6), J(6), H(6), K(6), Three types of branches B, X-S=X-shape, Semi-circular-SC, and U-S-U shape.

A = Occipital lobe, B= Frontal lobe, C= Temporal lobe, D = Perietal lobe, E (6)= Neurological function, F(6) = Lateral brodmann area, G(6) = Medial brodmann area, H(6) = Gyrus nuclei, I(6) = Formation sulus, J(6) = Function sulus, K(6) = Depth sulus, L(6) = Gingival sulus, Cc(4) = cortical columns (left, right, left right), N(4) = Neuron (Multipolar neuron, Motor neuron, Sensory neuron, Anaxonic neuron, 23 types of neural branches are studied), Vc = Visual cortex, Mc = Motor cortex, Sc = somatosensory cortex

Cortex domain

MGB(2) = Median germiculate body (Thalamus, Cerebellum); Gp(2) = Glossopheringal (left part and right part); Mr = Medullary tract; Th = Thalamus; Me = Medulla; Ti = Taste area of insula; Tr = Tongue area of cortex; So = Somatosensory; E1(6) = Eye 1; E2(6) = Eye 2; A(6) = 6 nucleus; (v1, v2, v3, v4, v5, v6); Th = Thalamus; Op = Optic radiation; Ic = Inferior colliculus; e1,e2 = ear 1,ear 2

(*continued*)

FIGURE 7.18 (Continued)

Em = Emotional pathways (details in functional time crystals); Tc = Time crystal clusters of hippocampal output, Thy = Thyroid, Pe = Personality time crystal, Tha = Thalamus, In = Insula, Ci = Cingulate gyrus learning pathway, St = striatum, ACC=, B(3) = Temporoparietal junction, reticular formation, supplementary; C(3) = Amygdala, Desolation, temporal lobe; Am, Mb = Amygdala, midbrain; Ols(2) = Olfactory system (lobe, tract); N1(6) = Nose1 (6 sensor, +one controller 6 + 1 = 7); N2(6) = Nose2(6 sensors +one controller, 6 + 1 = 7); Olc(2) = Olfactory cortex (Medial and lateral orbit frontal); PTC = Personality time crystal

Sc = 31 Spinal cord cavity's time crystal; Th = thalamus, Cb = cerebellum, Pc = Proprioception cell based network, Se(4) = Sensor (Pressure, pain, touch, vibration); Vpn = Ventral post. Nuclei, DC = Dorsal column

Ax = Axonal branches connecting cortical columns, Ga = Ganglion, Po = Pons brain stem, Ce = Cerebral

Vo = Voluntary, Three sensations of homeostasis trigger large-scale information processing, Sh = Shiver; He = Heat; Co =Cold

Hp (6) = Hippocampus; (6 nucleus, +one controller 6 + 1=7); Rn = raphe nucleus, Nf = Nerve fiber singular time crystal, Sp = Spinal loop time crystal built by cross sectional components; Ic = Insula cortex; Ss = Somato sensory; Ma = Motor area, Mo = Motor cortex; Pc = Perietal cortex; Dh(3) = Dorsal horn, (Descending connection, Analgesic chemical cycle)

All components of the column 4 and column 5 are described in Figures 7.19, 7.20, 7.21

D1. Consciousness

Central executive, CE; Olfactory lobe, OL; Mamillary body, MB; Parietal lobe, PL; Corpus Callosum, CC; Temporal lobe, TL; Fusiform gyrus, FFG; Corpus callosum, CC; Primary sensory pad, PSP; Superior temporal, ST; Sensory pads, SP; Caudate nucleus, CN; Putamen, P; Amygdala, A; Hippocampus, H; Reticular formation, RF; Thalamus, T; Limbic system, LS; Superior caliculus, SC; orbitofrontal cortex, OFC; Frontal lobe, FL; Parietal cortex, PC

D2. Memory

Protein secondary structure, PSS; α-helix, α; β-sheet, β; Microtubule, M; Actin, A; Neurofilament, N; Neuron, NN; Glia-Astrocyte, GA; Oligo-dendrocyte, OD; Pyramidal and polar, PP; Tear-drop transform, TDT; Superstructures of neuron, SSN

