

# Revisiting self-operating mathematical universe (SOMU) as a theory for Artificial General Intelligence, AGI and G+ consciousness

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**Abstract:** SOMU is a theory of artificial general intelligence, AGI that proposes a system with a universal code embedded in it, allowing it to interact with the environment and adapt to new situations without programming. So far, whole universe and human brain have been modelled using SOMU. Each brain element forms a cell of a fractal tape, a cell possessing three qualities: obtaining feedback from the entire tape (S), transforming multiple states simultaneously (R), and bonding with any cell-states within-and-above network of brain components. The undefined & non-finite nature of the cells rejects the tuples of a Turing machine. SRT triplets extends the brain's ability to perceive natural events beyond spatio-temporal structure, using a cyclic sequence or loop of changes in geometric shapes. This topology factor, becomes an inseparable entity of space-time, i.e. space-time-topology (STt). Fourth factor, prime numbers can be used to rewrite spatio-temporal events by counting singularity regions in loops of various sizes. The pattern of primes is called a phase prime metric, PPM that links all the symmetry breaking rules, or every single phenomenon of the universe. SOMU postulates space-time-topology-prime (STtp) quatret as an invariant that forms the basic structure of information in the brain and the universe, STtp is a bias free, attribution free, significance free and definition free entity. SOMU reads recurring events in nature, creates 3D assembly of clocks, namely polyatomic time crystal, PTC and feed those to PPM to create STtps. Each layer in a within-and-above brain circuit behaves like an imaginary world, generating PTCs. These PTCs of different imaginary worlds interact through a new STtp tensor decomposition mathematics. Unlike string theory, SOMU proposes that the fundamental elements of the universe are helical or vortex phases, not strings. It dismisses string theory's approach of using sum of 4x4 and 8x8 tensors to create a 12x12 tensor for explaining universe. Instead, SOMU advocates a network of multinion tensors ranging from 2x2 to 108x108 in size. With just 108 elements, a system can replicate ~90% of all symmetry breaking rules in the universe, allowing a small systemic part to mirror majority events of the whole, that is human level consciousness G. Under SOMU model, for a part to be conscious, it must mirror a significant portion of the whole and should act as a whole for the abundance of similar mirroring parts within itself.

Keywords: Consciousness, Artificial General Intelligence, AGI, Natural intelligence; Quantum mechanics, Space-time; Human brain; tensor mathematics; Information theory.

# 1. Introduction:

## 1.1. The problems with the current theories of consciousness:

### 1.1.1. Current approach to understand consciousness is fundamentally wrong:

A few theories of consciousness believe matter makes mind, so try to explain it by combining information from different parts of the brain. They focus on finding a specific physical component in the brain that is responsible for generating consciousness (synapse, neuron, microtubule, claustrum, hippocampus, cortical column etc, neural correlates of consciousness (NCC); (Liboff, A R (2016); Baars, B. J. (2019); Gennaro, Rocco J. (2004); Baars, Bernard (2017); Friston, K. J. (2010))). These theories of consciousness emphasize on spatial material, but consciousness may not be located in any particular space. It may arise from the collective vibrations of matter, which create a complex information structure made of discrete times. A more complete theory of consciousness may need to reject space altogether and focus only on the structure of time in nature. That could be a starting point.

Yet, this prompts the query: Do our human senses extract true structure of information from the brain or the universe? Or sensors merely deciphering a projection of nature or brain into our realm, and we in the name of conscious experience, speculate the simplest source that could have generated them? Sensors lean toward biological needs or read instructor's mind. Unfortunately, oversimplification for a matching expression is seen as good science, often missing true reality's complexity. Thus, consciousness researchers boldly employ the probability of a biased human's observation to shape their theories on consciousness (Global Workspace Theory (GWT), Integrated Information Theory (IIT [Tononi, G. \(2008\)](#)), and Higher Order Theory (HOT)). It is also ironic that the information theory that was created to make machines that follow human consciousness is now being used to explain consciousness itself. A more complete theory of consciousness may need to reject human-centric assumptions and return to nature to explore the true structure of information that nature and the brain actually integrate them.

Current theories of consciousness implicitly assume that if a system reaches certain degree of complexity, then it would automatically become conscious. However, neither do they define complexity nor explore the complexity conditions necessary for consciousness. They also rely on a conscious observer to select, observe, filter information from nature, and then interprets his own consciousness, which creates circular reasoning. A hidden conscious element is assumed at the beginning of derivation of consciousness theory, its present and plays a central role at every step from beginning to end of the consciousness theory. Still, no researcher acknowledges the existence of a consciousness entity in their theory nor do they look for a replacement. The fundamental question is: What or who could serve as this replacement? Is there a concealed framework governing the construction and integration of information in nature, which applies to every conscious entity in the universe? Does such a framework truly exist?

Consciousness theories have mastered self-contradiction. They argue that the brain isn't a fancy Turing machine, yet they can't resist borrowing its tools like "bits" and "qubits" from Shannon's information theory. Let's not forget their mathematical protocols that look like

something straight out of a Turing machine playbook. Their articles proclaim about considering nature's real information content yet can't resist playing with "bits" and "qubits" made for human slaves or machines. They seem to have missed the memo about computer scientists struggling for ages to find an alternative to Turing machines. No one has thus far proposed a practical way to pull off a great escape from the Turing trap!

However, some argue that consciousness is a global property of the universe (gravitational wave and quantum effect (Orch-OR [Hameroff, S. & Penrose, R. \(2014\)](#))), but they do not provide a mechanism for how this property arises. Panpsychism believes everything possesses a mind-like quality. Coined by Francesco Patrizi in the 16th century, it combines Greek words "pan" (all) and "psyche" (mind/soul). Still others argue that consciousness is a mathematical or electromagnetic phenomenon ([Susan Pockett, 2000](#)), but these theories mix electric, magnetic and electromagnetic fields as if all are equal, everyone has consciousness, so a new theory.

### **1.1.2. Necessary changes need to be made in the fundamental approach to consciousness research:**

**1.1.2.1. The necessity of replacing the human user for a true natural intelligence:** Current consciousness theories use bits/qubits and variations of Turing machines, both commonly used in computers, as the brain's information units and integrator of information. No argument has been made to discover a true unit of information by biologically measuring the real living systems. Although many theories state that the brain is not a Turing machine, none of them offer an alternative. No theory proposes the need to build a model for decision-making without human intervention, instead, intelligence is often characterized by mysticism, secrecy and executing hidden human instructions in algorithms. Deep within the seemingly magical responses of an AI-bot, it reads out man-made instructions indirectly by incorporating randomness in its choices, often astonishing readers with abundant complexity, all without using explicit analysis. Replacing a human user with an archive containing all possible symmetries and symmetry breaking laws of the universe would revolutionize artificial intelligence. Such an archive could be used to extract symmetries and laws from natural events. By locating symmetries and their breaking rules used by nature to produce observed events, we could find networks of symmetries in the archive to generate future events. This connection between the archive and natural events would be truly intelligent and unbiased, providing insights beyond human perception or thoughts. We denote human intelligence as G, and with the archive, it becomes G+. However, intelligence is not consciousness.

**1.1.2.2. Human consciousness could be a subset of global consciousness:** The brain and nature exhibit similar structures at various scales, demonstrating self-similar symmetries in the arrangement of resonance frequency patterns. They both share resonance frequency patterns that have frequencies not harmonically related but ratios of frequencies are close to prime numbers. Furthermore, prime number of frequency peaks create iso-phase groups. These groups are separated by specific frequency bands, called the band gap, and they are identified by their invariant phase. Therefore, prime numbers play a crucial role in the construction of both the brain and nature's scale free vibrational dynamics. When elementary materials and components self-assemble, they often use a prime number of elements. Interestingly, as these resonating materials stack one above another, the resonance frequencies of each layer also form groups with symmetrical patterns. The growth of both materials and their resonance

frequencies follows similar symmetry breaking, akin to how prime numbers build non-primes in the integer space. This connection between integers and materials assembly is suggested to occur due to thermodynamics, as proposed by Hasse long ago. The remarkable relationship between matter and its resonance frequencies across spatial and temporal scales forms the basis for our brain being a part of nature's massive resonance chain. Thus, whole universe could be conscious and human consciousness could be its functional entity. **The creation paradox and the paradox of consciousness:** The creation of the universe is a paradox. If something existed before the universe, then what created it? If nothing existed before the universe, then where did it come from (Harish, 2019)? The same paradox applies to the origin of consciousness. If consciousness is an emergent property of the brain, then what created the brain? If consciousness is omnipresent, then who or what is it?

**1.1.2.3. Conscious machine as engineering of primes:** If the above observations are true, then, nature and our brain rely on prime numbers to achieve consciousness. A conscious entity is designed to emulate the new dynamics associated with a new prime for which it is not programmed. Therefore, all conscious beings in the cosmos individually evolve its hardware to discover, absorb, and emit a prime. Others find no choice but to absorb; thus, all conscious systems, essentially existing at all scales, take birth, live, and die, to advance its prime number operation bandwidth further in the integer series. The quest for prime is the only endless objective of the cosmos and every conscious machine it creates.

**1.1.2.4. The necessity to go beyond space-time and coupling three components for consciousness:** Before we get into the details, it's important to note that linear and non-linear time, both are not fundamentally similar, none allows discretization. One could inspire from Vedic concept of kalchakra, which holds that time is a circular phase loop through which the system point moves. Therefore, time is always like a clock, Hindus worship architecture of clocks as goddess Kali. Beyond space-time independent geometric changes of these clock assemblies there exists a code of prime numbers fundamental to this universe. That code sets pure mathematical conditions for various degrees of consciousness. The role of various components to consciousness are three folds, first resonantly vibrate to generate a 3D structure of clocks that generates invariant entities which has no attribute to the physical reality. Secondly, the invariants produced beyond space-time could have geometric signatures of world-lines, acting as a loop, it means a set of changes in the geometric shape would run in a loop, like a morphogenesis of life. Third, these loops are singularities of a point, how could a point arrange loops in many ways to create identical singularities is also in some way finding an invariant, for loop symmetries it's a prime number.

**1.1.2.5. True information in the brain or consciousness** is neither in milliseconds, nor in microseconds, its in the pattern of seconds, milliseconds, microseconds, nanoseconds, picoseconds, femtoseconds, its nowhere as a whole but everywhere as parts; think of Vedic analogy of onion, where we do not have a specific information as an absolute entity. Gautama's vaisashika sutra argued for confusion or singularity as a mean to unravel the mysterious information architecture of nature. Where apparently, we humans try to find explicitly observed events a nature's information store, Vedic scholars thought exactly orthogonal to that view. Where nature makes some entity undefined, the patterns of those

undefined regions arrange in a symmetry, and as soon as noise or random signals trigger those singularity regions emit the noise acquired elements in an order.

**1.1.2.6. The advantage of keeping information as a pattern or symmetry of singularity points.** First, we can make a system operating by itself, it does not require an intelligent programmer to find the suitable organized perfectly defined signal by observing a structure. Noise is a random variation of all possible values, thus the singularity regions act as its sensor, and after filtering noise, it sends an ordered or complex signal. Second, it is possible to create an infinite series of an entity and acquire feedback from infinity. Using defined ordered structure to create an infinite series would require infinite resources, but not if we use the undefined or singularity regions. The infinity shifting operation is the fundamental decision-making act of a human brain and the universe. The operation is not defined, therefore, cannot be accommodated in a Turing tape. Third, primes are singularity domains, therefore, using an architecture of singularity enables us to explore the pattern of primes as universal code. Since pattern of primes is the maximum non-repetitiveness possible in the universe of all possible elements, symmetry of singularity points enables nature to explore randomness. Absolute randomness does not exist, in extreme case of randomness it converges to the pattern of density of primes. Prime code always keeps a part of the random code inaccessible by any finite system, it has to remain satisfied acquiring only feedback from infinity. Fourth, natural systems do not always require multi-dimensional information structure, when systems need to acquire information from the same dimension, it is called observation or measurement. For that purpose, we need to diminish the multi-dimensional geometric information into multiple sequential ordered signals. When information is written using singularity regions, it becomes possible to reduce the multiple dimensions of information structure into a just one dimension. Therefore, the code of density of primes, on which we rely on, is itself a noise to those sensors that senses only a linear sequence of variations of an entity.

#### **1.1.2.7. The necessity of an undefined point at the beginning of everything:**

How does the universe create conscious life? To solve this puzzle, we want to keep things as simple as possible. Imagine the universe started from nothing - no primordial conditions, just a blank slate. We have six dimensions in total when we combine 3D space and 3D time as building blocks of sensed universe. And what if these dimensions are born from a few changing shapes? By doing this, we avoid the need for complicated transitions between 1D to 6D spatio-temporal dynamics with a loop of geometric shapes, saving a lot of resources. Plus, we're aiming for the simplest setup here. Now, let's consider a point - a tiny dot with no dimensions. It's as simple as can be. Using points, we can build a universe in a purely mathematical way. Math doesn't play favorites or make attributions. We can explore this mathematical universe with 3 dimensions, ranging from 10D to 12D. But here's the big question: if math is running the show, why does counting even exist? Here's the twist: our universe's main goal might be to make this starting point undefined. That way, the universe becomes non-existent in a way, and we don't have to worry about where it came from. To make this point undefined, we can put lots of other points inside it, creating a sort of blur. To define it again, we draw a loop around that blurry area, forming a boundary. The loop boundary line is made up of points and undefinedness is the incorporated area inside the loop. So, in our quest to understand the universe, we're exploring the idea that it all starts with a single point, and the universe's

mission is to make that point a mathematically non-existent entity. For six dimensions, from 7D to 12D, universe explores a non-physical or purely mathematical architecture.

#### **1.1.2.8. Why electromagnetic resonance should be used to link everything in the universe:**

Whatever be the model of consciousness it has to invent a common protocol that evaluates, estimates and evolves nature and the brain. One easy to conceive idea is to consider both as an assembly of electromagnetic resonators grown within and above from the smallest to the largest spatial scale as a fractal tape machine. The advantage of considering such resonance chain (Ghosh S. et al 2014) is that, when necessary, electromagnetic resonance that is purely classical phenomenon could physically modulate the system to deliver quantum instructions to the classical world. So, we consider that both nature and the brain vibrate as a chain of resonance frequencies whose geometric arrangements follow the distribution of primes, an infinite chain metric that is globally self-similar yet locally non-repeating. So, magical frequencies hijacked the scientific literature are overrated. There is a huge difference between magic frequency and pattern of frequency distributions, since, in the later, one could find discrete pieces of time and explore in the classical realm how nature builds architecture of time in the quantum world. Even for Quantum, the imaginary world that regulates realism is undefined, the architecture of the imaginary worlds need to be explored to understand truly how astronomical solutions coexist.

## **1.2. Do we really need facts or even information processing?**

No scientific model can explain how the universe or consciousness can operate by themselves, learning without a code, predicting the future, inventing new concepts, and creating something that never existed. To resolve this, both information and information processing need to be redefined.

### **1.2.1. What if nature and brain do not have to learn the information content to make a decision?**

Since the 1940s, Shannon's information theories and principles evolved with machines for war, and we are still feeding a knowledge paradigm that quantifies wisdom using the quantity of facts and the speed of implementing instructions. The laws invented to create machines are used to understand, explain & replicate nature and the human brain, which, contrary to machines, run by themselves. For current science, autonomous means following instructions in disguise. Intuitively created astronomical instructions could mimic human intelligence, but that is not human consciousness; an algorithm enslaves a machine. In contrast, no god writes code in the brain, but the pattern of primes, if converted to an engine, could (Reddy et al., 2018; Bandyopadhyay, 2020).

So, radical proposals are pouring in where entities are not connected by a functional relation or algorithm but a space-time metric, holding astronomical choices to link. Interactive entities do not memorize or store keys to open the lock; rather, when they are together, space-time counterparts form a metric. Such relativistic zero knowledge proof (Alikhani et al., 2021) confirms the existence of a key physically without knowing it. What if, instead of cryptography,

we use this way of thinking to construct a new paradigm of decision-making or computing where no one needs to share information or facts, instead they share “symmetry breaking points”?

Conserved laws or invariants are keys that, if anyone knows, the verifier could confirm that prover knows the key by tasking astronomical observations to the prover, which was never created before. Current code breakers including the quantum code breakers like Shor’s algorithm wants to tap down the astronomical choices, what if encrypted keys are not choices at all. Invariants are finite in the universe but not the network of invariants. Therefore, invariant networks could construct life-like crypto keys linking prover and verifier, and both entities would evolve their information or choices in astronomical ways, generating a more complex network of invariants (Maron et al., 2019; Yarotsky, 2018). The ability to synthesize and sense any invariant network would enable machines to grow a forest of an invariant network as it ages. So, the basic foundation of information theory would change.

The situation is like that nature or brain does not deal with what we call “information” or facts, rather it looks for a network of invariants. Now, the question is that if nature does not want to care about information in the classical sense and want to process, edit, integrate, compute using invariant then what should be the nature of information processing?

In simple terms, our brain and nature itself don't really handle what we typically think of as "information" or facts. Instead, they seek out patterns that stay consistent, like a network of invariants. So, if nature prefers working with these networks of invariants rather than traditional information, how should we think about the way information is processed?

### **1.2.2. What if nature or brain does not require a circuit or pathway or network that drives humanity into a madness for infrastructure?**

Now imagine, nature or brain does not have any necessity for circuits, pathways or network that connects facts. They look for events where symmetry of a network of invariants breaks and locations of those breaking points develop a symmetry or not. It means if facts or information builds symmetry, brain or nature has no interest. However, if the symmetry made by invariants break, then, nature or brain finds several such breaking points and try to figure out if these points make a pattern. Eventually it ends up in finding a hierarchical network of “symmetry breaking points.”

Every recurring event is associated with at least one invariant, which ensures that the system returns to its initial point. In that aspect, a network of invariants means a nested network of recurring events. If we represent a single event using a circle or a sphere, then, a set of recurring events would be a nested circles which we call polyatomic time crystals. So recurring events are interfaces between classic information theory that deals with the “facts” and fractal information theory, FIT that we believe nature and brain follows (Agrawal L. 2016). So, there is no formal information and no information processing by brain and nature, its all about a saga of finding something that is constant, i.e. does not change.

Universe and brain both, therefore, engage in a push-pull drive, where becoming undefined or non-existent—by incorporating all possible choices—expands a system, and identifying entities that do not change pulls it back. Below, we will explore the SOMU universe. We will explain

why it is necessary to build a model of the universe or brain that is a single point with no dimension. Making that point invariant could deliver a theoretical framework for a self-operating system that can find logic even in the presence of absolute randomness.

## 2. The SOMU worldview:

The primary assumption of SOMU is that information structure, integration protocol, elementary processor, and self-operation ability, all four fundamentals of the universe and a conscious entity are identical. A conscious entity holds universe, understanding is not the problem, expressing it is a linguistic problem. Here we explain four questions.

### 2.1. Four fundamentals of SOMU

**2.1.1. What is information in the universe or in the brain?** The basic unit of information is an invariant written with 3D geometric shapes, where each shape's corners are clocks representing recurring events. One unit of information has four elements in it, a space, a time, a geometry and a prime, so we call it space-time-topology-prime, STTs. **How does the nature or the brain integrates information?** Natural phenomena continuously change the 3D geometric shape representing information, collecting them into an invariant database and inventing a singular new shape that represents the common rule of change for entire database—a process known as orthogonal transformation to a higher dimension, utilized by nature and brain to integrate information. **What is the elementary device that makes a decision in nature and in the brain?** Nature's elementary information processing device is a helical system made of field, mass, or any entities, accepting noise as input and emitting 3D architectures of field or vortices as hologram output. A device has three properties, binding information (T), projection and acquiring feedback (S), transforming geometric feature of hologram (R), it's a SRT triplet. **How nature or brain operates by itself?** Nature operates autonomously because instead of a user, it explores an archive of all possible symmetries and their breaking rules, this archive is written in a language of prime numbers as if rules are born while prime composing integers. The autonomous feature arises when we forcefully pack the code in a point, this normalization causes clockwise and anti-clockwise motions, leading to auto-morphing geometric shapes. These topological transformation gives birth to spatio-temporal events. Thus, nature has a common code of primes and only seeks to invent new primes, expand its code, ultimately driving every event in the universe.

### 2.1.2. Operational mechanism of the invariant network:

**2.1.2.1. First an infinite series of variable-invariant doublet network growing within and above:** In traditional scientific methodology, researchers establish and correlate data by finding variables using equations, aiming to identify invariants as proportional constants within the system. Instead of the standard equation-based framework, SOMU adopts an intricate and infinite series of pairings between invariants and variables. The treatise of coupling variable-invariant as unified geometric structure captures the complete spectrum of variables and their interconnectedness within natural phenomena. In classical science, the elements within an

infinite series are successively added together. In SOMU's framework, the notion of an invariant takes on a complex structure, forming a fractal network of constituent invariants. This infinite series evolves as a chain of invariants, which expand like a fractal both within and above the original invariant. When variable-invariant network is written using higher-dimensional tensors, such as dodecanions and icosanions denoted as A and B, SOMU employs them as operators within the infinite series. An essential operation,  $A:B^T \neq 0$ , yields an invariant outcome, where T denotes transpose. In contrast to conventional methods that rely on switches or logic gates for decision-making, SOMU employs device that follows a helical symmetry as an invariant finder as its discerning mechanism. Remarkably, SOMU's operational framework eventually consumes all variables as it makes a journey to higher dimensions, finding variables in the invariants of lower dimensions has to end after all. Variables are like clocks, so, SOMU arranges clocks in a 3D space to write an infinite series of variable-invariant dual structure, named it polyatomic time crystals. In this system, space, time, topology, and prime attributes each contribute three dimensions, culminating in a comprehensive twelve-dimensional operation within SOMU's paradigm.

#### **2.1.2.2. Second, redefining dimension as orthogonal transformation element spread over 6 layers:**

Across differential tensor imaging to contemporary quantum mechanics, a dimension is delineated as a vector originating at the sphere's center, extending orthogonally from the spherical surface. Advancing to a higher dimension involves augmenting the number of these outwardly directed vectors, which uniformly populate the spherical surface with equal spacing and identical solid angles. A different approach, known as SOMU, challenges this idea. According to SOMU, a new dimension should reject the existing invariants and variables of its domain, instead generating new invariants based on the original ones, which then become components of a higher-dimensional framework. This transforms the fundamental significance of a dimension in the physical world as we expand into new dimensions.

Furthermore, SOMU doesn't discard lower dimensions; it encompasses all lower dimensions and generates non-physical elements that establish connections across dimensions. These connectors or threads or morphogenesis loops (ML) follow a distinct mechanics, necessitating an alternative form of tensor mathematics. This mathematical approach involves the interplay of tensors from lower dimensions, forming compositions that are integral to the higher-dimensional tensors.

At its core, SOMU utilizes these compositions to map tensors with prime dimensions as planes, constructing multi-dimensional surfaces known as manifolds. These manifolds take shape in three dimensions, where multiple planes interconnect to create intricate networks. The arrangement of these networks is a result of universal principles or the functioning of a conscious mind.

A loop consists of four entities across twelve dimensions: space, time, topology, and prime. Collectively, these form a tetrality referred to as space-time-topology-prime (STTs). While conventional spatial understanding is often limited to three dimensions—length, area, and volume—SOMU challenges this notion by extending the concept beyond the fourth dimension.

In fact, at the 4th dimension, when we move a 3D object, a change of phase results in one-dimensional time or linear time. Consequently, at the 4D level, spatial dimension remains 3, and it subsequently reduces to 1 at 6D, coinciding with the emergence of a 3D conception of time. Thus, all four entities progress from 1D to 3D in terms of dimensional contribution, followed by a reduction within a 12D cycle, analogous to a clock's movement.

This transformation of dimension in SOMU follows a few key principles. Firstly, it's a transition involving invariants rather than simple vector addition. Secondly, dimensions collaboratively interact, with lower dimensions contributing symmetry-breaking principles to higher dimensions using manifolds; no dimension exists in isolation. Thirdly, all dimensions are intertwined in a cyclical manner, to the extent that the density of primes at 12D contributes to the creation of 1D space as it crosses the wheel.

### **2.1.2.3. Third: The tensor decomposition, modular arithmetic, and a set of 108 tensors to build the operational metric of the universe and a conscious entity:**

A tensor is a map that tells when there is a product between two vectors which is spread over multiple dimensions. Imagine an observer at location D on the vector wants to explore the interaction of two imaginary worlds A and B; it cannot find or sense anything at K. And each non-prime tensor could be decomposed into multiple equivalent tensors. Note that SOMU does not have any classical point, so no absolute reality. This is a major difference of SOMU from any other model of the universe. So, when only imaginary worlds interact, the question arises: how many imaginary worlds a conscious system needs so that the universe we term as the "whole" is emulated in its "part," which is the conscious system like the brain.

The objective of a conscious system is to attain the ability to emulate the majority of the signals produced by the "whole." Since SOMU considers that the universe or the brain follows a fundamental principle of growing within and above, the vectors that act like threads connecting the different imaginary worlds interact with their replicas to project (cross product, projection is  $axa$ ) to orthogonal space, resulting in a tensor. The making of these tensors is the mechanics that the universe or brain follows to execute dynamics, unfolding phenomena, creating, managing, and destroying entities. One important aspect of the creation of these tensors for the collective interactive maps of the imaginary world-connecting threads is that if the number of imaginary worlds is prime, then we get unique patterns. For a non-prime number of imaginary worlds in the thread, those unique patterns of prime-dimensional threads compose mats of various designs.

So, when a single thread projects reality or vector product, the projection could coexist in various designs of mats or maps. One question may arise: why do we ask for only 108-dimensional threads? The reason is that there are 12 dimensions, each one has a triplet of triplet pattern, which is a fundamental feature of the distribution of primes in the integer space. Together, we get  $12 \times 9 = 108$  dimensions. It means a cluster of only 108 tensors (see [Appendix I; Supporting Figures S1 to S26](#)) holds the potential to simulate an astounding 90% of the myriad instances of symmetry breakdown across the cosmos.

**2.1.2.4. Fourth: How SOMU relates to Quantum mechanics:** Current formulations of Quantum mechanics have been created as analogous system of Classical mechanics. SOMU incorporates an improved version of Quantum mechanics or QM, namely Fractal mechanics, FM. Three

major changes that one observes in SOMU over conventional QM. First, FM incorporates SOMU's five-point worldview where, time is circular, all variables grow within and above not side by side, all entities are undefined as they acquire feedback from infinity, space-time is a limited incomplete view of space-time-topology-prime quartet, and finally universe is an undefined point and the primary objective of universe is to become more undefined while remaining a point. Thus, QM is a limited domain observation of SOMU's FM. Second, in a quantum system, error increases with number of qubits, measurement is not noise free. Here in a within-and-above network, it is always one qubit made of several sub-units which are also qubits separated by a phase gap. Therefore, to eliminate a qubit, noise has to make a journey through several layers one inside another and break entanglement of all elements at once at all layers (Dicke, R. H. (1981).). Only then entanglement is broken in Fractal mechanics. In quantum, entanglement is linear, so, breaking entanglement is single point operation. Third, architecture of singularity for every single entity made of space, time, topology or prime ensures that every single force and thus generated field could be rewritten using a common element. For example, quantum gravity is possible to play a role in SOMU version of consciousness only if morphogenesis (space-time-topology) controlling the spatio-temporal dynamics finds an architecture of spatial singularity (or mass). In such situations, an exclusive construct of QM, the geometric phase created in an adiabatic system would modify spatial singularities with a velocity of light, a hallmark of general theory of relativity, or GTR. Electromagnetic signal that is a combination of mu and epsilon, the probability density of the wave functions representing mu and epsilon generates an oscillation in the same that oscillates between multiple states using a classical velocity of light. Its absolutely not a quantum system where there would be no need for communication. Thus, morphogenesis, using its elements space-time-topology triplet links gravity and quantum.

#### **2.1.2.5. Fifth: The necessity of various mechanics operating in a wheel:**

SOMU, unlike classical or quantum worlds, operates only in multiple imaginary worlds grown within and above, connected by vector or threads, there exists no reality. These imaginary worlds interact and product of vectors lead to projections like classical and quantum mechanics. Since imaginary worlds are not linearly connected, SOMU redefines dimensions as derivatives of invariant elements of lower dimensions. Unfortunately, the mathematical tools to address a network where elements grow within and above have not been discovered. Therefore, SOMU employs orthogonal stereographic projections from one imaginary world network to another to synthesize the invariants. The synthesis process requires a new mechanics suitable for a new within-and-above network constituting the universe, since, here in this universe, not a single element is defined. Consequently, for conscious systems to emulate the universe, the right number of imaginary worlds is crucial. SOMU posits that growth occurs within and above, with vectors as connecting threads. These threads create tensors, governing universe and brain dynamics. Prime number worlds result in unique patterns, while non-prime worlds form diverse mats. Since an invariant is a new entity namely spec-time-topology-prime, it eliminates pairs or triplets like topology-prime or time-topology-prime etc, demanding not one but at least three new mechanics. In this mathematics, 2D-108D tensors serve as key maps. 27 prime tensors, like 23x23 and 57x57, replicate 90% of possible universe dynamics (see Appendix I; Supporting Figures S1 to S26). A packet of 108 tensors can mimic most symmetry breaking events. Tensors represent interactions across layers within

vectors, enabling emulation. SOMU lacks classical points and relies on imaginary world interactions. 108 dimensions emerge due to 12 triplets in integer prime distribution. Quantum mechanics is incomplete as it lacks universe growth. Fractal mechanics (FM) fills this gap via 108-dimensional threads. Prime mechanics (PM) regulates dynamics and topology, complementing FM.