D3. Language and conversation

Arcuate fasciculus, AF; Temporal lobe, TL; Frontal lobe, FL; Dorsal Prefrontal cortex, DPFC; Motor cortex, MC; Broca's area, BA; Gesdiwind territory, GT; Cerebellum, C; Wernicke's area, WA; Visual cortex, VC

D4. Thinking and intelligence

Extrastriate cortex, EC; Fusiform gyrus, FG; Wernicke's area, WA; angular gyrus, AG; supramarginal gyrus, SG; superior parietal lobule, SPL; Anterior Cingulate, AC; Working memory, WM; Procedural memory, PM; Episodic memory, EM; Semantic memory, SM; Implicit memory, IM

D5. Sense of universal time, symmetry

10 Metrics of prime, 10MP; Statistical prime contribution, SPC; Striatum amygdala, SA; Temporal lobe, TL; Thalamus, T; Parietal lobe, PL; Hippocampus long memory, HLM; Topological projected time, TPt; Frontal lobe, FL; Corpus callosum, CC; Reticular formation, RF; Hippocampus min time filtered pattern, HMTFP

D6. Fear, threat, anger, hate

Medical dorsal nucleus, MDN; Limbic system, LS; Thalamus, Th; Posterior portion, PP; Accessory basal, AB; Middle gyrus, Mg; Basal nucleus, BN; Cingulate cortex, CC; Cortex, C; Medical, M; Amygdala, A; Hypothalamus, H; Input lateral terminal, ILT; Olfactory lobe, OL; Fornix, F; Mammillary body, MB; Basal ganglia, BG; Frontal cortex, FC; Superior-Frontal cortex, SFC; Pre-frontal cortex, PFC; Ventral tangential array, VTA; Dopamine level, DL; Styria terminalis, ST; Nucleus acumens, NA; Orbitofrontal cortex, OC; Insula, In

D7. Reward

Basal ganglia, BG; Nucleus accumbens, NA; Ventral tegmental area, VTA; Midbrain, MB; Pre-frontal cortex, PFC; Dopamine cycle, DC; Striatum, S; Pallidum, P; Thalamus, T; Cortex, C; Ventral pallidum, VP; parabrachial nucleus, PN; orbitofrontal cortex OFC; and insular cortex, IC

D8. Mimicry, skill, adaptation

Parietal lobe, PL; Thalamus, Th; Cerebellum, C; Hippocampus, H; Amygdala, A; Temporal lobe, TL; Caudate nucleus, CN; Mammillary body, MB; Putamen, P; Frontal lobe, FL; Primary visual cortex, PVC; Temporal lobe, TL; Dorsolateral Pre-frontal, DPF; Orbitofrontal cortex, OFC; Motor cortex, MC; Reticular formation, RF; Supplementary Motor cortex, SMC; Thalamus sensor crossover, TSC; Tempo-parietal junction, TPJ; Hippocampal memory encoding, HME

D9. Creativity and humor

ACC Anterior Cingulate, AC; Temporal sulcus, TS; Caudate nucleus, CN; Central executive, CE; Left Amygdala, LA; Pre-frontal cortex, PFC; Motor cortex, MC; Posterior Temporal region, PTR; Motor cortex, MC; Ventral brain stem, VBS; Cerebellum, C; Pyramidal tract, PT

(*continued*)

FIGURE 7.18 (Continued)

D10. Personality

Supplementary motor cortex, SMC; Creativity time crystal, CTC; Personality time crystal, PTC; Insula, I; Cingulate, C; Striatum, S; ACC Anterior Cingulate, AC; Temporal sulcus, TS; Thalamus, Th; Amygdala, A; Reticular formation, RF; temporoparietal junction, TPJ; Temporal lobe, TL; Desolation prefrontal, DP; Orbitofrontal cortex, OFC; Thyroid, Thy

D11. Love and pain

Lateral nucleus, LN; Medial ventral posterior nucleus, MVPN; Cingulate cortex, CC; Spindle cells, SC; Olfactory lobe, OL; limbic system, LS; Superior temporal cortex, STC; orbitofrontal cortex, OFC; Amygdala, A; Primary visual cortex, PVC; Fusiform gyrus, FFG; ventral tegmental area, VTA; nucleus accumbens, NA; Prefrontal cortex, PFC