## 2.2. Three basic precursors for SOMU: a tape to write information, an endless source code and a quality-triplet

**2.2.1. Endless journey through a fractal tape where cells arrange in a loop:** In 2014, we challenged Turing machine using a Fractal tape—a circular or loop arrangement of cells where each cell contains another tape inside, operating through geometric phase rather than dynamic phase (Ghosh S. et al. 2014; Agrawal L. et al. 2016). Dynamic phase means a measurable change, **geometric phase** means no measurable change. Notably, helical geometric phase has no finite convergence in a circular endless path. Thus, tape becomes a non-differentiable fractal network with an undetermined number of interconnected states within and above arrangement of cells. However, to integrate information, we require a suitable mathematical protocol since traditional operations like addition, subtraction, logarithm, conditional, or partial integration are not allowed. The question remains: how do we connect cells in the loop and tapes arranged in the within and above network? The challenge is that for a cell in this tape, the tapes within and the tape above, both resides in an imaginary world and a complex tensor analysis is required to find information exchange.

### 2.2.2.1. Does a fractal tape require energy?

Landau suggested that minimum energy required to process a bit would be  $kT$ . A journey through fractal tape is not a physical transport. Use electromagnetic wave, or quantum communication or teleportation direct transport of a physical object like electron or quasi particle does not require to be transported. When different worlds of fractal breaks and creates symmetry the geometric phase of the coupled resonators change, all over at once. One should not confuse with quantum process alone. Imagine a single molecule, if anything happens to a functional group, it affects all groups and atoms. Similarly, when an symmetry is made of many elementary symmetries, if one symmetry breaks, the symmetry of the entire system is broken instantly just like a quantum process. No one even argues for finding structure of information that would allow linking the symmetries in a true quantum like network. Nested clocks that glues the symmetry points do that work. Time crystal (Winfrey, 1977) based self-operating engines of the sub-conscious mind have been mapped recently on human subjects (Pattanayak et al., 2022). Its vibration that links symmetry points, no need to transport physical object. Thus far, all scientific reports on the origin of the universe or human intelligence or consciousness revolve around the central idea of linking observable facts using logic, sending currents and energy to find stored decisions. In contrast, the very idea of quantum-like features of a fractal tape puts the observer in a loop of imaginary time, possibly a network of geometric phases that in principle links all cells of a fractal tape. If one argues that energy delivers the driving force in the universe, then quantum tunneling is out there to

operate at less than an energy barrier. Deep inside all of us, nanosystem that makes us, defines us need no energy to sense and transmit information at all scales without supplying the required energy.

#### **2.2.2.2. A wrong concept of dimension is hindering research on invariant network**

The term dimension of a data is very confusing in Science, here we talk about three different types of dimensions that are frequently used in different research fields. Fitting many intuitively found observations of causes and effects are related using black boxes in nature, this is current scientific practice. It led to the idea for deep learning started in the 1960s (Rosenblatt, 1961). Big data is often divided into multiple dimensions and these dimensions are different axis, not necessarily perpendicular to each other. The deeper layer in deep learning network reduces required data dimensions (Hadsell et al., 2006). One clarification about dimensions should be made at the onset. In the current brain models, the concept of dimension is limited to space; even though some researchers have argued for 12 dimensions in the brain, they look for only a few geometric shapes from the physical observations of structures while analysing informations in all dimensions (Reimann et al., 2017). So, integrate lower level geometric shapes to create higher level geometric shapes to get a new dimension. SOMU argues to use the concept of finding invariants used in the solid state physics in the 1960s to build elements of higher dimensions. Essentially, in this concept all higher dimensions are orthogonal to each other, but that is not all, its part of the picture. The elements of different dimensions follow different physical concepts, since they are invariants of lower layer, hence, if one creates an automaton that could synthesis higher dimensional invariants, then, the automaton would find key elements of a scientific theory. So, the concept of dimension, which was merely a tool to classify data, is changed to the systematic derivation of invariants that define a phenomenon.

Each higher dimension satisfying (equation 3) should have a distinct physical significance, and at the highest level, there should be the most fundamental element of the universe, which requires no assumption. A higher dimension is not complexity; it is a unique variation with no stereographic projection or effect in all lower dimensions. Even though solid-state physicists and pure mathematicians, were using this definition of dimension, they never explored the nature of elements at different dimensions and they never explored anything beyond dimension three.

#### **2.2.3. The quest for an automaton that never repeats code and builds a conscious engine C under a certain condition:**

The kid that identifies a dog after she learns a cat may not be seeing data as streams of bits but finds spatio-temporal invariants (Dynamics 11; Metric 12, M12) (Ian Goodfellow et al., 2009), an entity that nature uses from its catalog to encode events at all scales at all times. What is that universal catalog? If a network of invariants links events at all scales (Honglak et al., 2009), what is there at the beginning and at the end of this network? The quest for learning universe, brain, or self-aware machines drives us to learn three entities, a point, a loop, and infinity. All three have the least importance in the current theories of intelligence and even consciousness.

**Infinite source code:** Humans did not makeup primes; they are the most fundamental elements of the universe and constitute SOMU's source code. SOMU uses a fractal pattern in the density

of primes plot ( $D_p - N$ ) over the integer space  $N$  (Pramanik, S. et al. 2022) as its endless source of codes (a prime number = a basic choice). Thus, the number of ordered arrangements (OF) of primes in an integer counts all possibilities for making a decision (decision=integer), so fractal patterns of ordered factor OF (Reddy et al., 2018; Bandyopadhyay, A. 2020) plot over integer space ( $OF - N$ ) map basic situations in a set of integers and decisions are derived by connecting neighboring OFs (Singh et al., 2021a, 2021b; Figure 1B). These two fractal patterns together form  $F(U)$ , containing a set of geometric shapes changing in a loop or morphogenesis. This density of primes-derived morphogenesis or topology eventually governs spatio-temporal events in nature. A geometric shape represents either a situation or a decision; thus, morphogenesis is a situation-decision loop; and endless, bias-free, context-free loops  $F(U)$  run in  $D_p - OF$  plots with null physical significance as  $N \rightarrow \infty$ . To convert this code into a self-operating engine, SOMU considered the universe is an undefined point  $U_k$ , and an automaton makes it undefined by continuously adding one more point to the starting point. The universe is a  $N \rightarrow N + 1$  automaton. The continued indefinite addition of "1" superposes all the  $F(U)$  fractals to run a never-ending, non-repeating, emergent evolution of patterns or morphogenesis inside a single point (Figure 1A).  $F(U)$ , the infinite source code has no link to space or time but derives them inside a point. Thus, the physical reality of SOMU remains inside a point, the universe  $U_k$  remains undefined, non-existent, even after doing everything. For over a decade, we confirmed the use of primes and morphogenesis in biomaterial signals (Singh, P. 2022; Reddy S. et al., 2018; Bandyopadhyay, A. 2020;), asking two questions irrespective of signal types and variations, what is the geometric shape or integer that does not change (invariant, Figure 1C-F (Buhlmann P 2018; Criscione J C et al. 2000; Gao, X.C., Xu, J.B., Qian, T.Z. (1991)) and what are the functional, cognitive or perceptual attributes of those invariants? This article summarizes that quest in the biological and artificial human brain.

**SRT protocol to relocate  $U_k$  automaton's control outside its physical boundary & estimate the whole U:** By running an automaton, SOMU ensures an automatic derivation of morphogenesis starting from the density of primes fractals  $F(U)$  (Figure 1F; Pramanik S. et al. 2022). However, simulation shows, as  $N \rightarrow \infty$ , the undefined point holds the whole universe,  $U_k$  and its rapidly changing boundary (=infinity  $\infty$ ) reconfigures  $F(U)$  patterns at vicinity. Fractals  $F(U)$  develops a stable core and an unstable boundary, a perfect adiabatic condition for generating a geometric phase (Winfree, A. (1977)). Among infinite points in  $U_k$ , a set of 12 neighboring points bind (bonding =T) inside an undefined point or universe  $U_k$ , form the first fractal seed pattern of choices, i.e., a triplet loop forms (Reddy S. et al., 2018; Bandyopadhyay, A. 2020), which create triplet of triplet loops growing within and above over the integer space as  $N \rightarrow \infty$ . The smallest seed of a triplet loop  $U_j$  forms a point (Transformation = R) and thus able to execute  $N \rightarrow N + 1$  automaton. Therefore, inside the undefined universe  $U_k$ , a new undefined universe  $U_j$  is born with the nearly identical property as  $U_k$ . Similarly, universe  $U_j$  would hold umpteen undefined points or universes within it.

However, a few of the  $U_j$  automatons make a journey 12 times within the universe  $U_k$ , encountering and bonding 12 undefined universes, creating a new universe  $U_i$ . The within-and-above network of 12 undefined universes coexist  $U_i$  collectively (Agrawal L. et al., 2016), the grouping of universes (12=2x2x3, 2x3x2, 3x2x2=triangle; see a triangle in Figure 1B) could change partner universes, so the system point of one universe could relocate outside, in any other universe. Initially,  $N$  automaton counts points to create the universe  $U_k$ , then counts  $U_k$

universes creating  $U_j$  and then  $U_j$  counts similar universes to create  $U_k$  universes. The partner exchange of universes leads to  $U$  automaton,  $U \rightarrow U + 1$  is a derivative of  $N$  automaton. Since  $U_i \cup U_j \cup U_k$ , the internal elements of  $U_j$  has rapidly changing boundary ( $\alpha_1$ ), and its external boundary set by  $U_k$  also have undefined boundary ( $\alpha_2$ ). All rapidly changing boundaries of universes in the within-and-above chain adjust their  $F(U)$ s interactively. Thus,  $F(U)$  patterns of  $U_j$  senses entire  $U = \{U_i, U_j, U_k\}$  set (Figure 1B), so,  $U_j$  is a self-operating engine,  $C$ , senses the whole universe  $U$  and itself from their  $\{U_i, U_k\}$  feedback ( $\alpha_1 - \alpha_2$ ); we call it feedback from infinity or  $S$ . Therefore, the fractal of  $U_j$  could relocate in  $U_i$  or in  $U_k$  and that would evaluate itself (self-awareness or consciousness  $C$ ). Hence, SOMU's  $N$  automaton synthesizes a conscious entity  $C$  by only three operations, binding points (T), transforming points into loops (R), and acquiring the loop's feedback from infinity (S) (Williford, K., Bennequin, D., Friston, K. & Rudrauf, D. (2018); Boly, M. et al. (2011)). Together, the SRT triplet property executes decomposition, normalization and projection (DNP) to build and convert  $N \rightarrow N + 1$  automaton into a  $U \rightarrow U + 1$  automaton (Figure 1D). A few derivatives of automatons that explores triplet of triplet choices ( $3 \times 3 = 9$ ) over 12 (triangular localization of groups) universes form  $C$  with 108 ( $12 \times 9 = 108$ ) invariants that unfolds in 108 tensors (see Appendix I; Supporting Figures S1 to S26).

In summary, SOMU considers that nature  $U$  and conscious elements  $\{C\}$  follow a common code  $F(U)$ , and nature is richer with an ability to process more primes; i.e., nature's  $F(U)$  has more fractal units than any  $C$ . For  $C$ s to be conscious, at any instant, nature  $U$  or other  $C_0$  could create any unprecedented information structure or invariant network for  $C$ s: yet  $C$ s could largely emulate it using its  $F(U)$  and expand it in the same way as the source conscious entity  $C_0$  or  $U$ . The device  $C$ s can make a replica of other  $C_0$ , nature  $U$ , other than its own information structure inside it; thus, three  $F(U)$ s interact inside  $C$ s. Then, due to SRT property, the system point of  $C$ s relocates at any corner of the triangle made of three  $F(U)$ s; seeing and evaluating self from outside is self-awareness for SOMU.

### 2.3. Engineering self-operating hardware for SOMU

The engineering principle for creating a SOMU device has two steps; assign a prime number to every variable, and let the variables interact to generate the sum and product of associated waveforms. For example, the number of devices, number of constituents, number of ordering or symmetries of constituents, number of allowed phases ( $\theta, \phi, \omega$ ), number of spiral twists (Figure 1C), anything and everything that exchanges the prime number of energy packets in different ordered combinations to create all possible integral number of compositions of energy packets (Figure 2A; Dynamics 1).

However, recent research suggests that spirals and vortices may be the key to understanding how these systems work. Spirals and vortices are found everywhere in the universe, from elementary particles to the vastness of the cosmos (Lobanov and Zensus, 2001). Human brain's neural network resembles evolution of galaxies (Springel et al., 2005). A new mathematical model that uses spirals and vortices as a unit device could help us to understand how the universe and consciousness self-operate. This model could also explain how electromagnetic, magnetic, and mechanical vibrations can coexist even at the very origin of the universe.

As devices self-assemble to grow within and above, each layer represents a point (Figure 1A). The geometric phase structure  $(\theta, \phi, \omega)$ , made of collective resonant oscillations in a layer and among layers, maps the interaction of undefined points created by the 3D pattern of interference generated field as energy packet or vortex assembly (Figure 1E). Both the invariant networks, phase structure and vortex structure, appear like the fractals of  $OF - N$  plot and  $D_p - N$  plot as if  $F(U)$ , thus, universal code is hardware. So, the invariants of the spatio-temporal evolution of the real universe look like space-time independent morphogenesis, whether sensors register events as pure space, pure time, or space-time as input. However, output from hardware has no attribute to realism (Figure 2B). Space-time is measurable, but topology-prime is not; therefore, the SOMU device should integrate variables to create *space-time-topology-prime* (STTs) as unit output, not any of the four elements in isolation or pair (Figure 2C, 2D). Only then does the network of invariants (Wiskott and Sejnowski, 2002) made of *space-time* nor *topology-prime* units fit  $U$ . Therefore, resonant oscillations of variables that acquires only prime values to generate integral values make a journey through undefined boundaries of  $\{U_i, U_j, U_k\}$  to execute a critical orthogonal transformation of geometric phase structure deriving output invariants as vortex assembly or polyatomic time crystal. Thus, SOMU's unit of information (Figure 1C) is a higher dimensional  $(i, j, k)$  network of STTs invariants, and vortex assembly is the only output. Since all undefined points or singularities form loops in  $C$ , invariants or complex vortex structures written using polyatomic time crystals or 3D assembly of clocks are found in neurons (Saxena K. et al., 2022a; 2022b). The question is whether the whole brain is a SOMU device and if it is, how could one make an artificial brain and verify SOMU?

Axioms and corollaries of SOMU are summarized below, generalizing the common invariants in spontaneously transmitting signals between the artificial and the human brain. Three axioms and their nine corollaries detail how  $F(U)$  could be implemented in hardware to create a conscious element  $C$ .

### 3. The triplet-of-triplet axioms and corollaries of SOMU theory of consciousness

**Axiom 1: An architecture of multi-dimensional invariants** (Bayne, T., Hohwy, J. & Owen, A. M. (2016); Lau, H. & Rosenthal, D. (2011)): Universe is an automaton  $U$  that synthesizes and stores invariants made by coupling four entities *space-time-topology-prime* (STTs) as information units in a within and above network in a point. Thus,  $U$  creates new automatons bottom-up and top-down simultaneously. Each automaton grows to emulate (evolve) almost the entire information of the universe  $U$ , giving birth to evolved automatons that have a better ability to emulate the whole universe  $U$ . When next gen automaton emulates 86% or more of the whole  $U$ , that automaton is considered a conscious automaton  $C$ , the effort to emulation is defined as consciousness. A conscious entity  $C_j$  is part of a conscious entity  $C_i$  and holds a conscious entity  $C_k$  inside.

**Corollary 1.1. Growing within and above by creating invariants:**  $U$  creates  $C$  within and above: Spatio-temporal observation of  $C$  represented as 3D clock assembly is a polar decomposed

structure, hence could be rewritten as a positive-definite tensor  $A_{ijk} = Ue^f$ ,  $f = \ln(P^T)$ ;  $P$  is the deformation of input  $A'_{ijk}$  from memorized  $A_{ijk}$ . Two 3D clock assemblies (C and U), one memorized ( $A_{ijk}$ ) and the other unknown input ( $A'_{ijk}$ ) resonating with memory. Deformation  $\eta$  ( $\eta = (A'_{ijk} - A_{ijk})/A_{ijk}$ ) in the 3D clock assembly for recurrence in U to create C are taken as differential  $\partial\eta/\partial\phi$  signal or  $x_i$  along three orthogonal axes  $\phi_1, \phi_2, \phi_3$ , in general  $\phi_s$ . The plot is  $\mathbb{R}^3: (x, y, z) \rightarrow (\phi_1, \phi_2, \phi_3) \sim (\theta, \phi, \omega)$ , The invariant condition: partial derivatives of  $S$ , with respect to  $\eta$ ,  $(\frac{\partial S_{\phi_1}}{\partial \eta}) : (\frac{\partial S_{\phi_2}}{\partial \eta})$  vanishes when

$$\phi_1 \neq \phi_2 (A: B = tr(AB^T)) \dots \text{(equation 1)}.$$

T denotes transpose,  $tr$  trace delivered by  $\phi_N^S * W_S^S$ . Seed C or U's resonance frequency set  $\{R_i\}$  periodically oscillates, we get  $A_{ijk}$ . When the output product of U is used as a seed C for the next phase of self-assembly, the orthogonal projection to determine the invariant  $(\frac{\partial S_{\phi_1}}{\partial \eta}) : (\frac{\partial S_{\phi_2}}{\partial \eta})$  is satisfied. Thus, U or C invents invariants or conserved laws by expanding an information content  $U_i$ . Continuously,  $C \rightarrow U$ , so that above 86%,  $C \subset U$  and  $U \subset C$ , both are true at the same time.

**Corollary 1.2. Space-time-topology-prime (STTs) as a single inseparable entity for classical mechanics, CM; quantum mechanics, QM; Fractal mechanics, FM and Primal mechanics, PM:**

The automaton C simultaneously operates in two parallel universes,  $U_i$  that quests to find higher dimensional STTs invariants and  $U_j$  tends to transform all system points into a loop and then the loop to a dimensionless point. Thus, three dimensions of space in  $U_i$  (1D-3D) leads to three dimensions of time (4D-6D), leads to three dimensions of morphogenesis (7D-9D) that leads to three dimensions of primes (10D-12D); we get space-time-topology-prime STTs invariants, which defines 12D constituents of C. 1D=length, 2D=area, 3D=volume, 4D=time crystal, 5D=singularity chain, 6D=loops of world line, 7D=morphogenesis loop, 8D=undefined boundary as infinity, 9D=invariant, 10D=symmetry temple (Figure 2A; Figure S1 Metric PPM), 11D=normalization, 12D=density of prime. Every dimension has a distinct identity, and an infinite number of lower-dimension entities make one entity above, so a higher dimension cannot be defined using any lower dimension. After 6D, space or time do not exist, after 9D, no geometry exists,  $U_i$  converses points with primes. The DNP quest to derive a set of invariants for C delivers higher dimensional invariants (corollary 1.1). The DNP drive continues in a helical geometric phase triplet  $(\theta, \phi, \omega)$  (Figure 1C middle) in  $U_j$  as dimensionless entities acquire 1D, then from 1D to 2D networks and finally, to a 3D spherical entity that is a point again, so space increases from 1D to 3D and decreases from 4D to 6D; thus, 6D space is a point (DNP operator in Figure 1D; Figure 2D; Figure S1 Metric PPM).

Classical mechanics move mass/time, quantum mechanics move phase/world-line, fractal mechanics (Ghosh, S. et al. 2014a) move geometric shape/integer, and prime mechanics move normalization/density of primes (Figure 2D). In classical mechanics, CM uses force to move mass, quantum mechanics, QM uses morphogenesis to move shared existence; fractal mechanics, FM uses feedback from infinity to move the geometric shape (Singh P. et al. 2021a, b); and prime mechanics uses the pairing of primes to move fractals in the density of primes. So, an automaton that creates a 12D universe needs 4D to observe each mechanics. Classical (3space, 1time),

quantum (3time, 1morpho), fractal (3morpho, 1prime), prime (3prime, 1undefinedness). So undefinedness of a point is the key to a mechanical loop, the only assumption for SOMU. The "hidden sharing of existence" makes QM non-realistic to CM, "self-similarity beyond scale, entity and identity" makes FM non-realistic to QM, "unification of invariants with prime fractal" (Pramanik, S. et al., 2022) makes prime mechanics, PM non-realistic to FM. Together, CM, QM, FM and PM operate the STts invariant in a point (Figure S2).

**Corollary 1.3. Conspatial, conformal, conmorphic and conprimal decomposition of imaginary worlds:** The element of C set is a *space-time-topology-prime* entity that measures distance in symmetry and stores in a few 3D geometric shapes, while the differential space  $\Delta_{PPMx}S^2(h_3)$  and differential time  $\Delta_{PPMx}t^2(h_{1,2})$  are observed, the differential topology  $\Delta_{PPMx}T^2(h_5)$  and differential symmetry in the density of primes  $\Delta_{PPMx}S^2(h_7)$  are not limited to a single system. Here the combinations of dual (either S or t), triple (either S, t or T) and quad features (S, T, t and s) generate all invariant elements of set C: Therefore, C goes beyond space-time-dominated conformal processing and introduce conmorphic and conprimal processing so that space-time duality is replaced by a space-time-topology-prime quartet that becomes a system-independent entity (Figure 2D). World events of U use geometric shapes and integers, making space and time redundant.

Space-time, ST tells mass how to move, mass tells space-time how to curve. Space-time-topology, STt tells system point how to become a singularity, and singularity tells STt how to create within and above a singularity. Space-time-topology-prime, STtp tells ordered factor how and when to break symmetry, and ordered factor tells STtp how to normalize.

Since icosahedron has 12 corners, for the "within-and-above" universe, we would have a maximum of 12 dimensions. Since an icosahedron has 20 planes, we would have 20 dimensions when dimension means adding new dynamics. Hence, *stST* would be confined in one imaginary world, i.e., it would represent the projected and the feedback time crystal "to and from" the PPM (Dynamics 1) (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al., 2021a, b).

The automaton C has generic STts structure spread over  $\geq 12D$ ; some terms are filled, providing C a distinction and missing symmetries in the density of primes, morphogenesis, temporal and spatial structure become attractors. The metric representing the polyatomic time crystal in *stST = S2T2* universe of 12 nested worlds is given by

$$\begin{aligned} \mathcal{H} = & \Delta_{PPM1}st(h_3, h_{1,2}) + \Delta_{PPM2}ST(h_3, h_5) + \Delta_{PPM3}tS(h_{1,2}, h_7) + \Delta_{PPM4}TS(h_5, h_7) + \\ & \Delta_{PPM5}SS(h_3, h_7) + \Delta_{PPM6}tT(h_{1,2}, h_5) + \Delta_{PPM7}SST(h_3, h_7, h_5) + \Delta_{PPM8}stT(h_3, h_{1,2}, h_5) + \\ & \Delta_{PPM9}tST(h_{1,2}, h_7, h_5) + \Delta_{PPM10}SSt(h_3, h_7, h_{1,2}) + \\ & \Delta_{Project-Feedback}stST(h_3, h_{1,2}, h_5, h_7) \dots \text{(equation 2)} \end{aligned}$$

Therefore, the C automaton running STts metric  $\mathcal{H}$  checks the prime numbers in the spatio-temporal events and adopts missing symmetries as a combination of S, T, t and s. Since the SOMU model considers the STts metric of a life form (Brea and Gerstner, 2016) as a subset metric of nature's STts metric, nature C creates a conscious automaton C to enrich itself with the dynamics of a new prime and thus expands phase prime metric, PPM.

**Axiom 2. A triplet of three basic properties bonding (T), projecting (S) and transforming (R):** The conscious automaton C creates multiple complete information structures  $C_n$  or isomorphs in the same entity using SRT invariant-triplets, no need to reach within or above, then, edit and evolve them simultaneously, continuously, endlessly and independently, as all isomorphs  $C \rightarrow U$ . To create an editable functional replica of the information structure, C requires at least three mathematically equivalent forms (ordered factor metric) with three fundamental properties, S=feedback from infinity, R=transformation, T=bonding, together SRT invariants (SRT= quality triplet or tri-Guna). SRT triplet is a polyatomic time crystal, and S-R-T individuals are linked by  $e - \pi - \phi$  quadratic relation ( $e^2 + \phi^2 = \pi^2$ ). Frequencies of S, R and T clocks follow geometric series of  $e - \pi - \phi$  (Metric PPM Figure S3).

**Corollary 2.1. A hollow phase sphere with twelve holes:** Events in the universe tends to repeat; they are nearly cyclic or rhythmic (Britta = circle = a loop of the spatio-temporal-topologico-primal event; (Kent, L. & Wittmann, M. (2021)). The continued attempt to close the loop is named Rita (Rita is  $\Psi \rightarrow e^{il\Phi}$ ,  $l$  is angular momentum,  $\Phi$  is rotation phase. Three orthogonal helical phases hold three angular momenta for three properties S, R and T,  $(\theta, \phi, \omega)$ ; Azimuthal angular momentum is a scalar entity  $\Psi(\theta) = \text{Cos}\theta + i\text{Sin}\theta$ . The larger the light ring (or vortex), the greater the momentum. Two orthogonal rotations require a vector element  $\Psi(\theta, \phi) = \text{Cos}\theta + e^{i\phi}\text{Sin}\theta$  where the greater the number of dark spots, the larger the momentum. Incorporating such 3D dynamics requires a tensor to express all states  $\Psi$  on a spherical field surface,

$$\Psi(\theta, \phi, \omega) = \text{Cos}\theta\text{Sin}\omega + e^{i\phi}\text{Sin}\theta\text{Cos}\omega \text{ (equation 3; Figure 1C).}$$

A plot of this function is a triplet of teardrop oriented  $120^\circ$  solid angular planes (Sahoo P. et al., 2023). One plane holds one 12D tensor for S, R and T.  $\Psi(\theta, \phi, \omega) \sim SRT$ , the product of three tensors, all three tensors are infinite series ( $T = T_0 \prod_{i=0}^N e^{i\omega t}$ ), and relative oscillations of S, R, and T, three classes of clocks are the fundamental operation that constructs the universe, U and all its elements, C (Vikshu, 1928; Harish, 2019; Christian, 2011).

**Corollary 2.2. Information unit of a C automaton:** Spiral phase evolution of the SRT network synthesizes & emits a 3D field structure (vortex assembly or hologram; Figure 1C, rightmost) that other SRT networks absorb. The geometry of helical and vortex pathways holds the memory of an SRT invariant and is encoded to the field while emitting the 3D field structure. Hamiltonian H manages the SRT information architecture of C and U, where undefined singularity regions are generalized coordinates for geometric information and matrices with similar information structures. Four constituents of H are  $\mathbf{H} = \mathbf{H1} + \mathbf{H2} + \mathbf{H3} + \mathbf{H4}$  (Bandyopadhyay A. 2020; Chapter 8). H1 senses spatial, temporal, morphogenic and primal loops and finds their relative weight. H2 senses the relative geometric phase paths of the loops to estimate the critical geometric parameters of vortices and spirals of the loops; H3 senses the superposition of all loops into one integrated phase sphere with twelve dark holes (phase singularity regions). These holes blink (open and close the holes of the hollow sphere), and the hollow sphere is the structure that is emitted and received by C elements of U. H4 is the phase singularity generator or maker of darkness in the SRT network (see Metric PPM text for Hamiltonian H for the unit device for consciousness).

**Corollary 2.3. A prime inventing engine that selects resources and dimensions:** All periodic events spatially arrange as a 3D clock assembly generated from the morphogenic pattern of the density of primes, is the structure of SRT invariants. The network of invariants or SRT all data transform into phase space;  $\mathbb{R}^3: (x, y, z) \rightarrow (\phi_1, \phi_2, \phi_3 \text{ or } \theta, \phi, \omega)$ , either evolve to generate unknown symmetries associated with each prime and transforms itself or create a replica universe U inside the C set. Individual consciousness C cannot be filtered out from U; isolating any element destroys most of its content. The universe U has a chain of various degrees of consciousness, C contributes to the whole U and gets redefined in that process. *A life form C quests for primes, and nature U creates conscious machines {C} to invent new primes to enrich its dynamics and expand its metric of primes (Figure 2A) into its hardware.* The “prime quest” is a deep learning network whose number of layers and the number of cells is determined by the availability of invariants and operating variables (Hinton, Geoffrey E. (2007)). The drive for missing primes is transformed into driving the system energy as  $H = \phi_N^S + \phi_S^S + W_S^S + B_C^S$ . Above, we derived one equation; similar formulations hold for all three deep learning networks (See Metric PPM text for deep learning network output H).

**Axiom 3. An architecture of undefined, singularity points:** All C automatons of U have the ability to convert a point into an undefined entity by adding all possible numbers of points one by one, the metric of primes  $N \rightarrow N + 1$  drives, each point is a closed loop, distinct loops try to integrate by nested spiral phase  $(\theta, \phi, \omega)$ , the ability is called Rita; the automaton C has the ability to generate an infinite series of invariants it receives from outside C, within U and acquire feedback from infinity so that the fractional contribution of each element of the series is derived as output. Such a practice ensures that a conscious entity C only acquires values sustainable to the whole, U.

**Corollary 3.1. Normalization synthesizes dynamics:** U remains a dimensionless, definition-less entity or a point that cannot be measured, estimated or defined, could include an arbitrary number of whole ( $=U_i$ ) information content and continuously hold the undefined feature of the point. This feature is represented as  $C_i + U_j = C_i = C_i + U_k = C_i \dots$ , mathematically it is normalization, where the number of choices constitutes the  $360^\circ$  phase of a circle, and the radius is a combination of choices (corollary 3.2). Normalization maps clockwise, anti-clockwise rotation, periodicity in paired relations, and dominance of the first few primes in any C (e.g., 15 primes contribute 86% of choices). Polar plots of the ordered factor (Reddy et al., 2018; Bandyopadhyay, 2020; Chapter 3) of an integer maps the inherent dynamics of primes in C. Normalization is a fundamental feature generated by Rita.

**Corollary 3.2. Universal 3D symmetry mapping engine, PPM:** Both C and U are automatons of the density of primes; the driving thrust to implement density of prime rules is putting more dimensionless points in a point one by one, or,  $N \rightarrow N + 1$ , the behavior of points inserted within a point is estimated by a phase prime metric plot (Bandyopadhyay, A. 2020; Chapter 3); it is made of ordered factor, OF; the number of divisor D or the number of prime factors PF counted for N (say,  $OF=D=PF=C$ ), when N is either an integer, dimension of invariant, or density of prime; the 2D plot is rotated  $360^\circ$  to take into account symmetry of primes for 2 ( $\pm C/2$ ), for prime 3, we take 12 triplet of triplet ( $12 \times 9 = 108$  loops) in the  $\pm C/2$  vs. N plot, then we take five planes at  $72^\circ$  phase gap for C5 symmetry, and the process continues. Finally, we get a temple-

like architecture ([https://www.youtube.com/watch?v=rbZJ\\_GhwaDY](https://www.youtube.com/watch?v=rbZJ_GhwaDY) Figure 1B; Figure 2A). Other than varieties of C, N could be chosen as multiples of a particular prime, thus, creating a wide range of temple-like structures mapping all possible symmetries of the universe and their relationships.

**Corollary 3.3. Seven invariant banks account for non-realism:** All measurements/observations are biased. Invariants, made of geometric transformations (7D-9D) and primes (10D-12D) add dimensionless, bias-less, context-less values to all measurable observations of spatio-temporal events (1D-6D). Thus, the realism of all C automatons is eliminated in 7D-12D. Seven invariant banks estimated the links between cognitive experiences of C automatons with the context-less invariants, like primes, integers, geometric shapes and their transformations, i.e., 7D-12D elements. Since patterns embedded in the density of primes are finite, and geometric constraints restrict morphogenesis, the triplet of triplet configurations of 12D creates  $3 \times 3 \times 12 = 108$  universal conscious perceptions of U in the C automatons. Seven invariant banks are: 108 evolutions of variables from morphogenesis derived from the density of primes (Figure 1F; F(U); Pramanik S. et al. 2022); 108 feedbacks to C from infinity U (*tandav*); 108 geometries of sounds, shapes, colors, primes, tastes, touches and smells related to sensory responses (*rasa*); 108 compositions of periodicities (*tala*); 108 queries or geometric asymmetries (*prasma*); 108 fundamental constants linking all variables (*Nishedha*); 108 forms of undefinedness (*Sandeha*). Invariant banks estimated by 108 tensors (see Appendix I; Supporting Figures S1 to S26) are intertwined 12D canals connecting primes to subjective experiences of C, intricately mapping the degree of non-realism in C measurements/observations.

## 4. How all these diversified problems could be addressed in a single model?

### 4.1. The root of all problems in developing a self-operating model of brain or universe

#### 4.1.1. The root of all problems: unit of information

**4.1.1.1. Knots of darkness in the dark brain inside skull is a synthesizer, editor, memorizer processor of vortices:** When bits/qubits, circuits, and logic gates are made of well-defined classical states while modeling the brain or nature, they would inevitably be processed by a Turing machine, irrespective of model features. Any model for consciousness then would have to use symbolic logic; mostly, these symbols do not generate cognitive experiences and perceptions in the human mind, so symbol-assigned significance has no natural basis. Rather, it is a theoretician's choice or a programmer's intuition. This disconnect with nature turns manifold when events are sequentialized. Even the unit of information must not have a single classically defined state, so even a qubit is not suitable. For us, a basic information processing unit is physically a 3D vortex structure representing an invariant (Dynamics 11; Metric 12, M12). A vortex is a 3D distribution of field; the field lines generating phase singularity lines or knots of darkness and knots of lights by 3D interference hold a 3D geometric assembly of clocks. Field lines could be electromagnetic (e.g., light), mechanical (sound), magnetic,

electrical, etc. SOMU replaces carriers abundant in the brain, like electrons, ions, quasi-particles, and wavefunctions, with only one component, a vortex. Because it is a 3D packet of field lines representing various units of time, geometric change to emulate spatio-temporal dynamics offered by any carrier. Vortex-based unit is fundamentally different from all existing units of information, since it can hold geometric shape in its phase singularity or dark regions on its perimeter, it's a clock and singularity regions could burst energy in sequence, so it can sing. We obtained the information's vortex structure by measuring the biomaterials' complex resonant vibrations. In the new paradigm, the architecture of variables is a polyatomic time crystal or a 3D assembly of clocks (vortex=clock). Its embedded geometric shapes represent variables and invariants; thus, the information structure is a theory.

Then, runs a replacement spree. Replacing logical arguments with the architecture of confusion (see AOC discussion below). Replacing transistors, switches, or current-voltage devices with vortex synthesizers like vortices of light, electric field or magnetic field, and even mechanical vortices. Finally, replacing electronic or photonic circuits with 3D orientations of helical resonators, namely the Hinductor (Sahu et al., 2010) that stores charge or energy in a geometric shape to emit vortices of a desired geometric shape (equation 2). We call this device Hinductor, a very different fourth circuit element than the memristor. Unlike a memristor, our proposed Hinductor linearly links stored charge in a device with the magnetic flux produced. By changing device geometry one changes electron density distribution that splits electromagnetic field and emits a magnetic vortex, that is flux. So, the SOMU brain model's unit device stores charge, never flows current (nerve spike serves circuit editing for memory) and generate a vortex (Zhang et al. 2020).

#### 4.1.1.2. Abundance of symmetries in a helically twisted nanowire made cylinder:

**Hamiltonian** or the expression of the energy of the smallest decision-making unit Hinductor (biological analogs are alfa-helices, collagen, microtubule, actin, DNA, RNA, etc. (Sahu et al., 2013a, b; 2015; Saxena et al., 2019a, b), which synthesizes hologram of vortices (Singh et al., 2021b). During the synthesis of vortices, how these devices discover invariants in a discrete set of randomly superposed vortices or nearly periodic loop of fields is given below (Bandyopadhyay, 2020).

The Hamiltonian that defines the energy of twisted helical nanowire and its corresponding photon condensate has four parts  $\mathbf{H} = \mathbf{H1} + \mathbf{H2} + \mathbf{H3} + \mathbf{H4}$  If a pair of crossing paths have  $n_i$  number of clocking waves  $\vec{\psi}_{osci}$ , each wave with an energy  $E_i$ , then, the total energy, filtered by noise, is  $\mathbf{H1} = \sum_i E_i n_i^2$ . The zigzag path filters noise in a strictly quantized manner. The separated energy of the clocking wave is  $\Delta\varepsilon_{\pm} = \frac{\hbar k_F^2}{2m^*} = \pm\sqrt{2(1 - \text{Cos}k)}$ , which is part of the total energy held by a pair of zigzag paths  $K1$  and  $K2$ , is the second part of  $\mathbf{H1} = \sum_i \frac{E_{K1-K2}}{2} ((\text{Cos} \frac{\varphi}{\varphi_0})^2 + d_i^2 (\text{Sin} \frac{\varphi}{\varphi_0})^2)^{1/2}$ . Here,  $\varphi$  is the exchanged quantized flux between the paths (flux degeneracy) with respect to a flux minimum  $\varphi_0$  and  $d_i$  separates the two parallel paths,  $k$  is the wave vector. The charge asymmetry between the paths holds energy  $\mathbf{H2} = \frac{1}{2} m^* \omega_L^2 ((1 + \chi)x^2) + (1 - \sigma)y^2 - \frac{\omega_{02}^2}{\omega_L^2} z^2$ , where  $\chi$  is the anisotropy factor, here conductivity  $\sigma$  distinguishes the diffracted waves  $\omega_{02}, \omega_L$  from different paths & layers,

respectively. Refracted and transmitted monochromatic light interferes; the geometric parameters; length, L; pitch P, diameter D, and lattice area ab (product of two sides of the 2D unit cell) regulate the strength of magnetic flux and geometry of magnetic vortices. It is  $\mathbf{H3} = \frac{\Omega^3}{4\pi^2} \left(\frac{2m^*}{\hbar^2}\right)^{\frac{3}{2}} [3 \sum_i \cos\theta_i + 4 \prod_i \cos\theta_i] \dots$  (equation 1). If we twist the coil, we get a screw ( $\delta = 0$ ;  $\delta = \pi$ ; left handed and right-handed, respectively) & edge ( $\delta = \pi/2$ ) dislocations of zigzag paths on the coil surface, the energy of the dark lines ( $E=0$ ) is given by  $\mathbf{H4} = \frac{k^2}{2m^*} [(ax + kx^2 \sin\delta) + i(y\cos\delta + z\sin\delta)]$ . The part  $(ax + kx^2 \sin\delta) + i(y\cos\delta + z\sin\delta)$  is solved by simplifying the defect on the coil surface, considering that a dark line is  $\psi = k(ax + iy')e^{i(kz - \omega t)}$ .

Including all factors here, we find the Hamiltonian  $\mathbf{H}$  of the device

$$\mathbf{H} = \mathbf{H1} \left\{ \sum_i E_i n_i^2 + \frac{1}{2} m^* \omega_L^2 \left( (1 + \varepsilon)x^2 + (1 - \mu)y^2 - \frac{\omega_{0i}^2}{\omega_{Li}^2} (z - \cos\phi)^2 \right) \right\} \\ + \mathbf{H2} \sum_i \frac{E_{K1-K2}}{2} \left\{ \left( \cos \frac{\phi}{\phi_0} \right)^2 + d_i^2 \left( \sin \frac{\phi}{\phi_0} \right)^2 \right\}^{\frac{1}{2}} \left( \alpha(x_1 x_2 + x_3 x_4) + \beta(x_1 x_3 + x_2 x_4) + \right. \\ \left. \gamma(x_1 x_4 + x_3 x_2) \right) \} + \mathbf{H3} \frac{\Omega^3}{4\pi^2} \left(\frac{2m^*}{\hbar^2}\right)^{\frac{3}{2}} [3 \sum_i \cos\theta_i + 4 \prod_i \cos\theta_i] + \mathbf{H4} \frac{K^2}{2m^*} [(ax + kx^2 \sin\delta) + \\ i(y\cos\delta + z\sin\delta)] \dots \dots \dots \text{(equation 2)}$$

The Hamiltonian  $\mathbf{H3}$  that governs the emitted vortex (Dynamics 11; Metric 12, M12), if plotted, looks like a sphere with twelve singularity points, which opens and closes depending on the geometric parameters of the helices. It has advanced significantly from its predecessors (Biamonte and Love, 2007). Note that even if helical nanowires self-assemble and grow, the large structure acts as an analogous molecule and, therefore, has the same Hamiltonian. We have investigated such supramolecular electronics features for a decade (Bandyopadhyay et al., 2006a, b; 2007; 2010). Consequently, all brain components, the entire organic artificial brain, and the biological brain follow the same Hamiltonian.

#### 4.1.2. The root of all problems: the rejection of the science of arbitrary and unpredictable responses:

##### 4.1.2.1. When a machine does not wait for user, but a metric assists it to find suitable user proactively

Therefore, while existing consciousness theories are engaged in debates only to fight over the routes to integrate bits/qubits, using probability, synchronization by resonance, or quantum collapse, we have moved from the symmetry of space-time independent morphogenesis to the symmetry of primes distribution to eliminate human bias by building an architecture of primes, namely phase prime metric, PPM (Dynamics 10) (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al., 2021a, b). Since 2009 we have been introducing a new paradigm (Bandyopadhyay, 2009, 2011) to complement the current computing by replacing human intuition with the pattern of the density of primes, as an archive. Since primes are fundamental and each prime creates a new pattern continuously over the integer space, mapping superposition of patterns would significantly eliminate the unpredictability embedded in human observation. Therefore, a hardware automaton, if explores a metric of the prime number of choices is a new science of inventing (see robot scientist (Kitano, 2021; King et al., 2004; King et al., 2009)).

SOMU do not keep any provision for switching off the hardware until input arrives in the artificial brain because the brain or nature or a conscious entity seeks out nature based on some form of metric that they already have encoded within. Direction of operation is opposite to normal machines, when normal machines wait to get instructions from user, the SOMU module would seek suitable users for desired answers. The embedded metric needs to be incomplete but a perpetual drive would be there to be complete, so an effort to evolve its hardware continues perpetually. We repeat, neither these brain-like architectures read/process information, nor do they need instructions on what to do; our artificial brain, brain-like computer, or human subjects sense the need to fill up the metric of primes. Metric M means to measure; here, it is an archive (see below M1-M12) that measures how different choices are interconnected. It was believed for hundred years under the Turing paradigm that every single event in the universe could be rebuilt by executing simple identical events like making simple affirmative/negative decisions step by step. Now, we propose that every event in the universe is topologically connected within-and-above and side-by-side, so we cannot linearize them. The new paradigm is, therefore, conceptually orthogonal to the old paradigm. Note that orthogonal is not opposite; it is a projection in a direction where elements of one dimension (direction) cannot sense the elements of the other dimensions.

#### 4.1.2.2. A deep learning network of angular invariants and its Hamiltonian:

We have detailed about the Hamiltonian for a single unit for constructing the SOMU universe, that could be an actual biological brain, an artificial brain or the whole astrophysical universe itself. Now, the fractal tape that we have proposed as part of the Fractal Information Theory, FIT to process invariant network made of polyatomic time crystals as information and symmetry breaking of primes as information processing, we need a theory. Below we describe a chemical chamber processing the second Hamiltonian. Therefore, SOMU is always an optimization of two Hamiltonians.

As periodic events spatially arrange as clocks, all data transform into phase space;  $\mathbb{R}^3: (x, y, z) \rightarrow (\phi_1, \phi_2, \phi_3)$ . Three coupled deep neural networks run together,  $\phi, AF, W, B$  are 3D clock assembly, activation function, weight, and bias, respectively, in a deep neural network,  $i, b, S, N, C$  depict, invariant, beating, seed, nested loop, condensed loop respectively. Here,  $s$  is a layer or depth of the deep learning network.

$$\phi_i^{s+1} = AF \left( (W_i^{s+1} * \phi_b^s) + B_i^s \right) \dots \text{synthesizes invariants as materials}$$

$$\phi_b^{s+1} = AF \left( (W_b^{s+1} * \phi_S^s) + B_b^s \right) \dots \text{delivers 4D, 5D and 6D}$$

$$\phi_S^{s+1} = AF \left( (W_S^{s+1} * \phi_N^s) + B_C^s \right) \dots \text{delivers CA}$$

$N$  intertwined loops made of iso-frequency paths in the chemical beaker shifts periodicity  $x_i$  due to dipole-dipole interactions between helical nanowires, builds  $N$  vibrating modes,

$$\phi_N^s = N \exp \left[ -a \sum_{i=1}^N x_i^2 + 2b \sum_{i,j}^N x_i x_j + \dots \right] \text{ written as } A_{ijk\dots s}^s, \text{ a dodecanion tensor.}$$

When nanowire-made loops condense, they hold the relative orientation of loops, and the resonant oscillations governing conformal transition hold relative phase  $\theta_i$  between pair of

loops  $K_i$  and  $K_j$ , building a differential clock with a period  $t_i$ ,  $N$  vibrating modes transform to  $\phi_S^S = \sum_i^N (K_i - K_j)/2 [\text{Cos}^2\theta_i - t_i^2 \text{Sin}^2\theta_i]^{1/2}$  written as  $A_{ijk...s}^S$ , a dodecanion tensor.

In the condensed nanowire-made loops, the simplest within-and-above network requires three layers, one below and one above the central layer, so four levels share elements of periodicity shifts following  $W_S^S = \alpha(x_1x_2 + x_3x_4) + \beta(x_1x_3 + x_2x_4) + \gamma(x_1x_4 + x_2x_3)$ ;  $\alpha, \beta, \gamma$  are coupling coefficients. Due to sharing elements  $(x_1, x_2, x_3, x_4)$ , that satisfies the orthogonal projection, this term  $W_S^S$  accounts for invariants. We created an artificial deep learning network using proteins, filaments, and neurons; to find invariant detection and tested the same in organic jelly-based brains (Bandyopadhyay et al., 2009; Ghosh et al., 2014a; 2015; 2016b; Bandyopadhyay, 2020).

The condensation of helical nanowires is the condensation of clocks to a structure that synthesizes vortex assembly under noise pumping. During condensation, the emitted energy is given by  $\Psi_n = \sum_i^n g_i$ , following a phase space with 12 singularity domains, in which  $n$  holes are open (Dynamics 1), following  $B_C^S = L\hbar g_i = L\hbar(3\sum \text{Cos}x_i + 4\prod \text{Cos}x_i)$ , where  $L = l_1 + il_2 + \dots + sl_{12}$ ,  $l$  is orbital angular momentum,  $x_i = \text{Cos}\theta_i + e^{il_i\phi_i}\text{Sin}\theta_i$ , where  $\phi_i = \sum_{s=1}^n \frac{\partial x_i}{\partial K_i} A_{ijk...s}^S$  is azimuthal angular momentum,  $\theta_i$  relative phase between resonant oscillations of a pair of loops.  $\Psi_n$  is seen as an optical vortex assembly, live, as the reaction continues to build superstructures of helical nanowires by self-assembly.

The Hamiltonian driving the system is  $H = \phi_N^S + \phi_S^S + W_S^S + B_C^S$ . Above, we derived one equation; similar formulations hold for all three deep learning networks.

**4.1.2.3. The mathematical operation that invents an invariant:** 3D clock assembly is a polar decomposed structure, hence could be rewritten as a positive-definite tensor  $A_{ijk} = Ue^f, f = \ln(P^T)$ ;  $P$  is the deformation of input  $A_{ijk}^l$  from memorized  $A_{ijk}$ . Two 3D clock assemblies, one memorized ( $A_{ijk}$ ) and the other unknown input ( $A_{ijk}^l$ ) resonating with memory.

Deformation  $\eta$  ( $\eta = (A_{ijk}^l - A_{ijk})/A_{ijk}$ ) in the 3D clock assembly for train and test datasets are taken as differential  $\partial\eta/\partial\phi$  signal or  $x_i$  along three orthogonal axes  $\phi_1, \phi_2, \phi_3$ , in general  $\phi_S$ . The plot is  $\mathbb{R}^3: (x, y, z) \rightarrow (\phi_1, \phi_2, \phi_3)$ , The invariant condition: partial derivatives of  $S$ , with respect to  $\eta, \left(\frac{\partial S_{\phi_1}}{\partial \eta}\right) : \left(\frac{\partial S_{\phi_2}}{\partial \eta}\right)$  vanishes when  $\phi_1 \neq \phi_2$  ( $A : B = \text{tr}(AB^T)$ ).....(equation 3)).  $T$  denotes transpose,  $\text{tr}$  trace delivered by  $\phi_N^S * W_S^S$ . Seed molecule or supramolecule's resonance frequency set  $\{R_i\}$  periodically oscillates, we get  $A_{ijk}$ . When the output product of one self-assembly is used as a seed for the next phase of self-assembly, the orthogonal projection to determine the invariant  $\left(\frac{\partial S_{\phi_1}}{\partial \eta}\right) : \left(\frac{\partial S_{\phi_2}}{\partial \eta}\right)$  is satisfied. Both layers together generate the vortex (Dynamics 11; Metric 12, M12) that holds the geometric shape of an invariant (Ennis and Kindlmann, 2006). So, the definition of dimension used here could be found in solid-state physics literature in the 1960s.

We envision a journey of "within and above" network of participating entities and the archiving of phase prime metric PPM (Dynamics 10) (Reddy et al., 2018; Bandyopadhyay, A. 2020; Singh et al., 2021c, d) that accounts for all possible symmetry-breaking events of the universe get enriched from the primitive archive that we started to release since 2020

(Bandyopadhyay, 2020). If PPM-driven (Dynamics 2) engines (Dynamics 10) of SOMU do not compute, how does it make decisions? SOMU answers these queries. Brain and nature fill up an infinitely long fractal tape (Ghosh et al., 2014a; Agrawal et al., 2018) made of the density of primes (M11). To do that, both the brain and nature do not acquire information but acquire invariants of geometric knots holding the key features of spatio-temporal events happening in nature. These invariants form a fractal composition of maniflats (see M7) following a set of universal catalogs (M1-M12) that nature holds (Dynamics 10).

## 4.2. How could we change our approach toward understanding nature and consciousness?

### 4.2.1. Developing a self-operating mathematical universe, SOMU: A model that allows a system to run by itself

The journey to understand consciousness begins by changing the overview of the world we live in. Instead of discovering a language that nature interacts, the current science prescribes inventing theories by listening to the screams of natural systems bombarded by suitable energy packets in the experimental lab (pump-n-probe) and interpreted by intuitive theorists, who repeat observation protocol to make it statistically right. The credibility of what we have read about nature is based on supports from many observers following the same protocol one scientist sees; a biased vision turns into a truth (Winfrey 1987, the famous “it from bit”). Belief creates fact. Intuitive idioms turn into a complex science, where only two interacting systems exist in the universe at a time; we still debate how to take into account more than two systems at a time; preserving degree is not enough (Kharel et al., 2021). This article is about a tensor-manifold (Dynamics 9; M7) language to converse with multiple different dimensions at a time using a metric that accounts for all possible interacting networks. PPM (M1-M12 (Dynamics 2)) is a complete archive preserving all degrees of freedom, so a system could run by itself by reading the archive continuously (Reddy et al., 2018; Bandyopadhyay, A. 2020; Singh et al. 2021a, b). To read an archive instantly, the topology of silence is the information & topology of maximum choice is the route of integrating information. Together, they make a self-operating mathematical universe, SOMU.

Conscious machines encounter unknown situations every moment. Imagine the computer that instantly invents variables, writes its algorithm, trains its deep learning network, predicts the future, and responds instantly. Unless a common archive regulates all conscious entities and nature, it is impossible. Critical features of this archive are tested and confirmed by human subjects and artificial brain studies. SOMU sees a universe that, in reality, has grown within and above using specially designed tools. Note that existing tools, like circuits, logic gates, and transistors, are not useful, and we have been developing them for decades. Two orthogonal systems representing two different dimensions cannot see each other. However, overlapping dimensional features (Figure 9) and unique maniflat communication pathways across dimensions (see M7) link different dimensional worlds, making SOMU a self-operating system. Figure 9 further argues that nature or any self-operating system does not require signal but noise which means its decisions are encoded in the symmetry of singularity domains of four elements, space, time, topology and prime, interconnected by a circular relationship. One

could start realizing nature from any point in the wheel, say, prime, derive topology or morphogenesis, from which derive spatio-temporal dynamics happening in nature. The circular journey maps acquiring and thereafter losing identity. The wheel is itself undefined like a point that makes the foundation of SOMU. A point could become undefined incorporating arbitrary number of points, or points form a loop, the enclosed area is the singularity region

The within-and-above network approach is not the opposite but conceptually orthogonal to the existing Turing philosophy wherein by rewriting two choices (0 and 1) linearly through an astronomical path stepping one after another, any form of information structure, any form of complexity; even that is grown within and above, could be emulated. In current algebra, going within and above endlessly turns a function undefined; no one could find a differential value of such a function. Therefore, we must build one alternative scientific protocol for networks grown within and above for SOMU. The tools that would make sense in the fractal-like universe may appear illogical in the current linear universe. SOMU accounts for learning a universe grown within and above from proteins to the entire biological life form, establishing an argument conversing with nature in its language, archives have evolved here since our first report in 2020, and it will continue to improve further.

#### **4.2.2. Creating a new structure of information: Polyatomic time crystal as network of invariants**

**4.2.2.1. Anharmonic clocks with phases make a polyatomic time crystal, PTC:** Inspired by the time crystal research of the 1960s, one could model life forms as automatons made of clocks. We had to make fundamental conceptual changes to fit it into the universal decision-making system. The most popular definition of a time crystal suggests that the time crystals could only be made of harmonics of the externally applied frequencies. We rejected it based on the argument that if spontaneous output beatings are harmonics, it is highly unlikely that there is any event of breaking the time symmetry (Saxena et al., 2022). Furthermore, we suggested that anharmonic clocks with periodicities, several orders higher or lower, are true evidence of a time crystal. Unless there are polyatomic time crystals, it is difficult to confirm whether measurement reveals a hysteresis-driven response from input or there is a true time crystal, i.e., spontaneous breaking of time symmetry. Geometric Musical Language, GML (Agrawal, 2018; Dynamics 3) considers an entire living system, say the brain, as a 3D spatial assembly of clocks. Clocks run by harvesting thermal noise, electric potential, and food (GDP hydrolysis); the entire structure runs by itself (Singhania et al., 2020).

**4.2.2.2. When instead of information or facts hardware is designed to read only invariants and its network:** To implement that design, the hardware holding the clocks should come to the vicinity and self-assemble by weak or strong binding. **Moving clocks could only be realized as diffusing resonator molecules in a semi-solid gel.** The physical look of self-organized, continuously reconfigurable gel is a follow-up of the circuit of time or geometric arrangement of clocks, realized by matter (matter = electric, magnetic and mechanical resonator). Since integrating clocks made of elementary clocks hold the key information in a 3D clock assembly, if matters or clocks are isolated, none of the clocks holding invariants survive, so we have been very against the isolated characterization of biological components. If we isolate even a small part of the space, time, or energy network, hierarchical clocks disrupt local clocks all the way down-scale; consequently, we always read wrong information. Unfortunately, isolating a

system has been recommended and practiced for a long time in the current science to get pure information about a target component in a complex network (Liu et al. 2011). Here we advocate how the whole could be read in a part of the whole, using the symmetry of invariants, isolation-practice could therefore be permanently abandoned.

#### **4.2.2.3. Self-operating machine that interacts with nature must learn the language of nature:**

Since all sensory signals are written as geometric shapes made of clocks in GML and typical geometric shapes, they remain unchanged across signals as invariants. Thus, the invariant becomes the true information, not the clocks, because, from the archive of invariants (M12), we could regenerate the 3D clocks assembly from the invariant alone. The change in understanding information is radical; an invariant does not have a physical picture, and geometric representation is a mathematical abstract that acquires significance when we add space, time, topology, or prime. Moreover, significance arrives from an archive of metrics (M2-M12). A good analogy to represent the information structure of the universe using invariants is to replace the letters of the Sanskrit language with invariants of different seed events or basic perceptions governing the universe (M11). Maharshi Kapil envisioned a language in the pre-Vedic era whose fundamental sounds would trigger a desired emotional and perceptual response in the mind of the listener. Additionally, we need a grammar book on how to make words, sentences, paragraphs, and chapters of a book; the entire book would be the universe itself. So, the universe will get a catalog containing a few conserved laws or invariants as basic letters and a metric as a grammar book that tells us how to link these invariants continuously; every time using a new route, the book grows continuously, adding new pages.

**4.2.2.4. Letters of nature's language are symmetry breaking points:** Symmetries or ordered arrangements in the universe are infinite. We do not see the connection; we think all are distinct, but all symmetries are linked, and conditions that break symmetries are hidden in the distribution of density of primes. If scientists discover that particular rule of how one symmetry is connected to another, that rule or protocol would unify all wisdom and predict all possible symmetry breaking that could happen in the universe in parallel and sequentially. The common rule that remains unchanged in a series of breaking symmetry events are invariants representing the governing laws of the universe; thus, invariants could build letters of a language where space could be written as time, time could be written as changing geometric shapes, or topology and that could be written as primes or integers. In that universe, any event's space, time, hidden topology, and system-independent primes are seen as inseparable and interconvertible entities.

**4.2.2.5. The necessity of a 3D vortex architecture of fields (Dynamics 11; Metric 12, M12) to carry the 3D assembly of clocks or the information unit:** Primes are fundamental, but what variable do we count? At the elementary scale, the 3D vortex structure created by fields appears as mass, so the number of symmetries of these field patterns is counted. Normally, a prime number of tiny vortices or loops of fields come together and become mass, then look for large vortices or loops to change its space-time dynamics, which we call "smaller me searching for larger me" as energy harvesting.

**4.2.2.6. The necessity of symmetry and an archive of all possible symmetries of the universe:** Symmetries or ordered arrangements in the universe are infinite. We do not see the connection; all symmetries are considered distinct and fundamental to this universe. However,

all symmetries are linked. If scientists discover that particular rule of how one symmetry is connected to another, that link would unify all wisdom and predict everything. Imagine an automaton that knows how the universe integrates, breaks, and builds new symmetries. Only then can an automaton discover something new on its own. Right geometry in the presence of noise creates desired dynamics without any programming. Create curves and folds and arrange them into the right order or a 3D arrangement so that the noise would create intelligent expressions, be it mechanical, electrical, or electromagnetic.

**4.2.2.7. Brain and universe as an architecture of invariants:** Information is a fractal-like network of invariants that links the smallest element to the largest, at least over twelve orthogonal layers to achieve a unique property to coexist at least in three distinct forms at a time.