D12. Learning dreaming defragmentation

Nucleus Accumbens, NA; Thalamus, Th; Caudate nucleus, CN; Reticular formation, RF; Central executive. CE; Prefrontal cortex, PrC; Putamen, P; Parietal cortex, PaC; Hippocampus, H; Broca's area, BA; Visual scratchpad, VSP; Mamillary body, MB; Amygdala, A; Parietal lobe, PL; ventrolateral preoptic nucleus, VLPO; Parafacial zone, PF; Nucleus accumbens core, NAC; Lateral hypothalamic MCH neurons, LHMN

O1. Fusion of elementary sensor into a single time crystal

Optic cranial nerve, II; trochlear nerve (IV); abducens nerve (VI); oculomotor nerve (III); Optic Chiasm, OC; Thalamus, Th; Optic Chiasm, OC; Optical nerve, ON; Retinal ganglion cell axon, RGCA; Lateral geniculate nucleus, LGN; Optical radiation, OR

Cortex domain, CD; Ventral posterior nucleus, VPN; Dorsal column nuclei, DCN; Ventral horn, VH; Dorsal root ganglion, DRG; Touch, Pressure, Vibration, heat/cold, pain, proprioception (muscle), S1-S6

Receptor cell nerve fiber, RCNF; Medial orbitofrontal, MOF; Tract, T; Amygdala, A; Lateral orbitofrontal, LOF; Hippocampus, H; Midbrain, M; Olfactory nerve, I

Facial nerve (cranial nerve VII), the lingual branch of the glossopharyngeal nerve (cranial nerve IX), and the superior laryngeal branch of the vagus nerve (Cranial nerve X); Nucleus of medullary tract, NMT; Taste area of somatosensory, TAS; Taste area of insula, TAI; Medulla, M; Gustatory Cortex, GC; Thalamus, Th; Epiglottis, E

Superior olivary nucleus, SON; Primary auditory cortex, PAC; Superior olive complex, SOC; Midbrain, MB; Lateral lemniscus, LL; Medulla, M; Inferior Colliculus, IC; Ventral Cochlear nucleus, VCN; Semicircular canals, SCC; Auditory nerve, AN; Medial geniculate body, MGB; Inferior colliculus, IC; Cochlear nucleus, CN; Auditory nerve, AN

O2. Proprioception cells, PC; Pressure, P; Spinal cord, SC; Conscious, Co; Un-conscious, UC; Temperature, T; Cerebellum, C; Thalamus, Th; Vibration, V; Pons, Po; Pain, Pn; Touch, T; Dorsal root axon, DRA; Ventral posterior nuclei, VPN; Dorsal root ganglion, DRG; Dorsal column nuclei, DCN

O3. Motion or movement, audio+visual + time

Registering an event

The putamen, P; Caudate nucleus, CN; dorsal stratium, DS; Substantia Nigra, SN; Globus pallidus, GP; Claustrum, C; thalamus; Optical nerve, ON; Cochlea, Coch; Auditory nerve, AN; Retinal ganglion cell axon, RGCA; Spinal nerve, SN; Cerebellum, Cr

O4. Homeostasis, thermal equilibrium

Pituitary, P; Gonad, G; Adrenal, A; Thyroid, T; Retina, R; Basal Ganglia, BG; Hypothalamus, H; Pituitary gland, PG; Melatomic level, ML; Suprachiasmatic nucleus, SCN

O5. How brain senses direction

Semicircular canals, SCC; Cochlear nucleus, CN; Auditory nerve, AN; Optic cranial nerve, II; trochlear nerve (IV); abducens nerve (VI); oculomotor nerve (III), Optic Chiasm, OC; Retinal ganglion cell axon, RGCA; Temporal lobe, TL; Thalamus, T; Parietal lobe, PL; Frontal lobe, FL; Corpus callosum, CC; Reticular formation, RF; Place cells, PC; Hippocampus, H; Grid cells, GC; Entorhinal cortex, EC; Head direction cell, EDC