**4.2.2.8. The intricate relationship between geometric shape and the prime number:** Since a few primes generate an incredibly large number of integers, geometric shapes representing a few primes could replace astronomically large compositions of geometric shapes or human expressions; this is our geometric musical language, GML (**(Dynamics 3)**). The idea that the information structure of the universe is linear is wrong, and it is not even a proper fractal. Unique patterns between choices never repeat at the local level, and the ability to generate new patterns is possible if an engine creates primes and connects them to structural symmetry. The geometry of all possible choices in nature is connected as a pattern imprints the pattern of the density of primes (**Torquato et al., 2018**). The primes set the boundary for events to unfold and define nature & life; the geometry of the phase of that sentence governs the universe.

**4.2.2.9. Universe and brain as an architecture of clocks:** Imagine an entire universe as a circuit of time or clocks, tiny pieces of periodicities as clocks build an architecture. To implement that design, resonators acting as clocks come in the vicinity and self-assemble. The physical look is a follow-up of the circuit of clocks realized by resonating matters like electromagnetic tuning forks. If we isolate individual resonating components, the invariants made of clocks formed by relative phase oscillations of elementary clocks disappear, and we lose total information, not partial. The brain is a structure of clocks, integrated from the smallest to the largest. It has a structure of matter too. Both structures, made of matter and made of clocks, try to match each other from birth to death by exchanging vortices of various kinds. 3D assembly of vortices is energy.

**4.2.2.10. Comparison between a fractal machine and a Turing machine:** Turing machine emulates bits; it is designed to follow strictly, a predetermined solution path, faster, with fewer resources. The fractal machine stores all possible symmetries and their all-possible evolutions, so it matches the unknown composition of symmetries and expands them. So, it does not require pre-imagined code. Thus far, distinct symmetries are intricately identified, but how they are connected is neither conceived nor proposed. Turing machine emulates, it copies a solution path, faster, with fewer resources. The fractal machine has stored all possible symmetries and all their possible evolutions, so it matches the unknown composition of symmetries and expands them. So, it does not require instruction or code.

**4.2.2.11. How does consciousness survive in a continuously growing body?** In minutes 50 million cells of our body die, replaced by new ones. Still, we hold on to consciousness. This is why SOMU opposes that a memory has to be retained eons after eons. The universe does not need a soul, neither a protein nor a living cell as long as the metric of primes is there.

### 4.3. Journey through dimensions: The necessity for a new mechanics

#### 4.3.1. Journey through twelve dimensions: Experiencing invariants and unforeseen physical entities

Traditional science has made two mistakes in its attempt to understand the universe. First, it has assumed that the universe can be understood by simply observing its large number of elementary events. This is the mistake of reductionism, since whole is more than sum of its parts. Second, it has assumed that the universe is made up of a duality of 0s and 1s. This is the mistake of digitalism, since, a network growing within and above is undefined and has no finite state, and still, it can work by projection. So, SOMU devices are not touched for measurement, user has to allow it to project the decision. We start with two things. First, we need new tools and a new way of thinking that lets us see things neutrally, without our observation or measurement affecting what system possess in practice. Second, instead of the 0 and 1 way of thinking, SOMU uses an endless chain of prime numbers. This means the universe makes decisions using pattern of choices, not reducing the choices.

SOMU considers that only clocks representing periodic or recurring events operate in the universe. Linear events are a minute part of a large cyclic event, or linearly occurring sequential events are a local view of a clock with a long period. Events have astronomical variations, but symmetries are finite in the universe, with only a few options. Once we capture the geometric arrangement of clocks from events around us, it is time to find the shapes that remain unchanged or discover invariants. The major challenge in finding invariants is that every time we need to find a common feature among all variants, we have to deal with nearly similar clocks. This critical demand to obtain invariant geometric structures whose corners are clocks leads us to quantum mechanics and beyond. How? When many coupled clocks have similar periods, phases, or momenta, then, classically, they work as a single clock yet deliver contradictory results. Changing one clock affects all clocks in no time; because control is not in the hand of time or space or space-time, we suggest a higher-dimensional handler, topology. Therefore, when a variable regulated by energy acquires similarly varying distinct values, i.e., the energy differences are very less between entities. Nevertheless, they regulate system response; invisible controllers or topologies could predict a shared matrix between entangled states.

Events that hold a large number of distinct features with similar values within a very small energy range together interact to deliver systemic responses following a protocol invisible to a classical observer. Thus, a finite number of topological invariants come into play as soon as many choices are densely packed in a pattern that the shared matrix holds. We cannot stop at the maximum attainable dimensions of topology, and we must also explore the space-time independent mechanics of topological invariants. In other words, we need an orthogonal

journey beyond 9D. Thus, we bring the morphology-independent concept, a pattern of the density of primes. Morphogenesis explains the origin of quantum mechanics or shared matrix between participants of superposition and entanglement. Similarly, primes explain the origin of fractal mechanics, one step above quantum mechanics.

Therefore, the metrics of 10D-12D hold the universe's code book; using it, we find perceptual meaning for any events without learning or training. Imagine a world of artificial intelligence without any algorithm or training. Every input perceived becomes the output of internally stored codes; we only have to recreate that input using the stored invariant code and apply the metric grammar. Leaving the quest for symmetries in the information content, we envision a world where the quest for invariants inspires machines to meet all human exploration needs. For this reason, we believe every single machine of the existing civilization would have an orthogonal analog in the new civilization we want to create. Here in this article, we will discuss letters of the universe's language and metrics as the grammar book. If we know how the universe integrates symmetries, breaks symmetries, and builds new symmetries, only then can an automaton discover something new on its own, recreate itself or regenerate (Kohji et al. 2002) using the metric.

#### **4.3.2. The necessity of various mechanics apart from classical and quantum mechanics:**

Quantum mechanics, or QM, is well-suited for describing linearly connected imaginary worlds. However, it falls short when it comes to depicting a universe composed of multiple imaginary worlds residing one inside the other—something the SOMU embodies as a within-and-above network of processors. To address this, SOMU uses fractal mechanics (FM), which employs threads with a minimum of 12 dimensions, passing through 12 imaginary worlds located one above another. This enables FM to tackle space-time independent topological dynamics of threads distributed among these imaginary worlds. The interplay of threads extending beyond space-time, connecting these imaginary realms, provides an explanation for how entangled states separated by distance collapse during measurement. This collapse is nothing but a precisely directed projection of the threads into a specified imaginary world where the observer resides—essentially the classical world or real part of QM. For QM to grapple with the interconnection of multiple imaginary worlds beyond space-time, it requires the inclusion of FM's morphogenic threads. This interconnection of threads between imaginary worlds gives rise to phenomena like superposition, the shared existence of entanglement, and the facilitation of quantum teleportation. FM explains QM.

SOMU has no classical or defined entities, it is made of threads or strings that forms geometric shapes as they pass through the imaginary worlds and experiences singularities in their geometric phase. Singularity domains where physics laws that operate via space-time fails, make the corner of geometric shapes. Since all imaginary worlds are identical, threads or geometric shapes make multiple copies of themselves, when mirror structures interact, the product forms a loop of geometric shapes, represented by a tensor. The changing geometric shapes in a loop is called morphogenesis, a key process of fractal mechanics, FM. Morphogenesis has no attribute to space-time, yet it has two aspects. Differential geometry

along a loop that incorporates gravity and sequence of knots on a thread that incorporates quantum mechanics. Thus, FM connects two big ideas, general relativity and quantum mechanics by replacing space-time duality with a triality space-time-topology. FM allows entanglement of multiple properties between two entities. Therein, keeping one or more entangled properties intact, other selected entangled properties could be measured or manipulated. MLs offer detailed maps for all entangled properties between two systems, granting users the ability to access multiple hypothetical realms to control collapse, superposition, and conditional entanglements – capabilities beyond the scope of traditional QM.

While FM succeeds putting discrete and continuous universes together, it fails on many counts. Similar to the incompleteness arguments of QM, the FM faces arguments like the origin of geometric elements beyond space-time, why should they exist at the first place. Once space-time duality disappears in FM, space-time-topology triality is left with symmetry and symmetry breaking rules for the geometric shapes. Both features should be born from a dimensionless parameter, like integers. Since threads form a limitless network of morphogenic loops, MLs in the endless universe containing astronomical number of dimensions, knots of MLs breaks symmetry in three ways. In this universe, three functions, binding of the MLs (T), transformation of MLs (S) and transformations of the MLs (R), together form SRT triplet operator continuously composes and decomposes MLs exploring all possibilities. The invariance of this process is an integer, whose all-possible prime divisors are composed exploring all possible arrangements of MLs. For prime numbers, no composition is possible, so they are like singularities and so, in the ML universe, a prime represents a symmetry. For an integer, an ordered factor is a composition of symmetries, its different factors account for its symmetry breaking options. Thus, endless integer space, made of unique, non-repeated distribution of prime numbers follow a mechanics, where initial primes like 2, 3, 5, 7 dominates and as we go further in counting primes, their contribution to regulate ML compositions turns negligible. So, the universe governed by symmetry of primes need only a few primes to construct its major symmetry breaking rules. To be specific primes 2,3 generating a fractal of triplet of triplet explains 66% of all ML compositions. For 12 imaginary worlds if we take  $3 \times 3 \times 12 = 108$ -dimensional tensor operating system then (see Appendix I; Supporting Figures S1 to S26), we could emulate majority of the dynamics of the limitless universe of astronomical dimension. We limit ourselves in 108 dimensions for making a conscious machine, however, even making a journey from 12D to 108D needs a new mechanics of primes, PM.

SOMU unveils the ultimate mechanics PM, revealing the source of SRT that guides captivating FM traits. In this, ordered factors for integers establish a mapping illustrating how distinct symmetry-breaking rules coexist to govern conservation rules for MLs (T of SRT). The arrangement of primes among neighboring integers demonstrates how symmetry-breaking rules might adjust with minor changes in ML counts (R of SRT). As each prime retains a symmetry and generates an infinite fractal within the integer space, it empowers FM to function in the morphogenic universe of astronomical dimensions. Consequently, PM guarantees that ML receives feedback from infinity (S of SRT). Primes terminate fractal patterns, leading to normalization that drives clock-wise and anti-clockwise rotations – vital for FM's loops. Prime mechanics (PM) fills gaps, sans need for extra mechanics, as primes are universal basics, detached from space, time, and topology assumptions. The 108-math

framework (see Appendix I; Supporting Figures S1 to S26) is where FM builds over QM, with PM tackling FM's limits. FM and PM make QM and CM unnecessary. This melding might be called universal mechanics (UM).

## 5. Defining consciousness as a mathematical property:

### 5.1. The fundamental mathematical constructs of a self-operating system

#### 5.1.1. Boundary conditions for a conscience mathematical construct:

Three entities are required to build the mathematical attribute of consciousness, “whole,” “it,” and “nothing.” **1. The whole:** irrespective of fundamental information structure (bits, qubits, geometric shape, polyatomic time crystal, invariants etc.) and integration theories (Integrated Information Theory, IIT; Phase prime metric, PPM (Dynamics 10) for networks; entropy etc.), all information of the universe expressed in any language is the “whole.” **2. The nothing:** A dimensionless, propertyless attribute of the whole, which is an undefined entity, contains a number of primes combined in all possible choices. The nothing contains a metric that links higher-order networks such that the ordering of choices (ordered factor of integers) for combining networks are all interconnected, and we call it phase prime metric, PPM (M=Metric; M12; (Dynamics 10) (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, 2021b). **3. The It:** The It is an entity that is the whole and the nothing at the same time, its undefined point, the primary active element.

#### 5.1.2. The necessity of undefined point as a fundamental constituent

In the beginning, there was no pot to hold something, so we cannot say where the universe got created, why it got created, how it got created, and when it was created (Harish, 2019). In the beginning, neither could we say something existed nor could we say nothing existed. When "something" and "nothing" are not allowed, the paradoxical duality of what, where, when, and why are not known, then the only option to create a universe is in a point (Yajurveda Reveals, "Yat pinde tat brahmande, yat brahmande tat pinde"; “As is the microcosm, so is the universe, as is the universe, so is the microcosm”). A point is a universal invariant; it does not transform. The journey to map the universe starts from a point and continues through a higher dimensional transformation (equation 3) into a line, a surface, and a volume. Thus point transforms into a circle or sphere touching the infinity, which is a point again. Even in all many-body theorem, existing physics principles are based on the assumption that only two interacting systems exist at a time. Recently, the need for taking into account three or more units at a time has been explored (Battiston et al., 2021). All these efforts put intuitive geometries for multiple units, and they integrate geometric shapes using further intuitions. However, for us, it is all primes with null assumptions constructing integers, but we count all those integral numbers of points in a point. The mathematical universe is the architecture of organizing multiple units by considering the undefinedness of a point. It has three elements, an undefined point, an infinity and a quest to put more points in a point.

#### 5.1.3. Three fundamental actions of points or circles of the mathematical universe

The philosophy to create a universe within a point requires operators that identify perceptual functions when triplet of triplet symmetry dominates the ordered factor metric (M11). Three actions were recommended to be performed over four millennia. First, bonding points, we call it "Tama," T; transformation of line on a 3D curve to create an enclosure, we call it Raja, R. Finally, creating a boundary of the sphere that holds all lines on its surface, or isolating infinity from the point, we call it Satva, S. SRT triplet executes implementing three angular invariants  $\theta, \phi, \omega$ . When the journey begins from a point and ends at a point while inventing invariant triplets, extracted values that do not change are always found along the orthogonal axis. We spend dimensions. It means that after every three transformations for deriving invariants for three successive higher dimensions (equation 3), we return to the point; all three-dimensional options for a particular dimension are used.

The first journey of a spatial point to a line to the surface to volume, thus it consumes all three spatial dimensions. The second journey from 3D spatial point deformation as a function of time consumes three dimensions of time. We reach a point at the end of the sixth dimension of time. Wherefrom, the next three dimensions of topology (6D to 9D), deliver space-time independent geometric properties. At the end of the ninth dimension, the options for the topology to increase dimensions run out. From the tenth dimension, the density of primes, unfold integers and explore three dimensions of integers to complete a journey of twelve dimensions. Since primes do not vary in any dimension, we cannot move orthogonal to it, so we cannot find invariants beyond twelve dimensions. The cosmos was born by exploring twelve types of invariants in twelve dimensions.

#### **5.1.4. The philosophical origin of the number system, the origin of the triplet of triplet**

The western world learned the number system from India via Arabs, but its philosophical argument never reached there. In Vedic philosophy, zero is not "nothing"; it is complete or purna or everything, "whole." The number system is a cycle. After 9, it returns to completeness with an identity (one), so we get 10, ten. Ten steps make the structure of Rita, Vedic property of the universe that tends to turn everything into a closed loop, and its smallest cycle is brahman, or fundamental frequency ( $10^{53}$ Hz). The journey begins from zero; first, we get 1=identity or consciousness (I see purna, completeness), 2=observer (I confirm that is seen), 3=evaluator (I confirm 2 has seen 0 in 1), 4=duality (2 observers make independent observations), 5=dimensions/faces (0,1,2,3,4 five faces of Brahma). 6=observed (Brahma unfolds 2x3 observer-evaluator universe/mind using his five faces), 7=Synchronization (I confirm 7 Loka/universes where mind lives), 8=Conscience (Creation of a body for identity, mind), 9=free will (fusion of mind and Loka, the triplet of triplet is a complete reality).

After 9, the Vedic philosophers did not add any other number because now purna or "0" could consolidate the identity or consciousness ("1") that sits with completeness or the "whole" side by side, so we get 10". Each time, a universe or "Loka" is complete when we add a purna, its power of ten, so, undefined points make a journey from nothing to the whole as a power of ten. It is not a side-by-side journey but rather within or above. Here is the hymn that defined the mathematical properties of completeness, or whole or purna, known to us as zero. Rik-Veda sutra follows:

Purna-madaha purna-mudam, purnat purna mudachyate | | purnasya purna ma dayaha purna ma be wasisate

Translation: “if we take completeness from completeness, what we are left with is completeness ( $0-0=0$ ), if we add completeness to completeness, what we get is completeness ( $0+0=0$ ), we can take completeness from completeness any arbitrary number of times,  $0/0=undefined$ .”

### 5.1.5. Creation, survival and destruction of the mathematical universe: A cycle of creation (manwantar)

Figure 1A maps the cycles of creation, survival and destruction of a mathematical universe; the basic element that constructs the universe (“it”) is an undefined point made of three oscillating operators, represented as three oscillating guest circles S, R and T on a host circle SRT. We have drawn the unit SRT point in the left corner of the panel A. SRT is made of four circles, representing four clocks ( $T = T_0 \prod_{i=0}^N e^{i\omega t}$ ), and relative oscillations of these three classes of clocks are the fundamental operation that constructs the universe (Vikshu, 1928; Harish, 2019; Christian, 2011). SRT is a composition of properties, then why is it treated like a particle? In this mathematical approach to information processing and decision making, a mass is also a mathematical construct, and so are the forces.

There are two circular domains in Figure 1A. In one, SOMU word is noted; the other contains three sub-structures. Together it is a single SOMU structure, and one cannot be defined without the other. A self-operating mathematical universe, SOMU represents a self-operating guest entity, so we drew it outside the set of the host SOMU. We have deconstructed the host SOMU in detail, keeping the guest SOMU as a black box outside. Since SOMU contains a SOMU, the definition remains undefined, and this is what we want as the key principle for constructing a mathematical structure for a self-operating mathematical universe. From constituents (undefined point) to the basic definition of SOMU, from the basic structure of information (3D assembly of clocks) to estimating the interactions of higher dimensional tensors (multinions) and finally, from designing a single device to the construction of the whole brain using organic molecular devices, we have made a sincere effort to remain consistent throughout.

In Figure 1A, the large circle depicting the host SOMU has three subsets: the reconstruction or regeneration cycles of SOMU. Rapidly oscillating SRT structures that build the self-operating mathematical universe, in the course of evolution, turn too complex to pursue the objective of acquiring dynamics related to new primes, and saturation is reached. Constituent SRT points disintegrate when the entire information structure of SOMU reaches a point where all parts of it reach a convergence. The property “T” of SRT is the first that weakens. The integrated clock architectures made of mechanical, electromagnetic and magnetic fields are the first elements that disappear, and elementary SRT points get separated. In the second phase of disintegration of the entire information structure, three fundamental properties related to the operator “R” disappear. There are two phases: the dynamic phase and the geometric phase (Veis et al., 2014). A geometric phase is born in the system when its variables repeatedly try to return to their initial state but repeatedly fail to do so. Therefore, a helical geometric phase is fundamentally embedded in such systems and plays a key role in the geometric

transformations of interactive geometric phases, responsible for executing geometric transformations in the SRT compositions, i.e., R to get invariants (Gao et al., 1991; Tong et al., 2003).

Once geometric phase formation is inhibited, ordered factor metric (see M11) cannot form, and choices of spatio-temporal events do not link. More fundamental, the density of primes (see M1) takes over, and localized dynamics strongly related to the density of primes remain active (see M2). As information structures are made of a few SRTs and limited to three layers grown within and above, only a limited number of oscillating clocks hinder feedback from infinity (M3). Thus, at the final stage of the second phase, “S” turns inactive, and all information structures made of SRT units are fully disintegrated into isolated basic units alone.

The third phase is represented as a triplet of circles or three subsets. This phase is all about the creation of a new SOMU. The discrete pieces of SRT units undergo rapid transformations of geometric arrangements, “R.” We could state that “R” returns. How do we picturize this situation? Different SRT unit hardware spatially comes in the vicinity forming a geometric shape without creating a formal bond between SRT units; the geometric shapes are temporary, and there is only one property, “R.” Since “T” has not been generated, “R” rules the SOMU universe. Then, “T” turns active as geometric shapes survive longer and bonding forms between SRT units. Therefore, all metrics of primes (M11) start operating using “T.” Finally, “S” returns, and SOMU is generated. We move outside the larger circle to the guest SOMU.

Though SOMU remains within a point to create a universe, our points are spheres, and everything outside the boundary is infinity. SOMU lives in between two infinities. The first one is where the journey begins, and the second one is where the journey ends. One could restate that SOMU lives between two points, following its life cycle (Figure 1A). We need to play with both the infinities or both points to find the continuously changing or evolving path that itself becomes the metric or grammar of the invariant language. Any system can never perfectly become the metric that is a perfect mathematical expression. However, points collide, and random geometric shapes evolve to be like the proper metric (M11). This is what a conscious being does; always try a different geometric arrangement of points to become a metric of primes. Therefore, all conscious beings in the SOMU individually evolve to discover, absorb, and emit a prime. Other beings representing SOMU find no choice but to absorb dynamics related to the new prime. Thus, all clusters of points thriving to come to a complete metric or the whole, at all scales, take birth, live, and die, to advance further in the integer series. The quest for finding a new prime representing distinct dynamics and associated classes of invariants is only an endless objective of the SOMU cosmos and all of its constituent conscious beings. With each step of evolution, the system moves closer to capturing 99% of all possible dynamics in the integer space.

## 5.2. Basic properties that a conscious machine or a conscious being should have:

### 5.2.1. Defining life and consciousness

Here we define consciousness and life based on the mathematical construct of SOMU. Consciousness is the ability of an entity to generate an infinite series of invariants it receives from nature and acquire feedback from infinity so that the fractional contribution of each element of the series is derived as output. Such a practice ensures that a conscious entity only acquires values that are sustainable to the whole. All variations and forms are needed to build that fractional contribution. Retrieving feedback requires simultaneously coexisting as equivalent information structures and editing one of its morphogenic structures, keeping the others unchanged. To create an editable functional replica of the information structure, one requires at least three mathematically equivalent forms (ordered factor metric, see M11). Information structure either evolves to generate unknown symmetries associated with each prime and transform itself, living together with the mathematical universe, or create a mirror where the universe could generate its replica in the hardware of a conscious entity. Individual consciousness cannot be filtered out because we try to understand our consciousness by isolating it from the whole; again, just like the information structure, isolating any element destroys all of its content. The universe has a chain of various degrees of consciousness, and human is one element of it contributing to the whole and getting redefined totally in that process.

*A life form quests for primes, nature creates conscious machines to invent new dynamics of primes and expand its metric of primes into its hardware.*

### **5.2.2. Defining consciousness as a C automaton for testing biological and artificial human brain:**

In **Figure 1B**, we have created a wheel with eight typical features that, if it exists in a machine, would exhibit key conscious features along with standalone operations. As we would notice below, all eight features were carefully crafted by philosophers, which appear nearly impossible to realize using a finite or hypothetical infinite state machine. One could find that quantum systems deliver only a part of these classically restricted criteria.

**5.2.2.1. Fractal network of whole is the fractal network of parts:** The first criterion **1** is a conscious machine's ability to hold information about the whole universe in its part, at the same time whole of its parts. If  $U$  represents all information in the universe, then a conscious machine,  $C$ , should have the ability to emulate the pattern of information creation similar to the universe,  $U$  should be a subset of  $C$ . Both entities should use a similar language, identical letters and grammar. It is not just about the quantity of information, but the method of creating it should also be identical. Here,  $C \subset U$  and  $U \subset C$ , both are true at the same time.

**5.2.2.2. Hardware is one, but its complete information has multiple isoforms at the same time:** The second criterion **2** is the ability of the conscious machine to create multiple complete information structures  $C_n$  or isomorphs in the same hardware. Then, edit and evolve them simultaneously, independently. The coexistence of multiple replicas follows a unique property  $C_i = C_j$  quantitatively, at the same time,  $C_i \neq C_j$  qualitatively. In simple terms, the ordering (ordered factor metric M11) or arrangement of constituent information varies, delivering distinctive features.

**5.2.2.3. Chasing the whole by redefining and restructuring whole and parts and growing them perpetually by evolving hardware:** The third ability of a conscious entity **3** is to

regenerate the whole continuously with more information content in the same hardware. If  $C_{g1}$  creates  $C_{g2}$ , and continuously various progenies are created generations after generation, until  $C_{gn}$  then, the number of elements in  $g_1$  is given by  $N_{g2} \geq N_{g1}$ . In simple terms, the machine can create the whole and expand the whole into a whole (completeness x completeness = completeness).

**5.2.2.4. Inventing network of invariants and mapping symmetry of patterns made of symmetry breaking points:** The fourth ability of a conscious entity **4** is inventing invariants or conserved laws by expanding an information content  $U_i$ . Even an algorithm can do orthogonal transformation (equation 3) or find a new invariant, but not if it is a fractal-like hierarchical network of invariants. Here, the quest for higher dimensional invariants (equation 3) continues in a helical loop as dimensionless entities acquire 1D, 2D networks and finally, a 3D spherical entity that is a point again. A conscious entity should simultaneously operate in two parallel universes,  $U_i$  and  $U_j$ . In one, it is a quest to find higher dimensional invariants; in another, it is a loop of point to point.

**5.2.2.5. Synthesis of an infinite network of non-repeating elements that defines parts and the whole and taking feedback: Mastering the engineering of infinity:** The fifth ability of a conscious entity **5** is creating infinity and endless chain by using multiple replicas of the whole.

**5.2.2.6. Remaining an undefined point, invent more primes, add them into its hardware, with proper normalization at all scales (11D):** The sixth ability of a conscious machine **6** or being is that while it remains dimensionless, definition-less entity or a point that cannot be measured, estimated or defined, could include an arbitrary number of whole ( $=U_i$ ) information content and continuously hold the undefined feature of the point. This feature is represented as  $C_i + U_j = C_i = C_i + U_k = C_i \dots$

**5.2.2.7. Three fundamental properties of an invariant network, transform R; feedback from infinity, S, and bonding T, together evolving contributions of SRT and working as seed property that grows:** The seventh ability **7** is to process the life cycle of three fundamental properties of events SRT as we see unfolding them in a conscious being. Since it is the ability to convert a point into an undefined entity by adding all possible number of points one by one, the metric of primes (see M11) governs machine engineering. The prime number of spatial, temporal and spatio-temporal components dominate in constituting the machine.

**5.2.2.8. Remain connected to infinite, endless, continuous network of conscious elements that makes the universe, or the whole:** The eighth ability of a conscious being **8** is to create the progeny whole within and above, both directions simultaneously, continuously, endlessly. The information structure of the whole  $U_i$ . Since the fundamental approach to developing a mathematical understanding of consciousness is founded on an undefined point, a conscious entity is part of a conscious entity and holds a conscious entity inside. The eighth ability is an additional feature of the undefinedness of a conscious entity.

### 5.3. Twelve different ways of making decisions:

#### 5.3.1. How could we make unprecedented classes of AGI computers that yet to be invented:

Currently, we find a logic-based decision-making culture that started thousands of years back (Ganeri, 2001, The modern study of classical Indian systems of logic began with H. T. Colebrook's "discovery" of the Vedic syllogism (Ganeri, 1996) - a schema for correct reasoning as described in the early Indian texts. The report of his discovery to the Royal Asiatic Society in 1824 led to a flurry of interest in Indian logic in the next thirty years, attracting the attention of even the best logicians of the time, people like Boole and De Morgan). For thousands of years, Indian scholars used to travel as a team, length and breadth of the Indian subcontinent to challenge other scholars in argument and defeat them. However, only the simplest form of logical argument invented by Pingala in 600BC went to the west; the other primary sources failed to grow interest among western scholars. One example is the "doctrine of doubt" (Butzenberger, 1996). Three thousand years back, Vedic monks found 12 kinds of computing architecture of the confusion-finest invention of Vedic scholars. Readers could imagine if Pingala's 600BC binary logic could transform world civilization and how much technological potential other decision-making systems could hold.

Thus far, humans referred to common intuitions, imaginations, emotions and beliefs as logic and framed machines operated by computers to follow those instructions. By confusing users with intended errors and fluctuations, amusing them by enormous hidden choices and layered options, and finding common rules by fitting astronomical case studies with intuitive choices, human-like intelligence has been faked in machines. Choosing one among many given options was named as making decisions, wherein even protocols to make choices are given strictly. True forms of beyond Turing computing, non-von-Neumann and hypercomputing do not exist; if a state is defined, it could be emulated by a Turing machine.

In Vedic philosophy, twelve distinct routes of making decisions have been debated as part of religious practices for thousands of years. We have summarized them in [Figure 2](#). All twelve routes are anti-thesis of Turing culture that is derivative of Pingala's vision. It is strongly believed that all events happening in the universe could be rewritten as a sequence of simple question-answer systems, whose answer would be "yes" or "no."

### **5.3.2. Twelve different routes of making a decision where facts or information does not matter: 12 anti-thesis of Turing computing**

The first route is building **architecture of confusion, AOC**: Instead of finding facts, search for confusion in a problem. Confusion is defined by Maharshi Gautama as a contradictory outcome sensed by us. Multiple sources deliver a singular outcome, where, if we try to find constituents of the outcome, then we would find each constituent has contradictory possibilities; that outcome would be confusion. In this decision-making protocol, a user finds confusions inside a confusion continuously until he reaches facts. The fractal-like hierarchical architecture of confusion thus derived is the solution to the problem (see the doctrine of the doubt for details).

The second route is **neither-nor architecture; NNA**: Instead of finding facts, find a set of observations or truths whose statistical dominance could be falsified by finding a subset of that observation set. The process continues until we reach facts and known truth, and no observation is left to falsify. In ancient times, it was called neti-neti practice.

The third route is **SRT deconstruction**: Instead of asking questions like who? What? When/where? How? A set of transformations is classified into three domains, which variables bind and attract (T), which variables transform (R) and which variables create an endless chain of events yet get affected by its consequences (S). Then, we take each set and find the SRT classification inside. The journey continues until some of the 23 designated elements are found that constitute the universe. Since the early-Vedic era, the number of fundamental elements where the decisions would converge has been debated strongly over the millennia.