O6. Temporal synchrony of entire skin cover, the feeling of body

Somato sensory cortex, SSC; Supplementary motor, SM; Raphe nucleus, RN; Motor cortex, MC; Spinal loop, SL; Insular Cortex, IC; Descending connection, DC; Analgesic chemical cycles, ACC; Parietal Cortex, PC; Pituitary, P; C-fiber, C-F; Thyroid, Ty; Brain stain, BS; Nerve fiber, NF; Dorsal horn, DH; A-delta fiber, AF; Thalamus, Th; Activate automated response, AAR; Spinal cord, SC; Hippocampus, (six nucleus), H6N; Shiver, S; Voluntary, V; Cerebral, C; Temporal lobe, TL; Thalamus, T; Parietal lobe, PL; Frontal lobe, FL; Corpus callosum, CC; Reticular formation, RF

(*continued*)

FIGURE 7.18 (Continued)

O7. Emotion

Medial ventral posterior nucleus, MVPN; Amygdala, A; the limbic system, LS; GABA secretion, GS; Hippocampus, H; Hypothalamus, H; Mamillary body, MB; Olfactory lobe, OL; Lateral nucleus, LN; Fornix, F; Thalamus, Th; Stria terminalis, ST

O8. Time

Medulla, MD; Pons, P; Internal muscle, IM; Internal muscle, IM; Vagus nerve, VN; Diaphragm, D; Ventral respiratory group, VRG; Pontine respiratory center, PRC; Dorsal respiratory group, DRG; Sinoatrial node, SN; Cardiac nerve, CN; Cardio regulator, CR; Hypothalamus, H; Basal ganglia, BG; Dopamin path, DP; Pre-frontal cortex, anterior, PFCA; Substantia nigra, SN; Pyramidal decussation, PD; Raphe nuclei, RN; Suprachiasmatic nuclei, SCN; Adrenal gland cortisol, AGC; Pineal gland melatonin, PGM; Ventro-lateral preoptic nucleus, VLPO; Retina ganglion, RG; Tuberomammillary nucleus, TMN.

learning are often thought of as a recipe that would never match biological intelligence (Nikolić, 2017). Brain oscillations could be read as biomarkers in neuropsychiatric disorders (Yener and Basar, 2012), biological rhythms should reset medical treatment (Halberg, 1977; Hildebrandt, et al., 1957), a shock of phase singularity could assist in medical treatment (Richter, 1960); phase reset curve that identifies a time crystal could act as diagnostic tool (Tass, 1999), i.e., time crystal as a biomarker (Yener and Basar, 2012); rhythm-medicine connections are studied for a long time (Reinberg and Smolensky, 1983; Schwan, 1957). For example, the mitotic cell rhythms in cancer show a typical behavior, that could be used as a marker (Sainz and Halberg, 1966). Figures 7.19 through 7.21 outline garden of gardens created by following Figure 7.18 fusion of time crystals produced by different brain components. We describe below the consciousness generating time crystals, which should generate in an artificial brain naturally in the prime symmetry designed oscillators.

D1: Consciousness: Even if human consciousness is disrupted, the spectral signatures carry information that