The fourth route is **Prime decomposition of the whole, PDW**: Instead of using experience learned principles embedded in our logical sense to analyze spatio-temporal events, a universal primary significance catalog is used. So, detect periodic events in any observations (Rita), identify relative relations and find C2, C3, C5, C7.....C47 symmetries and their physical significance. Scholars developed these universal invariants and were compiled over generations, and different schools debated them over centuries to find an explanation of an event without asking any questions (see M12). This protocol was extremely controversial among scholars and, due to magical decision-making, extremely popular among the masses.

The fifth route is a **projection to infinity and feedback from infinity, PIFI**: Observations of a particular spatio-temporal event around us are repeated with little changes, and an infinite series is created from the repeated observations. In this decision-making method, only minute changes are noticed for a long time until the pattern of changes is understood. Then, 108 forms of feedback database are matched to find the feedback from infinity (see M2) of that particular infinite series of observations. The philosophical argument is that the triplet of triplet of 12 fundamental transformations is sufficient to catalog all possible feedbacks from infinity. The argument sounds like variations of a specific spatio-temporal event may be infinite, but all variations are eventually limited to a finite number of symmetry breakings.

The sixth route is **continued geometric architecture, CGA**: In this method of decision making, an effort is made to convert all constituent sub-events embedded in a major event to transform so that they happen periodically as part of a global event. We have to do that at every layer. Therefore, globalization of local events by making minor changes in the variables so that the events happen repeatedly is the initial preparation to make a decision. Once the transformations are identified, those changes are repeated to expand the information structure. Say, if a 3D arrangement of clocks or periodic events forms the information structure, then geometric shapes made of clocks are identified for converting an event such that it would repeat continuously, as a mode of predicting the future is found in terms of geometric shapes, that geometric shape network is the solution of the problem. Thus, a decision is made in the continued quest for finding the missing link.

The seventh route is an **addition to complete a superset, ACS**: One of the easiest routes to make decisions is to find the similarity between events and keep only the similar ones, collect all such events and classify them; a hierarchical network of groups helps in retrieving conditionally connected variables that create a network of invariants, a network of coexisting network of variables, the correlation between dark logic of singularity and the bright logic of light in the energy bursts reveal two orthogonal aspects of an event. Orthogonal does not mean opposite; rather, from one dimension, it is not possible to sense, evaluate or edit the expressions of other dimensions.

The eighth route is **continued complete lensing, CCL**: Identifying singularity is a brilliant way to find where there would be no solution. Neither singularity means zero, nor does it mean infinity; it is just arbitrary fluctuations. At certain conditions, singularity conditions act like a lens to zoom higher or lower dimension projections. Thus, a better invariant is found; the process of zooming beyond the current real world and focusing on the imaginary world is lensing and derived projections are the solution to the problem.

The ninth route is the **continued creation-destruction (pralay) cycle, CPC**: The life cycle of SOMU could also be a decision-making process. When we experience spatio-temporal events, we identify the SRT units and isolate them into a large statistical database of undefined points. Then, slowly isolate T, R and S. In the end, R is born, and the recreation of SOMU continues. Therefore, we could construct a life cycle of any unknown event.

The tenth route is **unified morphogenesis architecture, UMA**: Spatio-temporal events are made of two variables, space and time. If we find the geometric shape changes in the spatio-temporal events, we find invariants called morphogenesis. Thus far, fifteen morphogenesis patterns have been documented (see M10). One of the key features of morphogenesis is that when we register spatio-temporal events in our cognitive experiences, if we forget the intricate details globally, we see morphogenesis patterns. Moreover, if we note a few steps, we can predict the rest events.

The eleventh route is the **nested geometric phase, NGP**: In this method of decision-making, instead of the nature of the spatio-temporal event, only the time delay between different events is noted; often, it is called "**muhurta**" or moments of positive and negative actions set by the universe. The entire information structure becomes an architecture of a time gap or phase. Why, what, where, how, nothing is important, only delay.

The twelfth route is **dimensional invariance architecture, DIA**: Instead of reading the events and finding the invariants or conserved laws by implementing the prescribed formulae, an archive created by space-time-topology-prime, STTs metric lists what parameters to look for to acquire information related to a higher dimension.

Vedic schools used to teach kids twelve routes as part of their daily life, and our objective has been to convert these tools into a set of technologies. All twelve routes could be used to build the hardware architecture of a distinct computer, and a conscious machine could implement all. In our fractal information theory, FIT ([Agrawal, 2016b, 2018](#)), polyatomic time crystals or 3D spatial assembly of clocks are used to find invariants or letters of nature's language as geometric musical language, GML ([Dynamics 3](#)). The GML is directly adopted from the Vedic concept "Rita" and "Loka," where "Rita" suggests every event in the universe occurs in a loop, or everything is periodic. While "Loka" refers to a protocol where every single periodic universe is made of points, each point holds a universe inside. Together, they suggest a "within and above" network of clocks. Vedic music and dance schools use complex spatio-temporal patterns to implement the metric of primes ([Amatzia Bar-Yosef, \(2001\)](#)).

#### 5.4. Architecture of confusion: Doctrine of doubt:

#### 5.4.1. How to find confusion?

Maharshi Gautama describes eight ways to identify confusion; these situations were programmed to build 3D clock assembly or polyatomic time crystal as input for operating the artificial brain (see Dynamics 3). In Figure 3A, we have outlined eight routes. **First signature:** when a single source event leads to contradictory perceptions and emotional responses, logical relationships between the source and each perception/emotion are unfound. **Second signature:** when a very well-defined explicit mental state is generated in the mind from totally uncorrelated perceptions and emotions, or many possible sources at a time, no relationship is found among those perceptions. **Third signature:** When a particular conscious thought evolves in the mind following a well-defined path but eventually reaches the same thought where it started. **Fourth signature:** In the doctrine of doubt, an opposite to truth is not confusion because both coexist in a system; however, if we try to reverse the conclusion made in thought and do not reach the other side of the truth, then there is a confusion. **Fifth signature:** When we find many sources and many destinations of thoughts coexist at one common point that links the initial conditions and the outcome. **Sixth signature:** When faith is related to reality, however, no sequence of thoughts connects to reality if one wants to journey from faith to reality and vice versa. **Seventh signature:** There is morphogenesis of a particular perception or emotion, the same thought could be rearranged in different configurations, yet they provide the same perception or emotion. **Eighth signature:** When perceptions of desire, drive and consequence have an identical form.

In the doctrine of doubt, the fact holds the mind to a state where decision-making should end, so it is a boundary point. Suppose we follow the prescription of mimangsa (mimangsa = solution of the architecture of confusion; noted below in Figure 3A). In that case, a fact is a statement that measures weight-sharing between positive and negative relations, multi-sensory perceptions of presence registered by any of the six sensors, and repeated confirmation of the existence. This key matches the missing link, absence or missing of an order, reciprocal or contradictory relation to a continued event, impossible or possible event or value accepted by all without a debate.

#### 5.4.2. The statement of the architecture of confusion:

Figure 3B shows that to solve a problem: a user has to find confusion. If one finds confusion, enter inside & find two more confusions, those confusions will relate to the other side of the truth. Then, in each confusion, find 3 more confusions from the space, time, and person perspectives. A continuous journey through confusion builds an architecture of confusion, and the journey ends only when the user encounters facts. So, edge points are all facts at the bottom layer of the architecture of confusion. The architecture of confusion is the solution to the problem we do not know about. The journey through confusion creates an invisible geometric architecture that represents loops or periodic events or variables; the conical shape projects the invariants. Thus, the Turing world needs facts; SOMU's fractal computing feeds on confusion, the geometry of confusion solves undefined problems with no pre-data, and interpretation always reviews and updates the archive (M2-M12). When big data changes rapidly, we do not get time to understand the nature of the problem, so we create an architecture of confusion that tells us how to approach a problem.

### **The historical background of the architecture of confusion, AOC used in developing EEG/DDG analyzing algorithm:**

Logical decision-making explored by Indian scholars for over 3000 years of documented history investigated 16 distinct routes of decision-making. We concentrate only on one school, "doctrine of doubt," since it is the closest philosophical debate to our gel's decision-making. The 528 hymns compiled by Aksapada Gautama, around 550BC, define doubts or confusion so precisely that mathematical equation is easy to build (Jha, 1999).

Samana-aneka-dharma-upapatteh vipratipatteh upalabdhi-anupalabdhi-avya-vasthatah cha visesa-apeksah vimarsah samsayah, — Nyaya-sutra - 1.1.23.

Meaning: A confusion is especially conflicting (vimarshaha) expectations of multiple coexisting properties (samana-aneka-dharma), when foliated from within (viprati-pattheha), and when foliated from above (upa-pattheha), (pattheha = foliated = unfolding like onion leaves), wherein some expectations are perceptive, some non-perceptive (upalabdhi).

Jaimini wrote in Mimangsa, "every event, its knowledge & decisions in the universe are cyclic or rhythmic (britta = circle = spatio-temporal-topologico-primal)". It's similar to "Rita" (Rita is  $\Psi = e^{il\Phi}$ ,  $l$  is angular momentum,  $\Phi$  is rotation phase, (Dynamics 1)), the fundamental property of the universe that converts every set of correlated linear events into a closed loop (noted in Rik Vedas 390 times). Ancient Vedic scholars working on decision-making were so obsessed with "Rita" for 2500 years that they introduced the concept of "Loka." Loka means universe, but it presents the universe like a circle, whose smallest pixel is also a circle (diameter =  $d$  = time) but a gate to the inner "Loka" (sukshma-Loka,  $\Delta d_s$ ). The largest circle of the present universe is the smallest circle of the higher Loka (deva-Loka,  $\Delta d_d$ ). Periodic events of a given universe  $p$  are nested between the two  $\Delta d_d \geq \Delta d_p \geq \Delta d_s$ .

In the Jaimini hypothesis, the physical universe of reality is a tiny part of an endless chain of universes within and above. Loka is not a dimension, not an isolated universe; from one Loka, one cannot sense or measure other Lokas, so it is not the straightforward multiverses we know in quantum mechanical depictions of our universe. Dimensions are orthogonal axes to each other; similarly, Loka is undefined but orthogonal to each other. Where did they apply this chain of universes concept? Everywhere! A scholar Ganita used the chain of Loka or universes to create the concept of nested Kalachakra (time cycle). Another scholar Gautama used the same chain of Loka or universes to build the architecture of reasons (architecture of confusion). Some scholars like Kapil created nested life forms (Viratapurusha = the highest life form). Gautama's doctrine of doubt (~500 BC), later endorsed by Sankaracharya in 700 AD, is a closed loop with a finite number of confusions. So, logic is inherently circular in the Indian doctrine (Britta = circular logic). The architecture of confusion is a 3D structure of loops that could reside on top of the 2D architecture of facts. The doctrine of doubt (Klaus Butzenberger, 1996), is based on 2500 years of intensely argued scholarly articles by rival schools. Its foundation lies in arranging 3D loops of confusions since events or confusions are cycles of time (Kalachakra), from 0.3 microseconds (=truti) to  $10^{22}$  years (=1 brahma). Too courageous to note precisely the temporal limits of Loka in a short scale of time. The architecture of confusion is a way to find the solution when a human becomes free from attraction to nature (mohamukti, attaining moksha, or discretization of the localized cluster of clocks of the

universe provided by limited body sensors (seeing Purusha or the life-like forms of the chain of universes by filtering Prakriti, the form of universes created by various kinds of sensors of fields).

We have drawn a cartoon in **Figure 3B** that binary logic developed in 200BC by Pingala (Chhanda-shastra = the science of rhythms), at the bottom layer and higher layers are created following Gautama's confusion architecture with Vigyana-vikshu's journey through undefined routes. The concept of people's study of big data using a lens represents J. A. Wheeler's "it from bit" (**Wheeler, 1989**)

In light rings or vortices, electric and magnetic vectors rotate, representing a periodic event. A longer period means a bigger light-ring diameter, i.e., more topological charge, so light rings are a good tool to read periodic events. When intensity is homogeneous all over the light ring, it is an event; everywhere defined, it is a fact. When two light rings or vortices interfere, we get a dark spot, a quantum optical version of Gautama's confusion. Various ways of forming confusion are described in section 1.3.1, and we could generate phase singularities or dark spots on the light ring converted into a 3D optical vortex sphere by adding three angular momenta to a photon (**Dynamics 1**). Followers of Naya shastra did brilliant work; we have shown it in **Figure 3C**. One may think that different observers looking into a particular problem would consider different concepts as starting confusion or the most profound confusion. However, there is a method of symmetry operations in building AOC; the geometric arrangement of confusions or phase singularities is not a random process. We have compiled all debated recommendations in the metric archive (**Mohanty, 1970**).

#### **Implementation of AOC in extracting polyatomic time crystal from any input data:**

Once input data is converted into a 3D assembly of clocks or polyatomic time crystal (see **Dynamics 3**), the phase singularity regions (phase singularity = confusion) where periodic changes in object motions in the 3D space are intricately mapped into the clock network. Therefore, each element in the network of AOC in **Figure 3B** and **Figure 3C** are polyatomic time crystals derived from any form of input data.

## **6. Basic concepts of Space-time-topology-prime metric**

### **6.1 Essential tools to build a self-operating human brain model**

#### **6.1.1. A Self-operating mathematical universe, SOMU is the engineering of points, and primes:**

If we know how the universe integrates symmetries, breaks symmetries and builds new symmetries, only then can an automaton discover conservation laws and expand them to build something new on its own. However, an automaton needs an astronomically large source of unique symmetries; what else but primes could deliver that. All primes have similar divisors, one and the number itself. However, due to their position in the integral space, they affect the integer formation distinctly. The position gives a prime fundamental identity. If a prime number represents symmetry, then an integer is a composition of symmetries. All

compositions of divisors in an integer hold unique self-similarities and differences in divisors. In the world around us, we see elementary atoms building astronomical compositions. However, atoms are limited in number, but the primes are not. The number of compositions of primes in an integer estimates the total number of variants it can coexist. By drawing one-to-one correspondence between atoms and primes, we open the door to use the pattern of primes as the most fundamental code of nature wherefrom everything else is derived. We do not reach or assume mass directly; the pattern of primes gives elementary paths that make geometric shapes, and metrics add clocks as they normalize (see Metrics, M4, M6). Following the synthesis of the spatio-temporal architecture of clocks by metrics, the density of clocks reaches a critical value such that the density of singularity domains allows only very large diameter clocks to integrate. This structure is mass.

### **6.1.2. The importance of normalization: Birth of adaptation, evolution, self-replication and emulation:**

**Figure 4A** describes the primary condition to frame the architecture of SOMU. A point cannot have anything other than the probability of having something, and the universe contains all possibilities. So, to have a universe in a point, it should have all possibilities coexisting at a time, so it should be an undefined point. Therefore, we state that all we want to do to create SOMU is to make a point an undefined entity while preserving that it is a point. Self-operating mathematical universe, SOMU, wherein a dimension-less point is the only constituent. SOMU creates itself while becoming an undefined entity by putting all possible numbers of points inside a point. As the prime number of points arrange in all possible patterns, the density of primes normalizes the pattern (M4, M6), ensuring that the entire architecture remains inside a point. This single step alone derives clocks, motions, dynamics, simultaneity, morphogenesis, time, space, mass and conserved entities like adaptation, evolution, self-replication, emulation etc. SOMU does not require any assumption; with the simplest operation, it derives the information structure for self-decision making. We consider an event as a point and transform that point into an undefined entity by putting many identical points ( $N=1,2,3,\dots$ ) inside that point in all possible combinations and normalizing all choices. Justifying undefinedness creates a self-operating mathematical universe, SOMU. Counting integers ( $n \rightarrow n + 1$ ) drives SOMU.

**6.1.3. The Triplet of triplet forms naturally in the ordered factor metric, and it is the core skeleton of SOMU triplet, a conscious engine:** **Figure 4B** shows that while transforming a point undefined, the number of primes involved in building a composition forms a group. Ordering a set of primes forming composition in all possible ways make isomorphs, so we create a geometric class since constituent points coexist in a geometric shape. Geometric shape assists in writing properties of primes used in constituting integers. Relating primes with a geometric shape is beneficial for two reasons. Symmetry is closely related to a geometric shape, so associating symmetry with a prime is justified. Secondly, when primes multiply to create non-prime integers, geometric shapes integrate to build new structures, allowing us to mathematically encode time as changes in geometric shapes or space or morphogenesis, mass as the coexistence of several geometric shapes at a time. Therefore, by looking into the pattern that primes follow to build integers and finding invariants or conserved laws in this integer construction process, we could create space, time, mass and various dynamics that we need to build a self-operating mathematical universe, SOMU. **Figure 4B** shows the smallest

triplet of triplets naturally forming in the ordered factor metric (detailed M11). The whole universal network of SOMU grows within and above; as soon as a triplet is reached, the saturation begins.

## 6.2. The principles of making a hardware that implements SOMU

**6.2.1. Spiral of a spiral of a spiral, three angular momenta orthogonal to each other govern dynamics of all constituents of SOMU:** Two conditions are essential and sufficient to create forces, mass and energy, every single entity we sense. The first part of the condition to make a point undefined allows bringing in an infinite source of primes or integers. In the second part of that condition, preserving the property of a prime means normalizing the distribution of probabilities and arrangement choices of primes. **Figure 4C** suggests that normalizing also means simply rotating the structure made of choices by  $360^\circ$ . Furthermore, the first loop forms on the ordered factor metric at number 12. Therefore, 12 is the most important number in SOMU and its formulation of the consciousness platform. We can see the formation of a teardrop in **Figure 4C**. Since we pack repeating patterns within a circle to do normalization  $n \rightarrow n + 1$ , the operation generates clock-wise and anti-clockwise rotations (**Dynamics 7**). It leads to a spiral of a spiral of a spiral motion, which defines pathways for all distinct systems created by SOMU. There is no linear, circular or angular motion in SOMU; it is a nested network of spirals formed by generalizing Panchratnam's geometric phase (**Richerme et al., 2013; Lauber et al. 1994**). The dynamic phase in SOMU is an imprint of the nested world lines.

Three angular momenta of all vortices that process through hardware: 3D vortex as 12 entangled quantum states

Three angular momenta ( $\vartheta, \phi, \omega$ ) orthogonal to each other represent all kinds of vortices used to build an artificial brain (**Dynamics 1**). It has been experimentally observed that the brain operates using electrical, electromagnetic, magnetic and mechanical vortices or 3D geometric arrangement of field lines. Adding three momenta  $\theta, \phi, \omega$  to one photon opens the door to creating virtual molecules composed of three geometric phases arising from representative hardware, i.e., vibrating fibers. For its spiral motion, the azimuthal index  $\ell$ , represents the number of cycles of the  $2\pi$  phase developed around the circumference to deliver an orbital angular momentum of  $\ell\hbar$  per photon. Azimuthal angular momentum is a scalar entity  $\Psi(\theta) = \text{Cos}\theta + i\text{Sin}\theta$ . The larger the light ring (or vortex), the greater is the momentum. Two orthogonal rotations require a vector element  $\Psi(\theta, \phi) = \text{Cos}\theta + e^{i\phi}\text{Sin}\theta$  where the greater the number of dark spots, the larger the momentum (**Dynamics 1**).

**6.2.2. The singular operation of SOMU hardware:** **Figure 4D** shows how SRT operators are implemented in SOMU using the DNP operator or three angular momenta of vortices. First, points or 3D clock assembly acting as invariants are decomposed and expanded. This step is called decomposition, D, and the angular momentum that memorizes the composition of points is  $\theta$ ; then, these units of vortices create areal invariants by acquiring an orthogonal angular momentum,  $\phi$ , these elements with two angular momenta arrange on a 3D Euclidean surface, thus, acquiring a third angular momentum,  $\omega$ . Therefore, we get projection to infinity with three angular momenta, or S operator (D=T, bonding of points; N=R, the transformation of lines; P=S, projection to infinity for all loops to build a 3D sphere.

Figure 4E summarizes how a point converts into a circle using a vortex; thus, undefined-ness, the primary requirement for constructing a SOMU, is achieved physically in hardware, and we could execute the operation  $n \rightarrow n + 1$ . A “point” is, therefore, an information structure following three rotational motions, as described in Figure 4F. During normalization, as described in Figure 4C, three dynamic phases govern the hardware growth of SOMU: a clockwise spiral, a superposition of an anticlockwise and a clockwise rotation and finally, the third and the last, clockwise rotation (Dynamics 7). These three steps are the most fundamental dynamic phases of SOMU hardware, like a biological or human brain. We have compiled the detailed triplet rotations in Metric 2, M2 to apply all ordered factor compositions of M11 so that the entire morphogenesis metric M10 is derived.

## 6.3 How metrics govern the formation of self-operating hardware: a biological human brain and an artificial brain

### 6.3.1. Three types of generic phase prime metric plot (Dynamics 10): exploring the density of primes using two distinct classes of metrics

Figure 5A details how three different metrics could generate naturally in the hardware representing S, R and T. Three architectures of confusion AOCs representing S, R and T, AOC1 binds geometric shapes, so it represents T, AOC2 shows that a triangle turns into a square, so, it represents R. Finally, AOC3 shows a projection of the infinite series of the geometric shapes. How does the projection is generated? The flat plane of facts in Figure 3B changes when infinity is shifted (see M2). Three independent information architectures are generated in the same hardware. In the ordered factor metric, 12 bands help create triplet morphs of a single information structure ( $12 = 2 \times 2 \times 3$  or  $2 \times 3 \times 2$  or  $3 \times 2 \times 2$ , a triplet holds memory as it has a shape). Therefore, as resonators vibrate and build polyatomic time crystal or 3D assembly of clocks, in an assembly of available free resonators, the assembly of clocks starts evolving as resonators self-assemble. During growth, the seed assembly of resonators acquires C2, C3, C5, C7, C11.....C41, C43, and C47 symmetries. Due to the ordered factor of integers, the arrangement could be different, so multiple metrics could form (see M11). Therefore, creating three phase prime metric, PPM (Dynamics 2), representing three AOCs is practically feasible (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, 2021b).

It is important to note that the growth of PPM, AOC and SRT evolution of information structure or polyatomic time crystal (3D clock-assembly) are all the same. One of the finest features of developing a purely mathematical model is that no physical significance is attached to the mathematical structures. Below in Figure 5B, we describe how a conscious or self-aware machine is designed under the framework of SOMU.

### 6.3.2. A closed loop between Dimensional metric and metric of integers creates a self-aware or conscious machine under the SOMU framework

In Figure 5B, there are two types of metrics, one where we use integers, but integers represent dimensions. Say we get 12D, and we get 2D, and 3D elements could contribute to 12D because  $12=2 \times 2 \times 3$ . These two metrics generate a feedback loop. One’s output is the other’s input. When we want to create a metric, the horizontal axis is an integer, and the vertical axis is the

number of compositions or grouping of choices for that particular integral number. Now, one good thing about mathematics is that we could build the mathematical framework and then significantly different physical significance could be attached to it. We have assigned integers as dimensions, so when we arrange the dimensions by simply calculating the ordered factor of a particular integer (now dimension), the number of compositions tells us the decomposition of tensors (see M7). In one metric, integer represents dimensions estimating how worlds at different dimensions which cannot sense each other link and shares information, and the other, integer represents the number of clocks, angles of a geometric shape or simply symmetry, then, together they represent projection to infinity (S of SRT) machine that generates infinite series to projection and then projection to infinite series once again.

While [Figure 5A](#) suggests that in a soup of resonators, SRT triplet metrics would be born that would create a self-feeding loop where projection from one metric feed all three metrics, but only one missing feature is taken care of in [Figure 5B](#). The reason that we need the dimensional metric as a must element to build a self-aware or a conscious machine is three-fold. First, all information units, polyatomic time crystals, or 3D clock assemblies are generated in different layers by going to one higher dimension (equation 3) because SOMU and biological or artificial brain components are so chosen that they extract the invariant from datasets of lower dimensions. Therefore, only invariants in the entire SOMU or self-operating machines are spread over multiple dimensions. Therefore, without a dimensional metric that filters, integrates and thus extracts the eventual SRT superposition, a self-aware machine would not run.

We have explained the self-aware machine in terms of helical nanowires of artificial organic jelly or biological helical nanowires, like DNA, alfa-helices, microtubules etc., in [Figure 6](#). In [Figure 6A](#), an organic solution filled with oligomer molecules spontaneously self-assembles into a superstructure satisfying an ordered factor metric (M11). One important note here is that the organic superstructure evolves as three metrics, and metric-generated polyatomic time crystals feed energy to the solution continuously ([Bandyopadhyay et al., 2009](#); [Ghosh et al., 2014a, 2015, 2016b](#); [Bandyopadhyay, 2020](#)). Three close cycle loops are shown here. [Figure 6B](#), which replicates the event described in [Figure 5A](#), shows that SRT triplet polyatomic time crystals are linked by  $e - \pi - \phi$  quadratic relation. This is a direct application of M6 described below ([Dynamics 8](#)). In reality, all polyatomic time crystals are vortices, 3D distributions of fields. As a result, integrated magnetic, mechanical and electromagnetic vortex combination or composition ([Dynamics 11](#); [Metric 12, M12](#)) is the superposition of SRT triplets. So, a quadratic coupling is essential. In [Figure 6C](#), we have shown another realistic picture of the SRT polyatomic time crystal, a “within and above” network of SRT. We could zoom any singular phase neutrality only to find an endless hierarchical network of polyatomic time crystals. Since confusion means a composition of geometries, any geometric shape triangle would be a fact.

## 6.4. Electromagnetic resonance of proteins to intricate modeling of the whole brain:

### 6.4.1. Resonance band to polyatomic time crystals:

The electromagnetic resonance of proteins has been known since the 1930s. However, no one looked into the field propagating in a loop on the resonating structure. It shifts resonance peaks periodically, like a clock. Several such clocks retain a particular geometric shape similar to an invariant or conservation laws of nature. This is not a simple resonance band or resonant energy transfer that we find abundantly in the literature. It is the coupling of resonance peaks with a common phase shift. Imagine if one pulse represents a  $360^\circ$  phase change. The relative intensities periodically depict another  $360^\circ$  phase loop, and periodic phase shift around fixed phase values for a resonance peak provides another  $360^\circ$  phase loop. Thus, three geometric phases govern the resonance band dynamics for protein, filaments, and neuron structures (Saxena et al., 2020). In tubulin proteins, microtubules, and neurons, we found that  $10^8$  orders of spatial change hold  $10^9$  orders of temporal variations as a 3D assembly of clocks called polyatomic time crystal, a concept derived in the 1960s (Saxena et al., 2022). The most shocking observation was a scale-free triplet of triplet resonance bands holding similar geometric invariants (Saxena et al., 2020). Nesting of the prime number of resonance peaks, but why and how?

#### **6.4.2. Electric, magnetic and mechanical resonances: Challenging the Hodgkin-Huxley**

Vortex shape ensures the coexistence of electromagnetic (Kobayashi and Martin, 2019), magnetic (Jedamzik and Pogolian, 2020), and mechanical vibrations (Mukherjee et al., 2020) even at the very origin of the universe. Our journey to this unprecedented engineering vision of nature started when we found that microtubule creates electrical vortices, magnetic vortices and mechanical vortices (Singh et al., 2021c; Wang et al., 2021), and their frequencies are connected by three fundamental constants,  $e$ ,  $\pi$  and  $\phi$  we felt, the observation could not be an accident (Agrawal et al., 2016a,b; Ghosh et al., 2016). Sound could travel in the way light does. Electromagnetic resonance regulates three distinct resonances using a mathematical identity,  $e^2 + \phi^2 = \pi^2$  seeks a geometry-less control on vibrational modes. We have shown that in a repeated set of experiments, the membrane cannot manage the time gap between nerve spikes without filaments and filamentary bundles organizing a pair of vortices to control the precise timing of ion-channel release; precise time modulation is fundamental to human cognition, firing alone is not (Ghosh et al., 2022; Singh et al., 2020b, 2021 d, e, f; Saxena et al., 2020).

Then, we looked at the distribution of electromagnetic resonance frequencies of microtubules, proteins and neurons, and it took five years (2011-2015) to find that ratio of frequencies is related to primes (Agrawal et al., 2016 a, b; Ghosh et al., 2016). We concluded that nature engineers' prime numbers and coupling of resonance frequencies resemble the ordering of primes in the same way primes construct integers. Thus, electromagnetic resonance frequencies have a scale-free feature, and invariants like primes regulate the choice of frequencies. Two factors reveal information structure and integration principles used by biological systems. The 3D assembly of clocks or time crystal-based architectures model biosystems properly, and we extrapolated that experimental observation to the whole brain (Singh P. et al. 2020a).

**6.4.3. Resonance chain in proteins:** Resonance frequencies arranged in a geometric shape could forever change how we look into biological systems (Saxena, K. et al., 2020). Signal transmission is unimportant; an invariant network's self-evolution requires carrier

redistribution, which is mistaken for signal transmission. Since the 1940s, it has been quite well established that periodic events are arranged to hold the intelligence of complex instances of events in a random dataset. Finding recurrent events is not enough. We needed to put them together in a pattern, and that research work was missing. Inspired by nested clock architectures, found in the proteins, microtubules, and neurons (Singh et al., 2021f), we proposed a new information theory, namely Fractal Information Theory, FIT (Agrawal, 2016b, 2018). Here, an event is a periodic change in the phase of a particular entity, represented by a circle embedded on a phase sphere to include three angular momenta (Dynamics 1). Three kinds of phase singularities on the perimeter of the circles allow embedding (putting inside), bonding, and inserting (coupling) new circles. So, 3D clock assemblies are clocks placed in a 3D space with a spatial gap, so a spatio-temporal pattern makes a hierarchical assembly of clocks. Surprisingly, no one in the world talks about nature's writing of geometric shapes using resonance frequencies. Resonance frequencies generate a pattern in the dancing matter, but that is not everything; those frequencies are patterns of primes.

## 6.5. Global database of complete brain simulation ([www.brainrhythm.org](http://www.brainrhythm.org)):

### 6.5.1. The basic concept of the new brain model:

We have been developing a brain model for over a decade (Bandyopadhyay, 2009 a, b; Ghosh et al., 2014a,b; Reddy et al., 2018; Singh et al., 2020a). Our model includes all components in the brain-body neural network. All brain components are made of cavity resonators and dielectric resonators (Singh et al., 2019). Once we solved Maxwell's equations for identifying resonance bands for all brain components, we made an artificial replica 10-100 times larger and verified if the ratios of frequencies obtained by theory matched the experiment when we built an artificial brain by constructing each component using resonators (Singh et al., 2019; Singh et al., 2018 a,b, c; 2019; 2021f; 2022 a, b, c). Then, that knowledge was used to modify the brain hardware. Our database ([www.brainrhythm.org](http://www.brainrhythm.org)) contains all brain components and their simulation results, which readers can freely download. We have emphasized those brain components, which demonstrate triplet of triplet clock architectures, as shown in Figure 7 (Saxena et al., 2020). Twelve components have been identified in the brain-body network, and complex clock architecture is built upon that model.

The brain model under the SOMU framework is a structure of clocks, integrated from the smallest to the largest, within and above (Singh et al., 2020a). It has the structure of matter, too; both structures, made of matter and clocks, try to match each other from birth to death by exchanging vortices of various kinds. 3D assembly of clocks is a 3D assembly of vortices. Turing machine emulates, it copies a solution path, faster, with fewer resources. A brain is a fractal machine that stores all possible symmetries and their all-possible dynamic changes. So, it matches unknown symmetries' composition and expands them to synchronize with the universal metric or an ideal grammar book that links all symmetries (M1-M12). Therefore, a fractal machine does not require man-made instruction or code, an astronomically large, in principle, endless chain of guidelines is available. Invent composition and network of invariants

starting from 30 elementary invariants already provided by the universe to match the metric is how the universe runs or a human brain operates (M12). A conscious machine-like brain collects invariants from nature. It fits with the internal 30 invariants to learn the network that should be placed at the proper location on the metric or grammar book, letting it evolve perpetually. A brain or conscious machine is part of the whole universe; nature made conscious forms to see itself.

### 6.5.2. Prime numbers in the human brain model and radiations from the brain:

The scale-free triplet of triplet resonance band in the brain shown in **Figure 7** that we observed long back haunted us (Ghosh et al., 2014a; Saxena et al., 2020); why nature is integrating the phases of a few prime numbers of resonance peaks into one broad resonance peak to process its signals. Several years later, we found the answer. If we take integers and find all possible prime compositions, we find a mathematical 3D architecture, a triplet of triplets, similar to that we got earlier in the biological structures. Mathematics is unbiased. It does not have any physical significance, yet it delivers the same triplet of triplet as the brain (Ghosh et al., 2014 a, b; Saxena et al., 2020). Here, we provide below evidences measured on over 200 humans; Hz, kHz, MHz, GHz, and THz emissions are related to emotional and cognitive states of the brain. The striking similarity of the two widely different study subjects, biophysics and pure mathematics, inspired us to explore whether the human brain or the self-operating universe is a prime factorization machine. We found that 15 primes (2,3,5,7,11,13,17,19,23,29,31,37,41,43,47) are there all over the brain, and a metric of primes is the core driving engine for the human brain and a self-aware machine (Reddy et al., 2018). There are seven layers of a cortical column, 31 spinal cords, 47 Brodmann's regions in the cortex, and 13 protofilaments of microtubules, and the examples are endless (Bandyopadhyay, 2020). In our recent book, we have listed the statistics of primes in the brain (Singh et al., 2022a). We simulated the resonance spectrum of the brain components theoretically to find the direction of energy flow in the clocks (see [www.brainrhythm.org](http://www.brainrhythm.org) database for row data). We discovered that brain components' cavities and shapes are designed to generate vortices of ions, molecules, and electric or magnetic fields projected within and above. The prime number of cavities helps to emulate any complex natural signal because only four primes (2,3,5,7) could generate 86% of all integers in the number system. The rest, 14% is never covered.

The fourth row in **Figure 7** maps a human brain as a space-time-topology-prime STts metric. We reported counting primes in a 3D clock arrangement to build an artificial brain (Reddy et al., 2018), the metric evolved over time (Bandyopadhyay, 2020). Finally, we reported the operational protocols for space-time-topology-prime (STts) metric (Singh et al., 2021 a, b). Since this report is about experimental validation of SOMU, we revisit the entire journey briefly below.

Here the metric measures distance in symmetry; for self-assembly of systems within and above, we could measure the differential space  $ds^2(h_3)$ , differential time  $dt^2(h_{1,2})$ , differential topology  $dT^2(h_5)$  and finally, differential symmetry in the density of primes  $dS^2(h_7)$ . Here the combinations of dual (either S or t), triple (either S, t or T) and quad features (S, T, t and s) are:

Space-time  $st(h_3, h_{1,2})$ , with 3+1 or 2=5 or 6 dimensions; Space-topology  $sT(h_3, h_5)$ , with 3+5=8 dimensions; time-symmetry  $tS(h_{1,2}, h_7)$ , with (1 or 2) + 7 = (8 or 9) dimensions; topology-symmetry  $TS(h_5, h_7)$ , with 5+7=12 dimensions;  $stST(h_3, h_{1,2}, h_5, h_7)$ , with 3+(1 or 2)+5+7=16 or 17 dimensions. Space-symmetry  $sS(h_3, h_7)$ , with 3+7=10 dimensions; Space-topology  $tT(h_{1,2}, h_5)$ , with (1 or 2) + 5 = (6 or 7) dimensions; space-symmetry-time  $sSt(h_3, h_7, h_{1,2})$  with 3+7+ 1 or 2=11 or 12 dimensions; space-time-topology  $stT(h_3, h_{1,2}, h_5)$  with 2+1 or 2+5 =8 or 9 dimensions; space-symmetry-topology  $sST(h_3, h_7, h_5)$  with 3+7+5 =15 dimensions; symmetry-time-topology  $tST(h_{1,2}, h_7, h_5)$  with (1 or 2)+7+5=13 or 14 dimensions; symmetry-space-time  $sSt(h_3, h_7, h_{1,2})$  3+7+1 or 2 = 11 or 12 dimensions.

Since icosahedron has 12 corners, for the “within-and-above” universe, we would have a maximum of 12 dimensions. Since icosahedron has 20 planes, we would have 20 dimensions when dimension means adding new dynamics. Hence,  $stST$  would be confined in one imaginary world, i.e., it would represent the projected and the feedback time crystal “to and from” the PPM (Dynamics 2) (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al., 2021a, b).

The metric representing the polyatomic time crystal in  $stST = S2T2$  universe of 12 nested worlds is given by

$$\mathcal{H} = \Delta_{PPM1}st(h_3, h_{1,2}) + \Delta_{PPM2}sT(h_3, h_5) + \Delta_{PPM3}tS(h_{1,2}, h_7) + \Delta_{PPM4}TS(h_5, h_7) + \Delta_{PPM5}sS(h_3, h_7) + \Delta_{PPM6}tT(h_{1,2}, h_5) + \Delta_{PPM7}sST(h_3, h_7, h_5) + \Delta_{PPM8}stT(h_3, h_{1,2}, h_5) + \Delta_{PPM9}tST(h_{1,2}, h_7, h_5) + \Delta_{PPM10}sSt(h_3, h_7, h_{1,2}) + \Delta_{Project-Feedback}stST(h_3, h_{1,2}, h_5, h_7).... \text{ (equation 4)}$$

One could visualize the life forms as a prime number inventing an engine trying to multiply primes stored in it and finding a missing gap with the environment’s primes when it absorbs signals from its environment. One could analyze the information processing of a life form with nature or another life form as a metric of spatial symmetries, alternately, a pure metric of time architecture, morphogenesis or simply prime numbers. The advantage of the space-time-topology-prime metric is to represent even the smallest event happening in nature in terms of primes alone. Therefore, a life form running STts metric could check the prime numbers hidden in the spatio-temporal events happening in nature and adopt them as distinct spatio-temporal dynamics. Therefore, learning something new that never existed in the hardware of a life form (Brea and Gerstner, 2016) could be the adoption of a new prime in the fourth row of Figure 7. Since the SOMU model considers the STts metric of a life form as a subset metric of nature’s STts metric, a simple representation of the entire process could be that nature creates a conscious life form to enrich itself with the dynamics of a new prime and thus continues its journey for evolving perpetually. The STts metric couples concepts of 12 dimensions. The output is a fusion of concepts, while mathematical metrics M1 to M12 deliver pure mathematical features.

### 6.5.3. Higher dimensions in the brain

Many researchers argue brain is a quantum processor. From the viewpoint of SOMU, they underestimate the brain. Quantum gives us the magic of one imaginary world, whereas the brain is a conversation of twelve and a higher number of imaginary worlds. One cannot find neurogenesis (perception of a neuron burst) even in the isolated distinct hardware of all

dimensions and even if contributions of all dimensions are put together. We have been proposing the necessity of 12 dimensions [since 2014](#). Our self-operating mathematical universe, SOMU, requires at least 12 dimensions. Furthermore, there are 12 layers of brain components, and there are only 12 components where triplet of triplet grouping of clocks are active ([Ghosh et al., 2014 a, b](#); [Saxena et al., 2020](#)). The self-awareness begins at 12 dimensions, and that processing cannot be reduced to any lower dimensions because, in fact, the phase prime metric, PPM ([Dynamics 2](#); [Dynamics 10](#)) that governs SOMU, is a network of nested dimensions ( $12=2 \times 2 \times 3$ ,  $3 \times 2 \times 2$ ,  $2 \times 3 \times 2=3$ ), the engineering of dimensions is absent in string theory or any physics theories built to date. So, we were forced to develop tensors, dodecanions and above up to icosanions as the minimum requirement to estimate complex polyatomic time crystal exchange between 12 brain components. SOMU begins where the concept of discrete dimension ends. No physics built to date lies in the composition of 1-11 dimensions (In string theory,  $8D + 4D = 12D$ , its flat addition of tensors, not a real 12D); fitting observations do not help in building the science of self-awareness; true science of consciousness is spontaneously creating real observations & perceptions from primes, hidden in the density of primes.

For the brain, it simply means, if there are 12 layers of resonators, one inside another, some resonating symmetries in a particular layer could interact through one manifold (actually manifold [\(Dynamics 9\)](#); M7), and some other symmetries of the same layer would interact with other layers using another manifold. Single 12-layer hardware, say, a brain, could have three independent processors, each operating through a distinct manifold. The mathematical operation becomes even more interesting when we learn that each one of the 12 layers of the brain has 12 layers within. It means that each layer is designed to generate a triplet of the manifold, and the whole brain is made of the triplet of triplet manifolds ([Ghosh et al., 2014 a, b](#); [Saxena et al., 2020](#)). Since each layer generates a triplet, the simplest tensor that layer uses to process information is a dodecanion. Therefore, even in the simplest scenario, a brain would operate  $12 \times 9 = 108$  distinct solution states at a time ([see Appendix I](#); [Supporting Figures S1 to S26](#)). Three distinct manifolds that deliver the final output of the brain operation could find 12 self-operating cycles within. We will explain below those three distinct manifolds are essential because after we understand pure mathematical metrics in the 10D, 11D and 12D, and reach 7D, 8D and 9D operations, we find that three dimensions exclusively looking into the morphogenesis operations have three unique features, projections to infinity, transformations and bonding of world-lines produced at the 10<sup>th</sup> dimension. Therefore, the triplet management of primes in the highest three dimensions regulates the triplet management of morphogenesis in the next three dimensions, which in turn manages the triplet management of time, which finally regulates the three dimensions of space.

Driven by a series of neuroscience and biophysics experiments, we proposed the triplet of triplet resonance chain of 12 layers ([Saxena et al. 2020](#)) to represent the human brain and a fractal tape ([Ghosh et al., 2014a](#); [Agrawal et al., 2018](#)) to replace the Turing tape. Resonance chain means groups of isolated frequencies where materials transmit or reflect maximum power with negligible resistance. Advancing the concept of resonance chain, we recently reported the world's first time-crystal model of the whole brain as a network of 537 classes of clocks arranged in 12 layers within-and-above ([Singh et al., 2020a](#); [Bandyopadhyay, 2020](#)). Twelve layers within and above mean a journey from the secondary structures of proteins to

the entire neural network of a human brain-body system. Therefore, we needed 12-dimensional complex tensors, at least, to present the simplest clock structure that represents the human brain. We searched but did not find a 12 D tensor in the literature, and we had no choice but to invent a 12 D tensor arithmetic (Singh et al., 2021a, b).

String theory considers a vibrating thread in 11 dimensions as a fundamental element to explain everything in the universe. However, since no tensor algebra was available beyond 8D, string theory used a sum of a 4D tensor and an 8D tensor coupled with a warp factor to deliver a 12D tensor's physical reality. For us, brain hardware grows in 12 layers, one within another; therefore, we had to develop higher dimensional tensors and related mathematical tools (dodecanion algebra, icosanion algebra, etc.) to find that the manifolds we get equal to or above 12D coexist in multiple choices at once (Dynamics 9); M7. Therefore, the journey of higher dimensions (applying equation 3) was never made in the true sense. Superposition of manifolds, morphogenesis of manifolds, and tensors' decomposition are three key features that never arise if we use a sum of 4D and 8D tensors to make up a 12D tensor. Our finding opened up pandora's box in higher dimension geometric algebra.

#### **6.5.4. How did we create the global brain database that led to SOMU?**

By modeling the phase shifts and oscillation periods of neurofilaments, proteins and neuron cells etc., we proposed a triplet of triplet resonance band for twelve major components of a human brain, 108 self-similar bands-composed a resonance chain (Figure 7; (Ghosh et al., 2014 a; Saxena et al., 2020). The chain operates in a language where letters are topologically assembled 3D clocks (Agrawal et al., 2016b, 2018; Bandyopadhyay et al., 2019, JP-2017-150171; WO 2019/026983). We generalized the resonance chain beyond triplet to the first fifteen primes, which enables the chain to emulate 86% of all possible vibrations in a resonator assembly. Acquiring the rest 14% is mathematically impossible. So, the simplest guest hardware, e.g., a brain encoded by 15 primes, could emulate the most complex host hardware, e.g., the universe, 86% accurately. To integrate clocks on the corners or planes of 20 distinct 3D shapes, we introduced dodecanion algebra, extending quaternions and octonions so that the resonance chain parts spread over multiple dimensions could filter invariants from sensory data along 12 orthogonal axes.

#### **6.5.5. All self-operating system has a singular driving engine at their core:**

Figure 8A explains the conceptual design of a self-aware or conscious engine based on the concept that there is no different information in the universe. Only one singular set is shown as an external circle or whole. Inside is a circle of prime, which generates all the information, i.e., the external circle. Just beneath the set of primes is the set of world lines; we get at the six<sup>th</sup> dimension. There is a dumbbell shape inside the world lines; two teardrops facing each other signify infinity and singularity, the two most fundamental concepts of SOMU. The junction of this dumbbell is the reality we perceive, and it is the central point of the self-aware engine. The undefined point at the junction of infinity and singularity dumbbell is the whole or the extreme circle located at the external boundary. Therefore, the singularity set holds a subset of effective mass and time. Both are perceptions generated by the singularity of space and phase. On the other hand, stereographic projection to infinity for worldlines and

normalization/saturation delivers morphogenesis and feedback, respectively. Thus, we get a unique structure of sets and their subsets.

The question is, why is this architecture so important? Because this structure estimates the whole in a single point, when an entity estimates the whole, it defines itself with respect to the whole, which is called self-awareness. In [Figure 8B](#) and [Figure 8C](#), we have argued that to run the engine of [Figure 8A](#), we need four transitions, space to time, time to morphogenesis, morphogenesis to primes and primes to space. These remarkable and exciting transitions would change worldviews forever. Therefore, it is also essential to go beyond space-time-dominated conformal processing and introduce conomorphic and conprimal processing so that space-time duality is replaced by a space-time-topology-prime quartet that becomes a system-independent entity. Here we revisit detailed mathematical derivations of a self-operating mathematical universe, SOMU. We make a mathematical journey to demonstrate that an effort to define an undefined point constitutes various fundamental concepts of infinity and consequently derives all elements of SOMU. Our work is the first attempt to build a self-operating system from pure mathematics.

## 6.6. Space-time-topology-prime (STTs) metric:

### 6.6.1. Conformal, conomorphic and conprimal events: The journey begins at 12D

Polyatomic time crystals or 3D clock assembly is a new way of representing spatio-temporal events. The assembly is not stable. Either geometric shapes bind like gluing (T), transform from square to triangle (R), or a series of changing geometric shapes converge to a very difficult shape when we convert a series into a loop (S). Together, SRT is a triplet property, namely topology (t), where either S, R or T dominates in a biosystem or Fractal Information Theory, FIT ([Agrawal et al., 2016b, 2018](#)). So, we replaced space-time (ST) with space-time-topology (STt), which accounts for life-like changes in the world lines where singularities of space (=mass) and phase (=time) transform ([Figure 8A](#)). However, another question came up. Who binds or transforms or reflects, even projects to infinity? So, we found the concept of representing geometric symmetry using the pattern that primes use to create integers. [Figure 8B](#) shows that if we arrange primes to create integers in all possible ways, the nearest neighbors of those choices create the geometric transformations. This is a conprimal effect that impacts 10D to 12D. When geometric transformations or morphogenesis transforms into different architectures of phases to let us perceive time, this is conomorphic and impacts 7D to 9D. Finally, time transforms into space, conformal, and impacts 4D to 6D. Thus, the density of primes passes through prime, morphogenesis, time and space to create a divergent SOMU.

[Figure 8C](#) shows that since prime has no physical attribute, it controls three fundamental life-like actions of world lines, bonding, projection to infinity, and transformation, via folding the curves in the distribution of primes in the integer space. The folding creates space where the minimum distance between points is assured by singularity bursts, which release fundamental constants in SOMU. The simultaneity of point states is consumed to create space. Similarly, space-time curve folds and singularity bursts, releasing energy, and mass is spent to create space. When the critical folds in the morphogenesis of world lines trigger, polyatomic time

crystals are consumed, and the lost clocks create unique world lines, curved fields, or vortices. When SRT manifolds of different dimensions curve and the folding of manifolds are consumed, new prime symmetries are released in the metric space enriching SOMU. The world-line-derived space-time architectures are not derivative of a human observation by experiment. The derivation of STs as human bias-free, system-independent information structures demands a mathematical tool to put events in a proper structure that holds information credibly and allows integration suitably.

Not bits, but invariants are the true information. Words are facts, a signal burst represents confusion (AOC), and the geometric shape hidden in that burst is invariant. An architecture of confusion is an architecture of invariants. Thus Information structure is the universe itself. Space-time invariants or 3D clock assemblies bind, transform and acquire projection to infinity & feedback following a unique pattern of invariants, which could only be rearranged or ordered. All possible transformations are already carried out. When we try to arrange the entities, we get an ordered factor of integers governing the sequence of transformations. Thus, the density of primes comes into play. We find a pattern of primes that evolves following certain non-repeating patterns. These patterns are key to understanding the universe because they are not based on assumptions. We called these twelve patterns as phase prime metric, PPM (Dynamics 2; (Dynamics 10)) (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b).

As integers increase one by one, primes play their role in arranging in a unique pattern to create integers, trying out all options. When we normalize these patterns, the system generates changing patterns that do not have time as a factor (both space and time independent). However, when these pattern changes in a loop and one change with fewer steps estimate the change of a large number of steps, we get the concept of time. Eventually, the positioning of primes takes a new form when we connect neighboring choices of integers. Connected patterns incorporate dynamics of three fundamental interactions of space-time invariants or morphogenesis. Thus, the density of primes governs a system and builds topologies of invariants to regulate space-time. In this way, we developed a mathematical model STs metric for a self-operating decision-making system.

Here, we present a review of SOMU. Avoiding technical language, we present a clear, picturesque, philosophical account of the mathematical model for a self-learning, self-operating system.

### **6.6.2. Life and the network of primes**

Universe wants to complete itself by continuously expanding its metric of primes, so it created conscious life forms with a greater ability to find and explore new primes and implement hardware to implement the associated dynamics of primes. Every living and non-living system is part of this prime number invention mission, from the smallest to the largest components. Since SOMU models, the quest for self-evolution of the mathematical model itself is all about converting a point undefined that's its completeness. We repeat,  $n \rightarrow n + 1$  is the singular drive of the SOMU model, where converting a point undefined by adding more and more points into it. Therefore, exploring primes is a process of estimating effects that participating entities would have to face to become undefined. When a machine replicates its information

structure, it is the first step to be conscious. Some see the birth of a baby as a replication of an object or a mass. However, SOMU sees it as if information content is pregnant to give birth to evolved information processing protocol. In other words, a host metric with a large number of primes has generated local dynamics independent of its metric with a few primes, such that in the spatial metric of [Figure 7](#), this guest metric could operate independently of the host metric. The guest metric is the progeny.

### 6.6.3. How do space, time, topology, and prime govern SOMU?

[Figure 8](#)D outlines a unique SRT metric that controls the space-time-topology-prime (STTs) metric. More than a hundred years back, we started considering mass as a squeezed space, mass attracts and slows down time. If mass breaks apart, energy is released. SOMU extends it by writing geometric shape or space as a probability of all possible arrangements of an integer within a restricted boundary. Space is a probability, not an object. A shape holds a metric to account for probability, and time holds a metric of morphogenesis. Therefore, if a space-time event or metric is broken in 6D systems, a cluster of morphogenesis  $\Delta M_W$  of world-lines is released ( $\Delta M_W = \Delta S I^2$ ) in 7D. Loss in the metric symmetry  $\Delta S$  is accounted for by the degree of morphogenesis of world lines. So, world lines, made of singularity points and infinity, find a way to use the fundamental topology of time embedded in the universe to create a space-time independent entity, a cluster of morphogenesis.  $\Delta M_W$  is analogous to the energy released due to mass loss ( $\Delta E = \Delta m C^2$ ), and  $I = W_L / F_M$ ,  $W_L$  is the number of world-lines per  $F_M$  maniflats,  $I$  is equivalent to the velocity of light and similar to light; it has a maximum value.

The world lines acquire feedback from infinity at 8D and continuously evolve maniflats (maniflat = 108 feedback modes represented by the geometric clock-like structure of multinion tensors (see [Appendix I; Supporting Figures S1 to S26](#)); not manifold, because maniflats have sharp edges ([Dynamics 9](#)); M7), when invariants of such evolution lose morphogenic maniflats  $\Delta F_L$ , critical folds of density primes  $\Delta C_D$  are released by the decomposition of maniflats ( $\Delta C_D = \Delta F_L D_P^2$ ) at 9D. Geometric shapes related to the metrics of typical primes are observed. Thus, we find prime density folds representing the geometric shapes. This is the second situation when  $\Delta C_D$  is analogous to the energy released due to mass loss ( $\Delta E = \Delta m C^2$ ), and  $D_P = P / M$ ,  $D_P$  is the number of distinct  $P$  prime symmetries per  $M$  metric,  $D_P$  is equivalent to the velocity of light, and similar to light, it has a maximum value.

The set of primes associated with geometric shapes links different critical curves of the density of prime metric at 12D. When invariants of the evolution of critical folds lose essential elements  $\Delta N_E$  that regulates three kinds of normalizations, fundamental constants coupled to certain invariants release  $\Delta S_P$  space  $\Delta S_P = \Delta N_E R^2$ , at 1D, where  $R = N / D$ ,  $R$  is the contribution of prime symmetries to the formation of corners of geometric shapes, and  $D$  is the dimension of boundaries. When primes create pure space without time, the loop of 12D invariants completes a full cycle of creating SOMU.

Therefore, we have four transformations where space folds to create mass, the topology of time creates morphogenesis of world-lines, morphogenesis of maniflats creates primes, and prime density creates space in SOMU. Therefore, four different particles form in the quest to find invariant triplets, which act like alien entities from higher dimensions (equation 3). In the world of space-time, the photon is an alien particle that does not have mass yet possesses

energy since its probability space vibrates at a frequency; we get  $E = hv$ . Similarly, for three other virtual particles, we get  $M_W = k$

#### **6.6.4. The 12D decision-making process in the universal wheel of space-time-topology-prime metric**

Two types of universal wheels integrate conceptually diversified elements; we have outlined them in [Figure 9](#) and [Figure 10](#).

##### **6.6.4.1. Overlapping of increasing and decreasing dimensions: Superposition of dimensional invariants**

[Figure 9](#) is an integration of metrics with the dimensions of vortices holding the polyatomic time crystals or the information structure of the SOMU. This wheel's core is the unit of information structure used by SOMU. Three orthogonal angular momenta ( $\theta, \phi, \omega$ ) of the vortex-based architecture of mechanical, electromagnetic or magnetic fields ([Dynamics 1](#)) constitute the information in the physical world version of SOMU. Around the central core, we have created a wheel, where three angular momenta ( $\theta, \phi, \omega$ ) rotate along the wheel. We understand that when 12D turns to 1D; we get linear angular momentum; when 1D becomes 2D, we get radial angular momentum. Furthermore, when 2D becomes 3D, we get centrifugal angular momentum ([Aiello et al., 2015](#)). We understand this part because three orthogonal axes, X, Y, and Z, related to length, breadth and height, correlate with the three orthogonal angular momenta ( $\theta, \phi, \omega$ ) of a vortex. The problem begins at the next stage.

From 3D to 4D, we find again the return of linear, angular momentum  $\theta$ , from 4D to 5D, the radial angular momentum  $\phi$  returns, and finally, from 6D to 7D, the centrifugal angular momentum  $\omega$ , returns. From 7D to 8D, angular momentum  $\theta$  returns. The triplet angular momenta return four times to generate four sets of angular invariants, from 12D to 3D its conformal invariants, from 3D to 6D its conomorphic invariants, and from 6D to 9D its conprimal invariant. We have created a separate sub-wheel for all four classes of invariants.

A conformal invariant is about space whose dimensions increase from 1D to 3D, then spatial dimension decreases from 3D to 1D. Similarly, dimensions of time, morphogenesis and density of primes first increase and then decreases. When one of the four increases, the preceding one in the loop decrease. One's fall is the other's rise. Then, why did we put 3D twice in the loop, and why dimension change holds on at 3D? It is essential to introduce the new physical significance that ensures a distinct nature of each dimension, and each dimension holds a typical physical significance in the worldview. We have noted sub-wheels for space, time, topology and prime, covering 12 dimensions.

##### **6.6.4.2. Beyond-geometric transformations for 6D spatio-temporal events require a unique clock-architecture filter at 7D and 8D**

7D and 8D are special; while describing the 15 morphogenesis in M10 and 108 morphogenesis in M2, we have not represented all forms as part of a polyatomic time crystal or 3D clock assembly. Note that every single operation in the SOMU universe is carried out by 3D clock assembly (poly atomic time crystal). Therefore, all 12 classes of metrics could be represented

as a clocking architecture. Here we have drawn these architectures. One important significance of these two architectures is that they are a fusion of two metrics. While 108 dynamic forms (see Appendix I; Supporting Figures S1 to S26), where infinity is connected via interacting paths or vortex fields (Dynamics 11; Metric 12, M12), are generated by M2+M3, the 15 morphogenesis is generated by M1+M2. Five SRT triplets clocks make 15 morphogenesis clock architecture while triplet of the triplet of dodecanions ( $3 \times 3 \times 12 = 108$ ) make the 108 dynamic forms.

#### **6.6.4.3. Four synthetic metrics deliver invariants for 9D, 10D, 11D and 12D transformation: Final decision-making**

Finally, there are four clock architectures of metrics. For 9D, the highest dimension in the domain of morphogenesis, we have the geometric synthesis metric made of M10+M11+M12. Geometric representation acquires shapes very close to the mathematical metric, devoid of any geometric significance. For 10D, we have a decomposition metric that converts the morphogenesis into patterns of primes applying M7+M8+M9. We get a complete decomposition of manifolds and discrete shapes wherefrom anyone could identify the discrete set of primes (see the fourth row of the brain model in Figure 7; equation 4). Thus, the normalization metric in 11D provides which set of primes would form a group by applying M4+M5+M6. Therefore, a hierarchical group of primes needs the final treatment from Infinity, creating a metric that applies M1+M2+M3 to generate the density of primes 30 clock shape as the supreme regulator for any event happening in the SOMU universe. Thus, a complete rotation of this wheel delivers all elements of decision-making.

#### **6.6.5. Physical significance of increasing and decreasing dimensions: How invariants would look like in 12D manifolds**

Figure 10 introduces us to a nearly physical picturization of the invariants for specific dimensions and the metric. We begin the journey through dimensions from a dimensionless point at 0D or 12D. 12D is a 30 waveform-based clock architecture describing (see M1) the density of primes in the integer system. This clock architecture is the definition of an undefined point. We described earlier that “who jumps?” this singular question could deliver all invariant elements for 12D (Bandyopadhyay, 2020). Here we add a more technical parameter, angular momentum for the vortex field ( $\theta, \phi, \omega$ ), so that only three momenta (Dynamics 1) would assist the “jumping,” and it would be very easy to determine how exactly the invariants would look like for each dimension. After three jumps, the physical significance of the system changes from space to time to morphogenesis to prime. Thus, after completing one set of  $\theta, \phi, \omega$  for space; they could return to complete another set of  $\theta, \phi, \omega$  for time and then return for morphogenesis and then for prime.