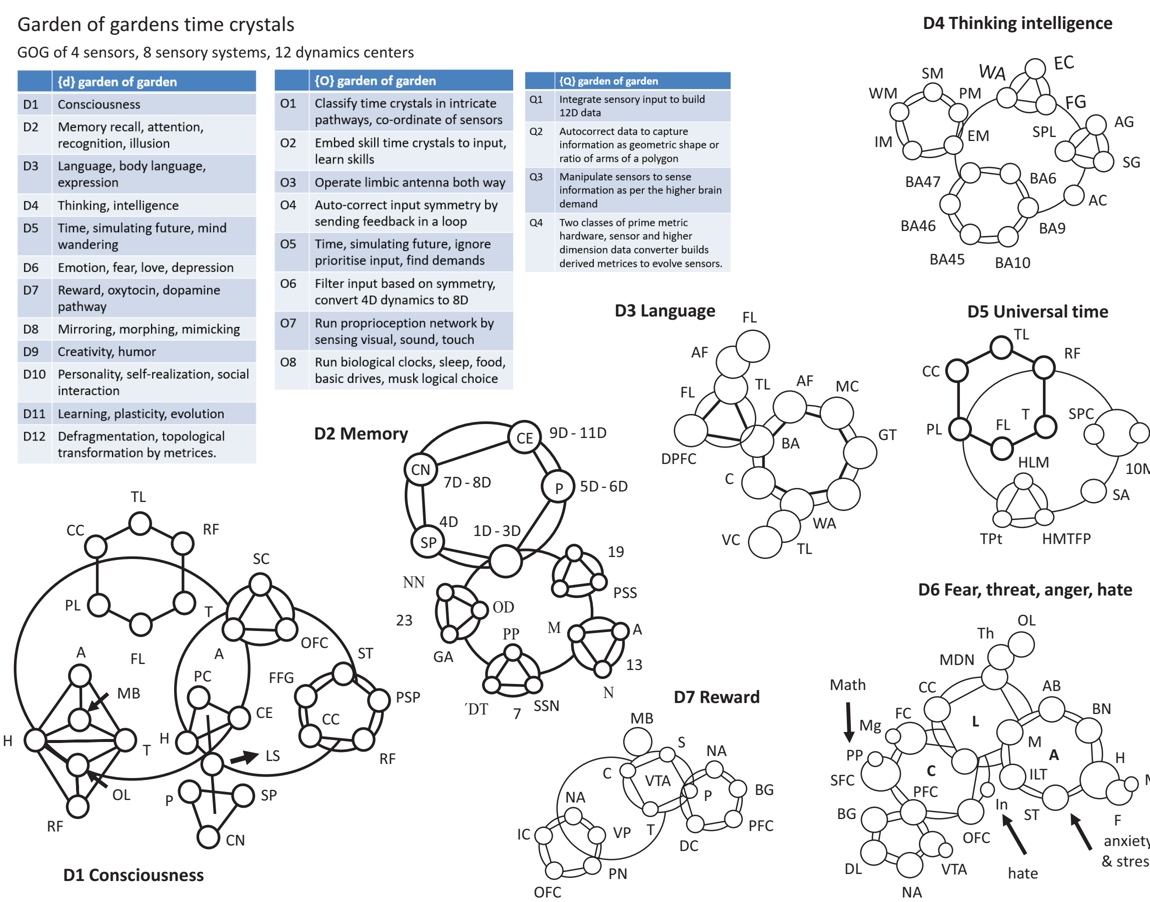


FIGURE 7.19 Garden of Garden's (GOG) of time crystal. Three tables show 12 dodecanion tensors that regulate fundamental conscious expressions of a human being, 8 octonion tensors that regulate sensory data integration and instantaneous decision-making, 4 quaternions that senses the input data. Note that all data structure is 11D, or dodecanion, but they are packed like four linguistic questions.