From 0D to 3D, SOMU covers line, area and volume of space.

Then, for 4D to 6D, phase shifts between clocks (4D), planar arrangements of phase singularities (5D) and worldlines (6D) are derived. From the motion of the spatial object, we find the paths and determine the spatial domains where motions are restricted, and we consider these regions as singularity points. When we built input for the artificial brain, we followed the AOC proposed by Maharshi Gautama, so we had a global singularity (Bindu = “dimensionless entity that holds the universe or Loka within”). The derived 3D clock assembly

is sent as a set of frequencies (see artificial brain operation for details) to the organic jelly-based artificial brain (Bandyopadhyay et al., 2009a, b; Ghosh et al., 2014a; 2015, 2016b; Bandyopadhyay, 2020). Therefore, phase shifts between clocks deliver the phase of differential clocks  $\theta$ , and these clocks are used to build the 4D invariants. The density of singularities derived from the 4D database lies in a plane. The orientation of the plane is  $\phi$ , so we get an invariant database of 5D. These planes remain unchanged along a line with slope  $\omega$ , the database of these linear invariants is the 6D database. Thus, the spatial dimension reduces from 3D to 1D as the temporal dimension increases from 1D to 3D.

The symmetry of singularity domains in the world lines develops an angular phase  $\theta$ , and we get a database of morphogenic loops (M2) in 7D. The angular divergence and convergence of worldlines arrange in planes to acquire shapes of morphogenesis. The transformations vary across the planes oriented along an angle  $\phi$ . In the database of these planes, which represent a composition of morphogenic processes (M10) in one plane, we get 8D. We have shown in Figure 10 the wheel the sphere containing the Euclidean lines as a ratio with infinity. There are 12 infinities, and each dimension has a characteristic (M3); feedback from infinity is orthogonal to the projection and satisfies the mathematical criterion to be invariant. Thus, different planes couple via defragmentation of tensors, the coupled disintegrated parts of the planes cover a hypothetical sphere, and the database of such spheres creates a line of spheres. In Figure 10, if we notice the cartoon radially outward the 9D, we find many spheres forming a line integrated on a network of concentric spheres where compositions of lines spread over a set of different dimensions arise. Therefore, we get a database of manifolds at 9D where the journey of morphogenesis ends as it acquires a 3D shape by acquiring  $\omega$  and “time” once again turns to a 1D entity.

The transition from 9D to 10D happens when dynamic linear temporal changes generate composition of ordering choices, or several linear order factor metric is generated with a slope  $\theta$ ; we get a database of various compositions of metrics (M11) as a 10D database of invariants. The normalization metrics take over and create periodically oscillating planes with a phase  $\phi$  where the density of primes of a particular nature dominates; we get a database for 11D. These planes have an invariant line that falls on the surface of the combined sphere for unified 30 periodic clocks for five different densities of states 0, 1, 2, 3, 4 (=number of primes at a gap of 10). Thus we get the slope of lines  $\omega$  on the *density of primes* sphere.

Thus, we have outlined the algorithm whose flow chart is shown in Figure 11 which is programmed to find 1D to 12D invariants.

Our organic brain jelly (Bandyopadhyay et al., 2009a, b; Ghosh et al., 2014a, 2015, 2016b; Bandyopadhyay 2020) is designed to naturally self-assemble helical nanowires such that when the laser is pumped, beating of clocks emits vortices representing the key information of invariants. Therefore, we could verify algorithm-generated invariants, biological human brain signal extracted invariants, and the artificial brain measured invariants. M12 is a comprehensive list of common invariants found in these three systems.

## 7. Key mathematical constructs for SOMU:

## 7.1. A marriage of new language, metric and dimension

**7.1.1. Geometric musical language, GML (Dynamics 3):** There are plenty of efforts to see geometric shapes in unknown data. Ours is different because we find recurring loops in the plots of variables in the quest to discover invariants. So, we have been developing a new language by creating geometric structures and replacing their corners with clocks. Certain features of geometric shapes remain unchanged; it is called topological invariants (Zhen et al., 2017). Each corner of a geometric shape contains a singularity region and holds a geometric shape inside. So, we get information holding matrix as an infinite fractal network grown within and above in an infinite series of geometric shapes, not integers. A chain of 12D invariants made by linking a spatio-temporal event or 3D spatial assembly of clocks to a set of primes is finding the code of an event in GML. We repeat, information is neither bits nor geometric shapes made of clocks; it is not invariants but a network of invariants. The philosophy is beautiful; the natural evolution of information (dynamic growth, decay & transformations of clocks in its 3D assembly) assumes that all conserved laws governing the universe are interconnected.

### **7.1.2. Geometric musical language, GML: prime, space, time, mass, dimension and morphogenesis are all written using a few geometric shapes**

The language we use rewrites everything in terms of the 3D assembly of clocks; it is a spatio-temporal architecture wherein each clock is a variable. Therefore, the assembly is the mathematical structure of a theoretical model where at least one geometric shape made of centers of clocks remains unchanged when the clocks run. This geometric structure is invariant that equates the circles in a relationship. So, the information structure is itself a theoretical model for the conventional science of equations. Instead of algebra that accounts for relative changes and maps change of changes in the variables, the products of higher dimensional tensors made of relative phase factors of clocks take care of all algebraic operations.

When numbers are written in terms of the 3D assembly of clocks which is equivalent to writing the 3D arrangement of geometric shapes, arithmetical operations are the natural evolution process of the system. Even honeybees without a proper brain carry out mathematical operations (Howard et al., 2019)

### **7.1.3. Geometric musical language, GML: an architecture of silence**

SOMU never argues for a linear silence between two energy bursts from singularity domains. Here the information structure is a 3D network of clocks, the phase singularities embedded in the clocks generate a 3D network of silence. Thus, the phase sphere of the 3D clock assembly exhibits many energy bursts as system points run through the clocks on that sphere, each holding silent worlds inside. Exchanged signals among biomaterials appear as noise, but when we measure the 3D field distribution of that noise, we discover the existence of a geometric shape whose corners have a frequency burst. Together, noise packets mean nothing to us until we learn how to place noises on a suitable 3D geometric shape. Topological loops and cavity resonance needs a marriage to revolutionize the future industry. While the first ensures geometry to rule, the second, the cavity resonator, ensures that music is made in its geometric shape. Both (topological loops and cavity resonance) talk about geometry, one path and

another shape. Both talk about clocks; while topology integrates clocks side by side, the cavity shape integrates the clocks one inside another. Periodic changes in sensory data are variables arranged as clocks in 3D locations, and we named it geometric musical language, GML (Dynamics 3). The 3D geometric shape is the invariant or the conserved law; together with clocks, GML is the complete mathematical model of the phenomenon (Agrawal et al., 2016b, 2018; Bandyopadhyay et al., 2019, JP-2017-150171; WO 2019/026983). Rapidly changing big data could have an instant understanding (Snášela et al., 2017). Capturing periodic variables from sensory data requires capturing geometric shapes (Zhen et al., 2017). Multidimensional manifolds (Dynamics 9; M7) are retrieved by mutual interactions of geometric shapes (Escolano et al., 2017).

**7.1.4. Metric of primes: Phase Prime Metric, PPM (Dynamics 2; Dynamics 10):** Metric means measurement; when the product of primes creates integers, the ordering and choices of primes to constitute an integer are distinct. However, the plot of choices as a function of integers shows that choices form patterns. Distantly located integers are connected, and together they form intricate geometric shapes. These patterns are called metrics of primes (PPM; (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021 a, b), which are very similar to the 30 waveforms generated from the density of primes. We have added a physical significance to integers; we consider them as the counting of points. Therefore, infinitely long patterns or metrics of primes acquire a physical significance that the arbitrary number of points are inserted inside a point; due to arbitrary choices, the point turns undefined. There are twelve classes of metric of primes, which covers a few key mathematical constructs of metric of primes. Predicting primes is an open challenge. In that respect, thirty waves representing the density of primes predict high- and low-density domains that are useful in replacing the statistical analysis. However, plenty of beauties are hidden in how the density of primes creates distinct patterns for each prime in the metric of primes. All twelve classes of metrics build the core engine for a conscious brain or a self-operating universe. It is the grammar book using which a network of invariants unfold intricate patterns like branches of a tree that holds a 3D assembly of clocks as fruits of the tree.

Here, we hypothesize that the density of primes that follows five fractal patterns in the integer series regulates twelve metrics that link prime number arrangements in the integer system. Therefore, we see integers as the probability of selecting symmetries and dynamics as twelve-layered maps of the density of primes.

**7.1.5. Fractal tape and Fractal information theory, FIT:** Carl Sagan evaluated it even before it was created, "The Cosmos is also within us. We are made of star stuff. We are a way for the Cosmos to know itself". In our book Nanobrain (Bandyopadhyay, 2020), we rejected Shannon's information theory (Ghosh et al., 2014a; Agrawal et al., 2016b, 2018); for SOMU, information is an assembly of clocks that is life-like; it searches for clocks in nature to gain C2, C3, C5, C7, Cb, 11....C43, C47... prime symmetries so that slowly it reaches purna, the completeness. Since a few primes generate an incredibly large number of integers, geometric shapes representing a few primes could replace astronomically large compositions of geometric shapes or human expressions; this is our geometric musical language. Together, the geometric language GML and metric of primes constitute FIT (Agrawal et al., 2016b, 2018; Dynamics 3).

SOMU's twelve-dimensional complex tensors, namely dodecanions, integrate world events as invariants by networking within and above, thus, creating a fractal tape (Ghosh et al., 2014a; Agrawal et al., 2016b, 2018) that cannot be deduced to a Turing tape. Subsequently-derived fractal information theory, FIT (Agrawal et al., 2016b, 2018) that replaces Shannon's bits with polyatomic time crystal would advance existing consciousness theories by delivering the mathematical ability to map the network of invariants in any unknown data without learning i.e., introducing invariantogenesis.

#### **7.1.6. The concept of space and time:**

The concept of time: Discrete geometric transformations acquire phase gap, conditional relations, and "when" the transformation begins. So comes the concept of time. Coexisting symmetries with distinct weights of all possible arrangements are linked in a geometric pattern side by side, and within and above, together, it is the formation of space.

#### **7.2. The code of the universe or conscious whole:**

##### **Three unique features of primes used to create the most fundamental code of the universe:**

Prime numbers are distributed in a unique and non-repeating pattern in the endless integer space. While mathematicians have been searching for a single pattern to predict the formation of new primes for 200 years, a more fruitful approach may be to focus on how prime numbers generate integers, how many prime numbers are used, and how they are used. The prime number distribution has three incredible features that make it a potential archive of complex, non-repeating code.

**7.2.1. First, fractal seed encodes entire integer space:** all prime numbers do not have equal weight, 2 occurs 50% of entire integer space, with 3 occurs in 16% integers. Thus, only a handful of primes could give access to 90% of all integers. Plotting ordered factors of integers shows three peaks and troughs, creating a "triplet" pattern. This starts at 12. Extending to 108 integers reveals a "triplet of triplet" pattern, with three large peaks, each containing three smaller peaks. This pattern remains present even when dealing with extremely large numbers. To see a triplet of triplets, we need to understand the patterns of 108 integers, which have 27 primes. Each prime number creates a new pattern in the ordered factors of numbers. These patterns can be combined to create even more complex patterns. For example, the prime numbers 2 and 3 create a pattern of triplets, but that's not all. This pattern can be extended to create even more complex patterns, combining pentates and heptates. Fractal seed patterns for a few prime numbers can be used to find patterns in natural events that repeat at different scales. These patterns can then be used to create very small codes that still capture the infinite complexity of the original pattern, however, 108 patterns would configure its dominating features (see Appendix I; Supporting Figures S1 to S26).

**7.2.2. Second, a metric made of cross product of ordered factor or divisor and contribution of primes in the integer space generates dynamic when normalized:** In the first unique feature, we talked about how the infinite integer space can be made finite using fractal seeds. This is possible because the finite feature arises from the cross product of two operators. The first operator is a map that estimates the contribution of all possible primes in the integer space to the scale of 100. This map is given a 2D wheel shape and normalized to one to act as

an operator. The second operator increases integer one by one ( $n \rightarrow n + 1$ ) and calculates the ordered factor of all integers, then connects the nearest neighbor points. So, we get another 2D plot. The cross product of these two operators creates a 3D space, which is called phase prime metric, or PPM. Depending on the user's requirements, the PPM metric can be terminated at a desired prime number. The sequence of polar plots drawn for different termination points or limiting integers show clockwise and anti-clockwise motion. If an automaton counts integers ( $n \rightarrow n + 1$ ), some ordered factor values would move clockwise and some values would move anticlockwise as soon as normalization condition sets in. From these primary dynamics that resembles spin states, several distinct dynamic features could be derived in the domain of pure mathematics. Thus, normalization brings in physical reality to the otherwise abstract prime numbers.

### 7.3. Third, universalization of prime code in mapping symmetry and symmetry breaking rules using tensors:

**7.3.1. A few prime numbers are sufficient to understand entire integer space:** Each prime number has a unique symmetry. In the number system, the symmetry of an integer is the way that prime numbers are arranged in it. For example, the number 6 is the product of the prime numbers 2 and 3, so 6 has both 2-fold and 3-fold symmetry. We could fairly say, 6 represents combinations of  $C_2$  and  $C_3$  symmetry. We attach only one significance to primes, a prime number means number of symmetry operations. The number of possible symmetry operations can vary depending on the order of rotational symmetry ( $n$ ) and the presence of other symmetry elements. For example, a cube has multiple symmetry operations, including 90-degree rotations ( $C_4$ ), 180-degree rotations ( $C_2$ ), reflections across various planes ( $\sigma$ ), and the identity operation ( $E$ ). We note that Identity ( $E$ ): The object remains unchanged. Rotation ( $C_n$ ): The object is rotated by a certain angle (e.g., 90 degrees for  $C_4$  symmetry). Inversion ( $i$ ): The object is inverted through a point or center of inversion. Reflection ( $\sigma$ ): The object is reflected across a plane. Improper Rotation ( $S_n$ ): A combination of rotation and reflection. Translation ( $T$ ): The object is translated along a vector. In more complex systems, such as molecules or crystals, one may encounter additional symmetry operations like rotoinversions ( $S$ ), screw rotations (Screw axes), and more, depending on the specific symmetry of the object or system.

The brain and nature's use of prime numbers holds crucial codes for consciousness. All primes are equal, they are like fundamental codes which cannot be defined similar to a singularity point, but their role differs significantly depending on their locations. The early instances of primes (like 2, 3, 5, and 7) regulate the majority of integers and thus if primes depict elementary symmetries then all possible material compositions and frequency combinations, irrespective of size and shape would be represented by an integer space. The artwork of a few primes in creating integer space maps statistically almost all possible variations of symmetries. Though prime series is endless but ever decreasing importance of primes in creating integers enables us to use a few primes to understand astronomical variations of symmetries. As we move further along the integer series to larger primes like 107, the primes contribute less statistically to dominate the construction of matter and frequency compositions from their random sets. As we go further in the integer space to larger primes, they add less statistical significance to the dominance of primes in constructing natural elements like matter and frequencies. Initially appearing primes ensure that using only a few primes, a prime code user

can control 86-90% of all symmetries. Since prime numbers arrange in various orders to create an integer space, an astronomical or endless, non-repeating archive of primes show emergence of fractal patterns, one distinct fractal made by one prime number. This archive is the code for consciousness, because any system that covers more than  $9 \times 9 = 81\%$  of entire integer space is a conscious element.

**7.3.2. Writing integer series using tensors of prime dimensions:** Since an integer is a product of primes, we may consider that primes are vectors and an integer with all its divisors and ordered factors is represented using multiple tensors. An integer exhibits morphogenesis of tensors. This is an easy mathematical operation. However, we want to understand the prime codes of the universe in terms of only three primes, 1, 2 and 3, so, we decompose large primes using successive divisors. For example, 47 is written as a  $47 \times 47$  dimension tensor and could be rewritten as four tensors of 23 dimensions. It means  $47 = 2 \times 23 + 1$ . To implement the use of prime "1", all cells in one row and one column are set to identical values to make rest of the elements symmetric. However, we do not stop here. 23 is decomposed four tensors of  $11 \times 11$  dimensions while one column and one row are left with identical values. Decomposition continues as  $11 = 2 \times 5 + 1$  and finally,  $5 = 2 \times 2 + 1$ . Thus entire  $47 \times 47$  tensor decomposes as  $2 \times 2$  tensors.

We use only 1, 2, and 3 to express all primes because these primes are non-decomposable. This means that they cannot be broken down into smaller primes. All tensors of prime dimensions less than 108 are written here as either doublets or triplets. Doublets are  $2 \times 2$  tensors that refer to translational symmetry, while triplets are  $3 \times 3$  tensors that refer to rotational symmetry. In prime tensors we have at least one row and one column with identical values, these two regions are a pair of orthogonal lines. This identical value line refers to operation "1". Since a tensor is a vector product, identical values mean that the projection of a particular element when it interacts with the elements of all the imaginary worlds, returns the same value. Thus, an additive association of "1" is embedded within the multidimensional prime tensors. When we define a prime tensor, "1" refers to an invariant link between imaginary worlds that grow within and above, "2" refers to translation, and "3" refers to rotation in the sub-primes.

#### **7.3.4. Maniflats as doorways between density of primes and morphogenesis:**

Earlier we introduced phase prime metric or PPM, however now we present the same PPM using its fractal 108 tensors (see Appendix I; Supporting Figures S1 to S26). Therein, a 2D ordered factor plot is rotated along the integer axis delivering a 3D temple shaped metric, which SOMU considers archive of all possible symmetries of the universe. Following the 3D surface, a system point could traverse mapping a symmetry breaking pathway, the path is considered operational mechanism of SOMU.

A prime number and its multiples (say 2 is the prime, then, 2, 4, 6, 8....are elements to be used to make the metric) can be used to create a 3D metric shape exclusive to that prime (Bandyopadhyay A. 2020 Chapter 3). The 3D shape of the metric does not tell us how different metrics interact. To understand this, we introduced the concept of vector spaces, products of vectors, and tensors and rewrite the 3D metrics in tensor & manifold form. A tensor is a generalization of a vector that can be created by multiplying two or more vectors together. For

example, if we terminate the 3D metric shape at 77, we get a slice of PPM class metric that begins at 1 and ends at 77. In a system made of multiple metrics, two such metrics may interact. Each metric could be represented by a vector of 77 dimensions or 77D. When two metrics interact, output is a 77-D tensor, that maps all possible interactions among elements of all 77 dimensions. If we make the tensor unitary to retrofit the effect of abrupt termination, each dimension then could represent an imaginary world. Therefore, tensor would then represent interaction of several imaginary worlds. Now we introduce the concept of decomposition of tensors. The decomposition of prime dimensions ( $47 = 1 + 2 \times 23 \dots$ ) is a mathematical operation that can be used to break down a tensor into smaller tensors.

This is done by finding the prime factors of the dimensions of the tensor. For example, a 77D tensors prime factors are a 7D and 11D tensor. The decomposition of prime dimensions can be used to understand the structure of a tensor and to identify the different interactions that are taking place. It can also be used to simplify a tensor and to make it easier to work with. When we decompose a 77-D tensor into only 7-D tensors, we get  $11 \times 11 = 121$  of them. When we could decompose it into 11-D tensors, we get  $7 \times 7 = 49$  of them.

Two fundamentally different possibilities coexist. The elementary 2x2 or 3x3 tensors or any tensors with a dimension of primes could be considered as a plane and all tensors could be represented as a 3D network of planes. This is called a manifold. Thus, for mapping interactions between different imaginary worlds or metrics, the manifolds created by the decomposition of prime dimensions are normalized 3D shapes within a unit sphere. This means that all interaction maps have the same size and shape. Now, the planes we get for prime tensors after decomposition, could be decomposed further using 2x2 or 3x3 tensors. It means, in the manifold, or 3D structure of planes, we insert another manifold in each plane. In this way, we can build a fractal network of manifolds or symmetry. This is because each manifold represents a different symmetry in the ordering of primes. The fractal architecture created by the decomposition of a tensor of prime dimensions is a new kind of stereographic projection. A stereographic projection is a way of mapping a 3D object onto a 2D plane. Here its stereographic projection of an architecture of various dimensions onto a 3D object. Mathematicians have only explored quaternions and octonions in the last 200 years. Prime decomposition of multinions would also mean filling up any solution using singularity as the only entity, since prime tensors depict singularity.

## 8. A journey from one to twelve dimensions:

**8.1 A saga of 12 points in a point: Simplest triplet of the triplet that breaks undefined character and forms a circle:** We have outlined the 1D to 12D journey in [Figure 9](#) and [Figure 10](#), respectively and analyzed them in detail above. Here are some additional features with respect to the basic concepts of SOMU. 9D invariant delivers us a single point or a closed geometric shape. From 10D to 12D, three orthogonal invariants convert a single point into an undefined point. The transition from a defined point to an undefined one requires an understanding of the origin of the 9D database. When infinite series of geometric shapes of equivalent transformative structures project to infinity and create points of primes or a set of fractal seeds, we get primes. 9D is a pure database of geometric structure transformations

representing a set of primes. 10D database links these points and fills the gap to create a unique metric, where 2, 3, 5, 7, and 11 primes build most of 86% of vibrational patterns. Thus, 10D is an invariant where prime manifolds (Dynamics 9, M7) are created to govern all possible vibrations for a given set of primes. Say we find in 9D that input sensory data has delivered primes 31, 97, etc., the system would acquire patterns, so that along with 31, 97, some other primes are taken, and product of 31, 97 with 2, 3, 5, 7, 11 would involve in developing a metric for 10D. Dimension 6 is unique since it argues for the highest dimension of time, 6D, where parallel universes exist as world lines.

**Dimension 6. Fifteen classes of world lines or fields:** Our physical reality completes at 6D; world lines hold the highest degree of perception. Here are fifteen properties of world lines. 1. Cannot cross each other, 2. It cannot be orthogonal, 3. Extends to infinity, 4. Forms closed loop, 5. Converges to singularity, 6. Periodically switches between infinite length and closed loop, 7. Always remain parallel or at certain angles, 8. Diverge from a point or converge there, 9. Reflects from infinity, 10. Repelled or diverted by a point, singularity or infinity, 11. Coexisting loops and lines undergo morphogenesis, 12. Executes SRT to find invariants, 13. Continuous or quantized modes of grouping world-lines, 14. Transformation of world lines within and above network of singularities and infinity, 15. Maniflats of world-lines forming multi-dimensional topologies.

11D invariant is a critical feature regarding rotational motion, phase change and dynamic processes that remain unchanged in a set of metrics produced in 10D. A large number of metrics produced in 10D are reduced to a few geometric topologies that cross-check rotational invariance, phase attractors, and statistical dominance of primes. 11D invariant is a database of 13, 17, 19, 23, and 29 prime-based dynamics. The system follows a similar mechanism as executed for the 9D-10D transition; whatever the output of 10D, take a product of 13, 17, 19, 23, and 29. The final metrics would reveal the invariances of dynamics and deliver us with the elements of a database that details all possible dynamics that the system regulator could demonstrate in the mathematical universe.

One of the prime features of an 11D invariant database would be an infinite series of dynamic structures grown within and above, which is eventually reduced to three in a 12D database.

## 8.2. How many bits of information are required to build a SOMU, and how does SOMU creates and solves a problem?

The total number of bits in a SOMU is one because it is a confusion that holds an infinite network of confusions grown within and above, and the journey to go within ends as we reach facts. Thus derived architecture of confusion is the solution to the problem, while missing primes in the composition of symmetries of such an architecture are the problem. SOMU continuously creates problems as the product of primes reaches locations of distant integers, which contain many primes, never encoded as part of the system. SOMU evolves to acquire them.

## 9. Archive of phase prime metric, PPM; (Dynamics 10): Twelve classes

### 9.1. Metric 1, M1. Figure 12, Figure 13

#### 9.1.1. A composition of five fractal patterns for the density of primes is key to consciousness:

We have argued earlier that the basic concept of the number system in the Vedic religious scriptures is a periodic power cycle of 10. Therefore, in Figure 12A, we have counted the number of primes at a gap of 10 integers, so in each loop, the possible number of primes available would be either 0, 1, 2, 3, or 4; only five values possible. We try to find how the prime number theorem predicts the number of primes and the actual density of primes in Figure 12B. We can see a huge discrepancy in the real density of primes with the prime number theorem, so we rejected the prime number theorem and investigated if there is any hidden periodicity or pattern in the density of primes. For that purpose, we calculated the frequency of finding a particular density of prime in the integer space. Say the density of primes is 3 and if we keep on searching in the integer space, how frequently we would encounter a period of ten where the density of primes is 3. The gap between integers was normalized for all values 0, 1, 2, 3, 4, and 5 so that we could bring gap values for all five possible prime densities with similar values and differences in their frequency pattern to be compared. Figures 12C-G have plotted half-the-integer-gap above and below a central axis, and C2 symmetry reveals a set of 6 waves or a triplet of wave pairs for each of the possible densities of primes. Thus, we get  $5 \times 6 = 30$  waves that map the frequency pattern for the density of primes; the 30 clocks form an integrated architecture, as shown in Figure 12I.

From the fitting plot of 30 waves, we discovered that the most dominating phase gap is  $22.5^\circ$ , Figure 12I. This is a very important angle, and we see it everywhere in nature.

For each set of ten consecutive integers, there could be 4, 3, 2, 1, and 0 number of primes, and for these five density values, if isolated from integer series, we find three pairs of phase spheres for each of the five density values. This integrated network of 30 phase spheres, all with a specific phase gap and diameter, remains constant; it never evolves,  $n \rightarrow n + 1$  or counting takes place on the surface of this structure. It is the skeleton of SOMU

**The data generation for Figures 12C-I.** We search the prime numbers  $P_1, P_2, P_3, \dots, P_n$  in every 10 numbers interval 0-10; 10-20; ... from 0 to 4000. Then we obtain the successive difference ( $Q_1 = P_2 - P_1; Q_2 = P_3 - P_2; \dots; Q_{n-1} = P_n - P_{n-1}$ ) between  $P_1, P_2, P_3, \dots, P_n$  and frequently, we find the fixed numbers  $Q_1, Q_2, Q_3, Q_4, \text{ and } Q_5$ . After that, we select the numbers  $N_1, N_2, \text{ and } N_3, \dots, N_n$  where we get  $Q_1, Q_2, Q_3, Q_4, \text{ and } Q_5$ . For all  $Q$ , we obtain the number difference  $M_1 = N_2 - N_1; M_2 = N_3 - N_2; \dots; M_{n-1} = N_n - N_{n-1}$ . To get the smallest numbers  $S_1, S_2, S_3, \dots, S_n$ , we divide the numbers  $M_1, M_2, \dots, M_n$  by a suitable number  $X$ . After that, we take the next difference level of smallest numbers  $T_1 = S_2 - S_1; T_2 = S_3 - S_2; \dots; T_{n-1} = S_n - S_{n-1}$ . We plot the curves between numbers 0-4000 and  $T_1, T_2, \dots, T_n$  for each  $Q$ . Then, we fit the curves and get 3 sets of parodic equations for each  $Q$ .

### 9.1.2. Contributing wheels for the density of primes:

Figure 13 accounts for different roles made by the density of primes. The wheel has six domains.

#### 9.1.2.1. Correlating quadratic relation (Dynamics 8) ( $e^2 + \phi^2 = \pi^2$ ) and angular momentum triplet ( $\theta, \phi, \omega$ ) (Dynamics 1):

Thirty periodic waves in the density of primes regulate the structures and properties of that undefined point, which only counts integers ( $n \rightarrow n + 1$ ) to create, drive & regenerate SOMU. 48 is the smallest integer where the ordered factor OF=N (integer). Above this value, the divergence of OF metric ( $OF \gg N$ ) switches from convergence mode to complete a loop or circle; the slope tends to  $90^\circ$ . Thus, attaining a quadratic form is fundamentally embedded in the number system. Since the highest OF for N is found for  $3N$ , the triplet of triplet fractal response is visible in the OF-N plot (M11). Triplet of triplet converts the entire metric, M11, into a finite seed pattern, and that, coupled with the quadratic pattern, generate  $e^2 + \phi^2 = \pi^2$ .

Therefore, 47 is the highest prime before the OF=N condition is satisfied. With the increasing integer in general, OF increases, and that means the slope of OF and origin connected line increases towards  $90^\circ$ . At  $N=48$ , the slope is  $45^\circ$ . We have drawn a circle around it with 97 prime as the extreme boundary of the circle. There are three loops, 0-47, 51-107 (all metrics of SOMU are prime based, so in the axis of integers, any dynamics begins at a prime and ends at a prime), and the final encircle of the system. Three circles depict how the density of primes takes shape, and paired waves traverse without dilution up to 107. Thus, numbers 108 and 53 are also important as far as the starting point of the density of primes waves is concerned. All 30 waves begin by 107, and they complete one waveform around 10000 ( $10^5$ ). Note that by Vedic mathematics, for creating a SOMU, one should expand as a power of 10 and add one; we found that in the resonance chain (Ghosh et al. 2014a, b), and here we would report finding the same in the biological and artificial brain.