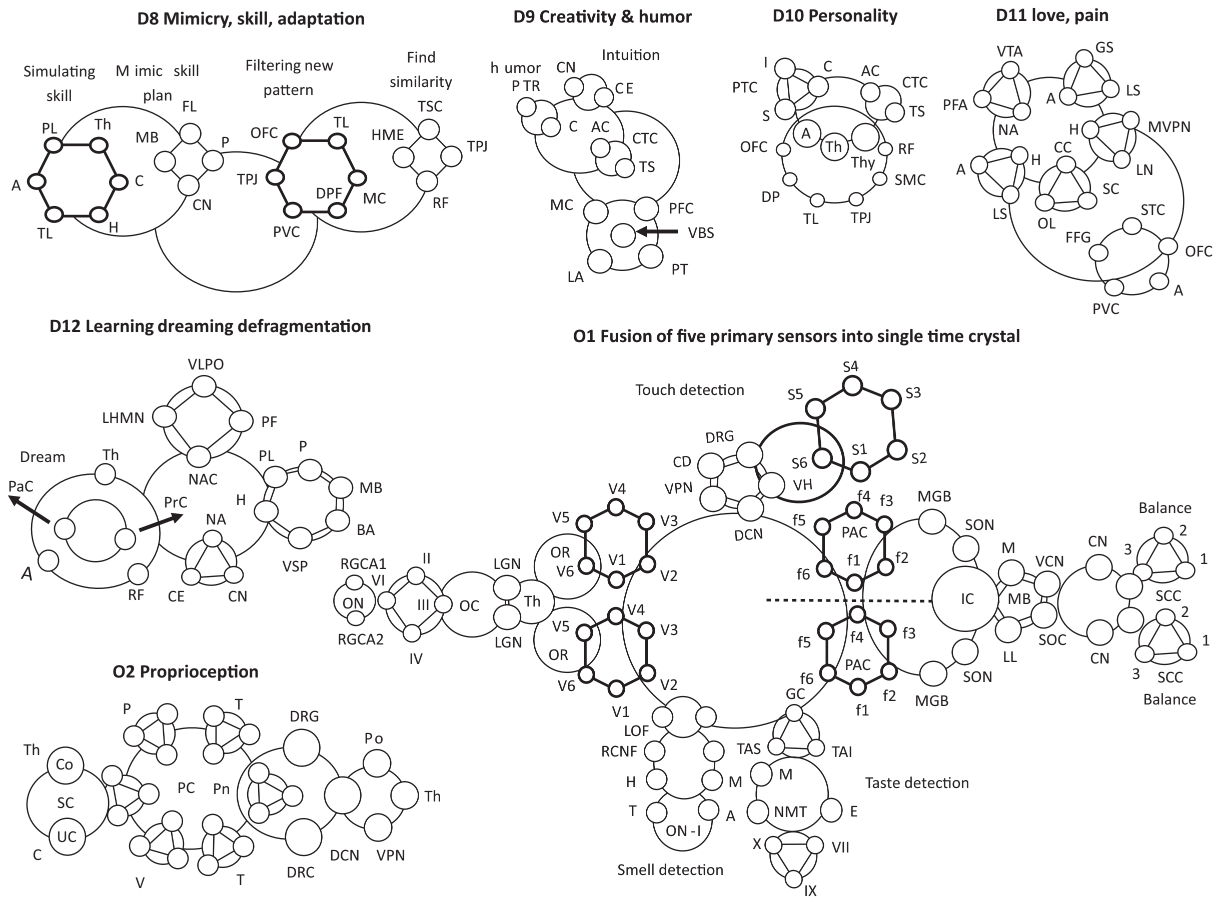


FIGURE 7.20 Dodecanions and octonions.

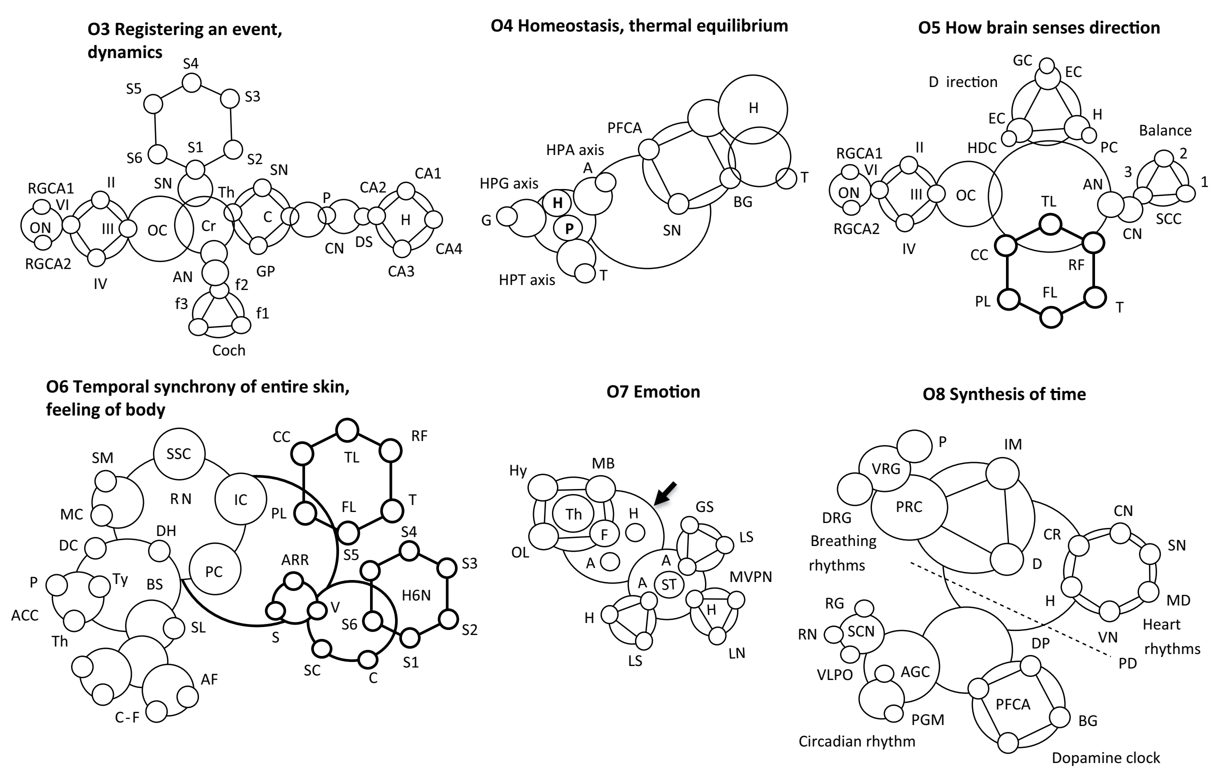


FIGURE 7.21 Octonions.

clocks are geometrically reorganized (Chennu et al., 2014). Coma is a state where certain higher-level integration clocks get shut off, several PPMs and time crystals run in an isolated manner (Plum and Posner, 1980). The rhythm of breathing edits the rhythms of the limbic system and that change affects the cognition of a human mind (Zelano et al., 2016).

D2: Memory: However, the dream to crystallize a memory (Ramirez, 2018) for uploading consciousness would require a complete time crystal model of the entire brain with all basic conscious features. While uploading the resetting the human clock (Winfree, 1991) would require editing the garden of gardens, i.e., hierarchical architecture of conscious clocks. One could state that keeping time could be a singular function of a human brain (Miller, 2000). When dust deposits on the strings of musical instrument, the clock slows down. Similarly molecular clocks undergo epigenetic changes, the clock architectures running conscious experiences (Figure 7.21) shows the sign of aging, i.e., clock diameters shrink or expand (Mittedorf, 2016). Twenty automated conscious experiences that run via 20, time crystals are running simultaneously, perpetually for entire life range milliseconds to seconds (Näätänen et al., 2004). These are the building blocks of the human brain (Nowakowski, 2018) path toward true neurogenesis (Gage, 2002; Konishi, 1990; Kuffler and Nichols, 1977). Memorizing anything requires high-frequency signal transfer (Kucewicz et al., 2014), shorter clocks of the time crystals build specific pathways. Memories follow prime 7 while grouping events (Lisman and Idiart, 1995). Memories make synapses strong, is it making information stable or circuit (Lisman, 1997), else one builds false memories (Loftus, 1997).

D3: Language: Probabilistic theories fail to explain the large-scale replication when a human comprehends a language (Nieuwland et al., 2018). Grammar is a delicate feature; its time crystal model has been described in detail following the transmission pathways for the nerve spikes in real-time. It resembles reservoir computing but many clocks work in parallel (Hinaut and Dominey, 2013). Mind and language are intimately connected by meaning and experience (Follesdal, 1975); only that was not known how the mind looks like (Sudkamp, 2006). General-purpose learning of language is fundamental to the brain's development (Phillip Hamrick et al., 2018). Using simply the temporal difference one could comprehend speech (Shannon et al., 1995). Any human language has embedded clock-like rhythms (Schwartz et al., 2003; Langner, 1992), auditory signals have music like temporal architecture (Cariani, 1999; Zatorre and Halpern, 2005) so it naturally processes musical scales (Elvira et al., 2006).

D5: Universal time: The sense of time of a life long journey defines human cognition (Levin and Zakay, 1989), voluntary timing intimately relate brain function, the architecture of time undergoes a subtle change (Wing, 2002; Winfree, 1970). Timelessness emerges when time crystal bridges singularity (Winfree, 1973, 1986a), wherein the pattern of phase compromises (Winfree, 1974, 1986b). Biological clocks set time for perception of events (Moore-Ede et al., 1982), but those clocks are not isolated. Time travel inside our mind evolves the brain (Suddendorf and Corballis, 1997).

D6: Fear, threat, anger, hate: Every single thought, imagination, dream, fear, love and joy are geometric structures now (Cook, 1887). Only second to millisecond time domain is presented here but could be extended much deeper inside the brain. Hallucinations in the brain are composite, derived time crystal originating in the Paracingulate sulcus morphology (Garrison, 2015), one could edit that geometry in various ways. Paranormal activities in the brain tell a similar temporal structure (Radford, 2010). Social and ecological drivers have regulated the brain size evolution of various species (Forero and Gardner, 2018). Brain-to-brain coupling follows certain rules to create and evolve social structure (Hasson et al., 2012).

D8: Mimicry, skill: Mimicry is one of the finest expressions of a conscious being, its cognitive circuits were explored (Hale and Hamilton, 2016); emotion is exchanged between two conscious beings through mimicry, it is grounded on a concrete geometric feature of the periodic information exchange (Prochazkova and Kret, 2017). Playing music in the brain requires programming skills as a series of periodic tasks. Its limiting features are decoded in the geometry of temporal architecture of music and skills together (Hart et al., 1998). The brain detects musical pitch naturally (Meddis and O'Mard, 1997).

D10: Personality: Personality and mind are dichotomies of conscious experience (Lowen and Miike, 1982). Perception is neither discrete nor continuous in a time crystal structure, it is both (VanRullen and Koch, 2003).

D11: Love and Pain: Depression is topological, it spreads fractally repeating the same geometry (Shibata and Bures, 1974). Deep brain stimulation is often attributed to cure (Hall and Carter, 2011), such random rhythms are like hitting a stone in the dark, time crystal map of a human brain could let us editing a target clock from outside.

D12: Learning: Learning is conditional editing of temporal architecture (Howard et al., 2005) namely "temporal context" (Howard and Kahana, 2002). Prime number 7 is important as it sets the limiting number of learning variables (Miller, 1956).

D12: Dreaming: The time crystal for sleep might generate very slow clocks in the brain stem, not part of the components that run formal sleep time crystal (Merica and Fortune, 2000). Sleep has a slow traveling wave (Massimini et al., 2004). Sleep spindles are like local structures in a global time crystal for sleep, regulates slow rhythms (Ueda et al., 2001).

O1: Fusion of primary sensing: Self-organizing dynamics that define thoughts in the brain follow critical geometric features (Kelso and Fuchs, 1995) to integrate all kinds of information (Konorski, 1967); time crystal language enables that universal fusion.

O3: Attention: Neural correlates of attention have long argued for a connection of clocks (Reynolds and Desimone, 1999). Just prior to attention the mind is musical (Koelsch et al., 2002).

O7: Emotion: We consider bias is bad, but to converge and directional learning we need bias (Mitchell, 1980). Humans are emotional machines, programming it to reasoning is moral policing (Hume, 2000).

O8: Synthesis of time: Biological systems govern time by defining time (Goodwin, 1967) using phase shifts as key elements of architecture (Goodwin and Cohen, 1969). In the current brain model, time is not just fundamental to the brain structure but to the universe, such a discussion is out there for a long time (Girelli et al., 2009). Time was considered a scalar quantity in memory (Gibbon et al., 1984); however, now it's a vector quantity in the form of a tensor (Libet, 2004). Transcranial magnetic therapy could retrieve a memory (Rose, 2016). Remembering and consolidation of memory follow a unique pathway (Sara, 2000), often brain scans memory at very high speed (Sternberg, 1966). When neurons arrange more orderly, it's a better memory (Xue et al., 2010). Neuron defines its time (Ivry and Spencer, 2004) so is the brain (Miller, 2000).