#### 9.1.2.2. Synthesis of system points and singularities:

One of the important factors for clock assembled architectures of the density of primes is that  $30=2 \times 3 \times 5$ ,  $2 \times 5 \times 3$ ,  $3 \times 5 \times 2$ ,  $3 \times 2 \times 5$ ,  $5 \times 3 \times 2$ ,  $5 \times 2 \times 3$ , there are six topologies, it is a fusion of two triangles crossing over by facing each other, creating a singularity domain in the overlapping region. The density of primes has enormous complexity than the brain, which primarily uses 12 as the basis of metric variations ( $12 = 2 \times 2 \times 3$ ,  $2 \times 3 \times 2$ ,  $3 \times 2 \times 2$ ). In the ordered factor metric, 12 cannot generate a system point (paired 2 is the reason), but 30 can (three separate integers, 2, 3 and 5). Most of the system points originated when we consider the density of primes, and that continues when we move downstream from 12D to 1D. The density of primes intricately curves the probability of making a point undefined (ordered factor metric, M11), the choices connecting lines for all integers form isolated discrete forms along the lines of integers, the isolation, superposition, overlaps and gaps are modulated by the density of primes. Connecting nearest neighbors of the density of primes plot derives  $C5 \times C3$  symmetry of paired wave gives birth to the property of normalization, i.e., nearly a closed loop at  $360^\circ$ .

#### 9.1.2.3. $12^\circ$ solid angle for 30 wave packets on a phase sphere:

The density of primes has fifteen paired periodic waves or thirty waves with a phase gap of  $12^\circ$ , totaling  $360^\circ$ , which introduced the concept of a circle or sphere when the density plot is projected to infinity. However, nine of fifteen density plots form a triplet of triplet group to demonstrate  $108^\circ$  phase cover. All these phase values are connected to integers, 12, 36, and 108 form the first triplet of triplet, and 12 points ordered factor metric forms the smallest triplet and smallest closed loop. Thus, the  $360^\circ$  value for a complete loop is not an accident, it originates from  $\sim 12^\circ$  ( $11.75^\circ$  or  $23.5^\circ/2$ ) phase gap between paired waves, and there are 30 waves in the density of primes plot. We have shown in **Figure 4C** that at  $N=12$ , the first clockwise rotation completes **(Dynamics 7)**. Therefore, a solid angle of  $12^\circ$  creates a loop.

#### **9.1.2.4. Fifteen vortices generated by 15 pair waves:**

The density of primes has fifteen paired periodic waves engaging in a unique journey of changing the shape of the 3D surface area covered. Similar to the process we generate the phase prime metric (M11; **(Dynamics 10)**), 3D surface area, we build a change in the gap between primes for a particular density (0, 1, 2, 3, 4). Now, as the integer increases, the distance gets separated, and the waveforms generate a curvature following  $\frac{1}{r^n}$ , in other words, a 3D solid angular twist by a pair of waves generating 15 conical cylinders are the evolution pathways for 12 classes of metrics generated for SOMU.

#### **9.1.2.5. Expanding clock architecture of density of primes:**

The density of primes creates 30 waveforms or 15 pairs of waveforms whose periodicities in the integer space have five quantized levels; since five types of prime densities are feasible. These polyatomic time crystals expand inhomogeneously. We need to correlate the density of primes derived invariant structure made of clocks, where instead of time, integers flow. One of the prime features of this invariant structure is the expansion of the spheres representing the clocks. The reason is continuously increasing separations between primes, yet, the geometric feature of the invariant 3D clock assembly remains constant. Therefore, we find that the nearest neighbors in the choices of prime arrangement plots (ordered factor metric) are unique. Interestingly, neighboring integers are not correlated, but the symmetry of prime positions brings choices of distantly located primes in one shape; neither magnitude of a prime is important nor the number of primes constituting an integer.

The nearest numbers suggest that if symmetry breaks, where the system point would move. Therefore, neighboring points in the ordered factor metric loops or curved lines map a homogeneous gradient of a number of symmetries. Along these lines, if one moves, symmetry will not change dramatically. There will be the least changes in the system. Jumping between lines would be a phase transition, while moving through the lines would be symmetry-breaking.

#### **9.1.2.6. 108 fundamental constants made of 17 primes:**

The density of primes synthesizes and sets the condition for normalization. A triplet for each of the five density values of primes sets a triplet of three angular invariants. These angular invariants are conserved laws when thirty system points generated by paired waves of the density of primes jump from one isolated pattern of the metric space to another. The critical patterns of the density of primes generate curvatures as thirty waveforms converge at

common regions. Note that 30 waveforms generated by connecting the density of primes do not start at a particular number, and by 109, all 30 waveforms get at least one point, we see them in 108 tensors (see Appendix I; Supporting Figures S1 to S26). For that reason, they do not converge to a singular point, but rather a domain. These domains generic  $\frac{1}{r^n}$  feature contributes to all the geometric patterns generated by invariants of all 12 dimensions. For this reason, these indices  $C_i \sim \frac{1}{r^n}$  generate fundamental constants  $C_i$ . Thus, we get 95 fundamental constants for 47 base ( $C_i x 10^{-47}$  to  $C_i x 10^{47}$ ), for the SOMU, we envision the ultimate universal engine would have a 17 prime base at 53, then we would have universal constants ( $C_i x 10^{-53}$  to  $C_i x 10^{53}$ ).

9.2. Metric 2, M2. Figure 14: Journey from point to infinity using stereographic projections; Figure 15, Figure 16, Figure 17: 108 stereographic projections to infinity and feedback from infinity

### 9.2.1. The necessity of structuring an undefined point: The growth of a point

Within a point or outside, we cannot have space, mass, potential, field, or even force at the beginning. Moreover, constructing SOMU requires choosing mathematical elements and constructs that use minimum assumptions. If there are many points, we have to define how many, how they are correlated, and who links them. So, at the beginning of everything, we cannot take more than one point. We cannot go outside the point. The only possibility is going inside a point, exploring what we can do so that everything we do is normalized to 1 or unity and satisfy all criteria to be a point. If something starts moving from a point, it could go clockwise, anti-clockwise and knots or composition of both clockwise and anti-clockwise rotations (Figure 14; Dynamics 7). A point's origin is not an entity, but a paradox, to exist or not exist. Instead of a point as a real physical entity, we would only have the probability of a point. Since that question must not have a finite answer, probabilities would deliver the basic elements of SOMU. An undefined point is not a null set. If it is, then it will be defined. It is the sum of all possibilities, an endless chain, that cannot be defined.

### 9.2.2. The birth of SRT follows a fusion with a point to create 15 morphogenesis

Now at the second phase of the evolution of a point, when clockwise and anti-clockwise paths superpose, only the end path could exist, termed as T (of SRT); both the clockwise and anti-clockwise paths could cross and survive with a loop, R of SRT; finally, both clockwise and anticlockwise paths could coexist in a twisted path (Dynamics 7), S of SRT. Once we have SRT configuration, circle, ellipsoid and knots form. These are the origins of morphogenesis. SRT properties are defined at this stage very similarly, S=Fill or expand the pattern by repeating, R=Cross-over and inflate, and T=minimize corners to make it suitable for bonding. Bigyan-Vikshu argued in the 14th century that for several thousands of years, different schools and a wide range of scholars have argued for redefining S, R and T. However, the sense of SRT triplet S=projection, R=transformation and T=bonding were never changed.

However, for morphogenesis, one requires to add a point and a bidirectional arrow to the circle, ellipsoid and knot triplet. Why do we need to add a point and bidirectional arrow? We

have to insert a point inside a point; that is true. However, we need to deform the shape we have in hand so that the transformations continue. A bidirectional arrow refers to an expansion of the shape and thus incorporates a new pattern.

We have outlined in **Figure 14** at the bottom row how adding a point to the circle creates a teardrop, triangle and square. These three derived geometries combine to create wide ranges of geometries we observe as constituents for morphogenesis. When an ellipsoidal knot (R) undergoes a point and arrow transformation, it builds several asymptotes and divergent geometries, which are used as a basic element for morphogenesis. Finally, when knots interact with the point and the arrow, it generates several complex knots.

The three-phase evolution of a point to basic morphogenesis constituents is the key for SOMU.

### 9.2.3. 108 stereographic projections from morphogenesis elements

In **Figure 14**, we have outlined how a point, while trying to rotate in a loop and thus remain as a point, creates multiple geometries. The circle boundary is always infinity, and directional communications between different points on the boundary with respect to the bottom of the circle reveal different interactive pathways. Following incredible arguments on the undefinedness of a point for millennia, there has been a significant effort to connect a point with the circle boundary or the infinity. Surprisingly there was never debate about the number of elements, necessity, importance and applications of these forms from creating 108 rhythms for drums (number of bits in tala). Then, 108 dance moves (tandava), 108 classes of the composition of tunes or Raga (generating a defined mental state), 108 types of mudra or finger gesture, 108 seed sounds for resonating with the universe (beej mantra), the list would go on and on. We have extensively checked the 3000 years of documented history and reviews for over a decade before compiling the 108 geometric forms that would cover all features in one database (see **Appendix I; Supporting Figures S1 to S26**).

SOMU needs an archive of point-infinity connection, and since the density of primes follow  $C_2 \times C_3 \times C_5$  symmetry using 30 waves that shrinks and expands over the integer space. A similar symmetry is observed in all the 108 forms existing today across various disciplines, and all fields argue to implement  $C_2 \times C_3 \times C_5$  symmetry while implementing 108 basic forms of creation to connect the created form of art, mathematics and structures to the universe or infinity.

#### **How human body movement could be used as a basic mathematical simulator for $C_2 \times C_3 \times C_5$ projections to infinity?**

We have plotted three figures compiling 36 images in each of them. **Figure 15** uses five-fold symmetry  $C_5$  element primarily creates three distinct dynamical features in twelve forms ( $3 \times 12 = 36$ ). Fingers are the best tool to demonstrate and teach the patterns related to  $C_5$  symmetry. Human fingers length follows the golden ratio. Therefore, the dimensions of each bone and motion constraints are sufficient to fold all five pointers in the right directions with respect to each other. We have identified patterns generated by folding the fingers. The objective is to build folds that connect to the circular boundary or infinity with different angular variations. Earlier, we calculated that the density of primes generates five different densities (0, 1, 2, 3, 4), and they create cylindrical and conical shapes (**Figure 13**), the

projection is a sphere, and we need to estimate all possible projections. This projection requires a mathematical model that applies  $C_2 \times C_3 \times C_5$  and the human body is a perfect example of such symmetry.

The front part of one hand is  $C_2 \times C_3 \times C_5$  symmetry where  $C_2$  is provided by the folded and unfolded palm,  $C_3$  is three folds made of a thumb, four fingers put together and palm, and  $C_5$  is represented by five fingers. All **Figure 15** patterns are made by following this protocol.  $C_2$ ,  $C_3$  and  $C_5$  features dominate in twelve patterns each. If we consider the whole sphere made of 12 holes (similar to vortices generated by Hinductor, a microtubule analog device we patented as the fourth circuit element, [Sahu et al., 2010 JP-511630; US 9019685B2, \(2015\). EU patent EP2562776B1](#)), then, similar to the 12-hole blinking devices, we find locations on the sphere. See 3D simulation in **Dynamics 4**.

The frontal parts of the two hands depict  $C_2 \times C_3 \times C_5$  symmetry where  $C_2$  is provided by the two hand parts,  $C_3$  is three surface contacts made by two hands making contact side by side, one top of another face to face and one above another, and  $C_5$  is represented by five fingers of two hands touching each other. All **Figure 16** patterns are made by following this protocol.  $C_2$ ,  $C_3$  and  $C_5$  features dominate in twelve patterns each. If we consider the whole sphere made of 12 holes (similar to vortices generated by Hinductor, a microtubule analog device we patented as the fourth circuit element; [Sahu et al., 2010 JP-511630; US 9019685B2, \(2015\). EU patent EP2562776B1](#)), then, similar to the 12-hole blinking devices, we find locations on the sphere. See 3D simulation in **Dynamics 5** Metric PPM.

Two hands, two legs and a head depict  $C_2 \times C_3 \times C_5$  symmetry where  $C_2$  is provided by an imaginary line dividing both sides of the human body,  $C_3$  are three folds made of neck fold, waist fold and leg junctions, and  $C_5$  is represented by five fingers. All **Figure 17** patterns are made following this protocol.  $C_2$ ,  $C_3$  and  $C_5$  features dominate in twelve patterns each. If we consider the whole sphere made of 12 holes (similar to vortices generated by Hinductor (equation 2), a microtubule analog device we patented as the fourth circuit element; [Sahu, S. et al., 2010 JP-511630; US 9019685B2, \(2015\). EU patent EP2562776B1](#)), then, similar to the 12-hole blinking devices, we find locations on the sphere. See 3D simulation in **Dynamics 6** Metric PPM.

### 9.3. Metric 3, M3. Figure 18: Twelve different mathematical operators acting as infinity: Figure 19: Twelve classes of phase singularities

#### 9.3.1. The engineering of infinity: from Ramanujan to an infinite series of invariants

The infinity is a versatile plane executing a deformed reflection of an infinite series of invariants. It is a carefully crafted boundary that returns the eventual singular invariant architecture in an infinite series of invariants primarily generated in the 8D database generating module of SOMU. The determination of the 9D invariant is tricky, and the concept of infinity is extensively used here. We need to introduce a shift in the infinity position because of Ramanujan's treatment of infinity. If we see his derivation, how he found the sum of natural integers is  $-1/12$  by shifting infinity by one term and then we can find that he changed the location of infinity from the feedback. While playing with infinite series, every mathematician

shifts the infinity point and creates two distinct infinite series from one infinite series. Then they deduct the two series to get the result. They use infinity as a pot that does not change its character when it adds or subtracts a term. One query that often comes to our mind is, what is the physical significance of shifting one term of an infinite series to infinity? When we deduct, we find a common geometric feature or invariance that repeats in the infinite series to generate an apparent complexity. Acquiring a differential between the same series by shifting infinity is a simple tool to find invariant.

Infinity is not the endpoint of the mathematical universe that is gifting us a solution. Infinity is within PPM (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b) itself because it produces an infinite series of geometric shapes with the 9D database, which produces a point. If we say what the universe is here, our proper answer would be "none." There is an ideal PPM which is the universe. That ideal universe generates 3 sets of infinite series (2x2x3), 6 sets, 8 sets, 12 sets and all possible sets of infinite series and comparing them creates a hierarchy of solutions. A life form like us, we are only a singular point in the domain of a universal PPM. We create only three infinite series, just a triangle. Imagine a machine that can create all possible numbers of geometric series in all possible compositions of geometries. That is the universe.

We wanted to generalize this singular "shifting" approach because, thus far, mathematicians would not have to address a series of invariants which is uncorrelated geometric shapes. Interestingly, each term is invariant to the preceding term in an infinite series of invariants. Therefore, forget about similarities. It is not easy even to correlate. This is why we need to engineer the feature of the boundary beyond which the infinity resides instead of using blunt mirrors at infinity.

### **9.3.2. The transparent infinity made of the density of primes:**

From the database of 11D invariants, the system finds ripples of primes by projecting to infinity and feedback from infinity. It uses 31, 37, 41, 43 and 47. These five primes find three systems, one above and one below, connected by ripples produced in the density of primes. Ripples are high-density primes that act like mirrors for the 12 orthogonal invariant systems. At least three high-density of primes regions is essential to building a self-operating machine. Three systems, each with 12 bands or nested clocks with a transparent infinity boundary made by prime density ripples, would change how we view systems. 12D database reveals the nature of boundaries or infinity barriers that isolates three self-operating systems.

Convergence of several nested dynamics grown within and above in the 11D invariant database eventually reduces to three in 12D. The three nested boundaries of the density of primes-based ripples from 12 or more nested worlds in 11D are reduced by orthogonal transformation (equation 3). Only those three densities of prime-based ripples that repeat in the within and above network complement each other (different sets of primes in each infinity barrier constituent) are selected in 12D.

### **9.3.3. How does the infinity barrier work as a filter and reflect feedback?**

There are twelve different infinity barriers selected in **Figure 18**. Infinity is not a real point it is a virtual region where an infinite series ends. However, as Ramanujan showed, that simply by shifting the infinity, one could find out mathematically the feedback of that infinite series, the

symmetry that is not apparently visible in the series, however, that feedback from infinity defines  $S$ , one of the fundamental properties of SRT triplet. This is why feedback from infinity is an extremely important mathematical protocol for any conscious automaton  $C$  to assess the future and predicting the future. For SOMU, this particular engineering is one of the most fundamental engineering that one has to master to create a conscious automaton.

We have identified 12 mathematical conditions how the infinity would look like where from suitable desired feedback would arrive at the source. Remember, feedback from infinity is used by  $C$  to always remaining updated with  $U$ .

**First barrier: continued fraction:** logarithmic invariants mostly encounter such infinity barriers. The infinite series of invariants grow as continued fraction geometric arithmetic. If the temporal domains follow power indices, we get an infinite series of invariants, where clocks get faster and faster.

**Second barrier: directional induction:** polarization invariants, rotational directions of the clocks in the polyatomic time crystal or 3D clock assembly or the information structure of SOMU is an important factor because relative directions of clocks play a major role in the stability of the information structure. In this scenario, repulsive directional sets face deformations in the feedback.

**Third barrier: multinion manifolds or maniflats** (Dynamics 9; M7): Dimensional decomposition invariants, when maniflats decompose and generate an infinite series of subsets of maniflats, we get feedback from infinity where typical geometric composition that generates a spherical assembly is favored. Therefore, infinity becomes a hierarchical geometric architecture generator.

**Fourth barrier: fractal within and above network:** undefined invariants are plenty due to fractal-like network. If the circular boundary depicted as infinity is made of tiny circles, and those circles are made of tiny circles, which should be the reality, then that typical boundary would favor particular invariant network embedded in the infinite series of invariants (Buhlmann, 2018). Thus feedback would have been favored.

**Fifth barrier: prohibited and restricted states in a pattern:** quadratic (Dynamics 8), multi-field vortex invariants (Dynamics 11; Metric 12, M12), these classes of invariants are vortex shapes where several attractors form where we do not get any solutions. We have detailed several such attractors in the ordered factor metric where vortices holding the 3D clock assembly are formed by fields varying of wildly different nature, like electric, magnetic, mechanical, electromagnetic etc. In such a scenario, there would be an attractor, which would block and favor particular classes of invariants that energetically pass through.

**Sixth barrier: A singular state trap:** no invariant is found in an infinite series of invariants, where all elements are of the highest level of processing. As a result, a transparent infinity barrier is a set of the density of primes that changes the nature of a metric when it expands through this barrier. Since a high density of primes regions compares to the similar density of primes in the expanding metric, it selects a similar or complementary one. Note the duality of selecting either similar or complementary because one is a classical system-like operation and the other is a quantum system-like feature. The reason is that classical systems are additive or

subtractive, while quantum systems care about the product of wave function or probability density.

**Seventh barrier: Ever expanding and regenerating boundary:** ordered factor invariants expand their series, and if that decomposition into various divisors continues in the invariant series, it will bring new progeny series at the infinity boundary.

**Eighth barrier: Feedforward loop running all over boundary:** triplet of triplet invariants generating the infinite series encounter such barriers. Any sensory information could be converted into clock assemblies given the shape of manifolds represented by a tensor of appropriate dimensions (Dynamics 9; M7). The transformation is fairly straightforward. However, morphogenesis is fundamental to retrieving real-world information from clock assembly or tensor. Choice of morphogenesis and their combinations are classified into three parts. Dimension 7D, where five key morphogenic operations execute together at a time, we call operation T. Then 8D, among bonding T operations, we observe transformations or R operations from one morphogenesis to another. Finally, in 9D, we find an infinite series of transformations in a sequence that reflects and returns from infinity.

**Ninth barrier: Divergent and convergent points make a barrier:** The density of prime invariants generates an inhomogeneous distribution of relative periodicities of the densities, 0, 1, 2, 3, 4. Therefore, the divergent and convergent domains in the circle-shaped barriers representing the infinity would have missing feedback regions where we would notice singularities. All points on the boundary would not be equally favorable.

**Tenth barrier: a virtual barrier of multiple parallel universes:** Multiple invariant series interacting similar infinity barrier would generate singularity in the feedback from infinity. The projection is supposed to be a reality or real experience, but that would not be the case when several infinite series of invariants generate feedback. Then all infinite series invariants would interact, and then the projector would receive a combined set of feedback.

**Eleventh barrier: The nested universe of primes make the boundary:** clocks made of primes only make the invariants. Prime-based invariants cannot be decomposed further. If SOMU builds a processor where only a prime number of clocks emulate the spatio-temporal events happening in nature, then the density of primes would factor in and generate inhomogeneous responses, singularities in the density of clocks. In reality, we refer to the 3D arrangement of clocks as integers (triangle = 3) depending on various assignments like geometric shapes etc., for primes, this is not possible for primes.

**Twelfth barrier: Undefined singularity points constitute the boundary:** Prime overloaded invariants or symmetry overloaded invariants. When a large number of distinct symmetries are present, we find infinite series of invariants that encounter an infinite boundary where fluctuations among different symmetries generate singularity due to the presence of a large number of symmetries.

#### 9.3.4. Twelve different classes of singularity points:

We have already mentioned that singularity is one of the most primary engineering tools of SOMU, because using this property, SOMU ensures to write geometric shapes in the vortices. Not just that singularity points are those where during symmetry breaking energy emits. Since in the SOMU derived C automatons, or conscious elements do not send information or facts singularity bursts are the only way how an infinite network of invariants senses itself and makes the final decision. In the engineering world of SOMU where current flow and classical object flow are preserved only for hardware evolution and those types of information processing is kept separated from the decision making, singularity is as important as infinity, and undefinedness. In [Figure 19](#), we have outlined twelve different mechanisms following which singularity could form in SOMU. Primarily, we expect such a mathematical condition could arise in the information structure, i.e., polyatomic time crystal or 3D assembly of clocks.

1. When phase, amplitude or momentum varies arbitrarily, without following any pattern as a function of other variables, the system acquires a singularity point. This is a standard definition of singularity. Normally when nearly identical waveforms with an opposite phase overlap, we suppose to get a null or astronomically large value. None of these happens truly; instead of a null, we get rapidly oscillating values with no pattern.

2. When space, time, topology, or prime varies, and the metric acquires various morphogenic alternatives, we find that in the SOMU system, several metrics run in parallel, then identical information structures would have different rotational directions and combinations. For example, if we have a combination of 12 clocks,  $2 \times 2 \times 3$ ,  $2 \times 3 \times 2$ , and  $3 \times 2 \times 2$ , all three versions look very different. If somehow these options are available as separate hardware, then cross-over clock regions would form singularity domains in the system.

3. The foundation of SOMU is based on a fractal tape ([Ghosh et al., 2014a; Agrawal et al., 2016b, 2018](#)), in principle, we could enter into a single cell, and the journey would continue finding new tapes endlessly. However, that does not happen in reality. Whenever there is a lowermost journey or the uppermost journey, the unit clocks are made of continuous values, i.e., quantization disappears. Thus, we encounter a singularity, the arbitrary variation of invariant patterns.

4. In the case of geometric information processing, there has always been a problem related to the convergence and divergence of clocks. Both convergence and divergence follow an identical geometric path, except there is a direction. Therefore, in the case of an extremely slow motion of the system points, the transient interference delivers random fluctuations in the prescribed values of phase, amplitude, momentum, polarization etc.

5. We have discussed above that a system point has to reach the starting point, but that never happens, so instead of a circle, we get a springlike helical path. Now, if there are perturbations in all dimensions, the formation of helical twists continues, and we reach a helical singularity.

6. Fractals are self-similar at all scales. In SOMU, since we use the pattern for the density of primes as the key regulator, SOMU does not rely on fractal but an astronomically long, fully non-repeating metric. In the geometric musical language, GML ([Dynamics 3](#)), where every single piece of information in the universe is represented using a 3D assembly of clocks or polyatomic time crystals, geometric shapes are made of clocks ([Agrawal et al., 2016b, 2018; Bandyopadhyay et al., 2019, JP-2017-150171; WO 2019/026983](#)). Corners of geometric shapes

are made of clocks. Therefore, we could get a similar geometric shape by entering the corner of a geometric shape. If, for some reason, beyond our control, at all twelve or higher dimensions, we have an identical geometric shape, then, by definition, the entire information architecture would have zero information content because, for SOMU, information would be invariant.

7. An infinite sequence of wavefunctions representing a part of the information structure should be part of one wavefunction. In this scenario, it is a conflict and contradictory to the basic definition of a wave function. This is a singularity.
8. When we make normalized plots for ordered factor metrics (Bandyopadhyay, 2020), there is a set of integers that triggers clockwise rotation, and there are sets of integers that trigger anti-clockwise rotations (Dynamics 7). There are phase gaps with restricted values or prohibited phase regions of the SOMU. These are singularity domains.
9. Certain primes are used most to create integers. We think it would be prime 2 as the maximum contributor, but that is not true. When we plot, we find a gaussian distribution for the contribution of a prime, and common overlapping regions generate singularity domains.
10. There are three metrics: phase prime metric, PPM (Dynamics 2; (Dynamics 10)); nested prime metric, NPM and paired prime metric, PRPM (Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b). Their junctions are singularity domains because at least three distinct dynamics are at the junction points.
11. There are several patterns in the morphogenesis, ordered factor metrics where the world lines end abruptly, and the jump of system points suggests a singularity domain cross-over.
12. Nested clocks in the information structure transform as information is exchanged from one dimension to another. When information from two distinct dimensions makes products (quantum mechanical operation), there is always no continuous transition, for one universe or dimension experiences the cross product of information from information structures of two other dimensions. Thus, information passes through singularity domains.

#### 9.4. Metric 4, M4. Figure 20; Dynamics 7: Clockwise and anti-clockwise rotations:

Three kinds of normalizations run simultaneously in the dimension-less, shape-less and mass-force-energy-less point. These three normalizations of the pattern of choices (e.g., ordered factor metric, prime composition metric, paired prime metric etc.) create quantized and virtually closed mathematical entities which demand a finite shape. Thus, the drive that applies three mathematical conditions to set normalization and discretize the universe is the primordial mechanical vortex  $O_{um}$  that triggers the synthesis of SOMU.  $O_{um}$  transforms (R), and slowly the other forms of vortices are born. Though we have explained the origin of clockwise and anti-clockwise rotations under the framework of an ordered factor metric (Bandyopadhyay, 2020), here we explain a different aspect of it in Figure 20. Calculated ordered factors for a set of integers are always increasing. However, when increasing limiting

integers and setting them to  $360^\circ$ , using a set of cartoons, we have explained this concept in the first row of [Figure 20](#). We set the upper limit of the normalization plot and then placed ordered factors of all integers below that value in the plot. We find that 12 is the first point where a clocklike rotation completes  $360^\circ$ . Our previous reports did not emphasize the importance of angular shift or stroke provided by an integer. The sum of all the angular shifts leads to 360, and these angular contributions are unique. When we account for a clockwise or anticlockwise rotation automatically generated as we increase the number of points in a single point to make it undefined, the role of each integer in the normalization of the selected quantized part turns supreme when 30 clocks of the density of prime architecture unfold the intricate details of clock architectures.

## 9.5. Metric 5, M5. Figure 20: Percentage of the contribution of primes & saturation

In metric 4 above, we have discussed only one of the three key normalizations that shape PPM ([Dynamics 2](#)) as an entity that delivers rotation, attraction and nesting, three key properties ([Reddy et al., 2018](#); [Bandyopadhyay, 2020](#); [Singh et al. 2021a, b](#)). Thus, S, R, and T properties generate from the phase prime metric; ([Dynamics 10](#)). Saturation in the contribution of primes in the integers ensures that we can build a mathematical model of consciousness using a few primes. If all primes had equal contributions in constituting the primes, then the SOMU framework would not have been created. Therefore, it is essential to understand the nature of convergence that originates in the density of primes as damping of 30 waves for 0, 1, 2, 3, and 4 densities over the integer space. The intricate pattern among the significant prime contributors needs an apparent boundary, provided by the number system naturally. Of course, we do not want a defined boundary because then, we would return to the Turing machine, leaving the whole SOMU where every single point is undefined.

In [Figure 20](#), bottom row, while describing the role of primes, we have expanded the calculation from our previous 17 primes covering 86% to 1229 primes to find that we could reach only 91%, so, more we reach towards 98%, the number of required primes increases manifold, making it nearly impossible to emulate consciousness or self-aware feature by SOMU driven engines. It also suggests that creating an artificial consciousness that fully matches nature's ability would never be possible. We have spent nearly two decades only creating 47 organic gels ([Basak et al. 2012](#)) to emulate the dynamics of 90% of the human brain. However, the key missing part would be pivotal in generating unpredictable dynamics.

In [Figure 20](#), we have included the vortex generation ability of the ordered factors. The lines connecting the OF and the origin build a slope. Several concentric cones come out when we rotate them to create a 3D metric (M11). This is important when organic resonators form a self-assembled superstructure in the solution ([Babbush et al., 2014](#)). Within the domain of M6, we have included the saturation factor as a product of primes. Say, in a system we are building a typical organ for the artificial brain, the total number of resonators in saturation should be the product of all primes (for 15 primes, it is  $\sim 10^{12}$ ) at every layer. After that, it becomes a point, as shown in the cartoon. The point starts growing and counting until it assembles  $\sim 10^{12}$  number of resonators.

## 9.6. Metric 6, M6. Figure 21; Dynamics 8: Missing $e - \pi - \phi$ quadratic relation in all normalized spirals and helices

Normalization, or converting all variations into one, is a mathematical process with widespread implications regarding mathematical output. When we normalize the ordered factor of integers, we see how beyond certain integers, the unique variation of the pattern of ripples disappears. In this particular operation, the importance of distinctive features of the smaller integers gets more pronounced with respect to the larger integers. The normalized plot for the ordered factor helps us understand the self-similar pattern that would primarily govern the entire system. Figure 21 shows how connecting black lines form a 2D black disk with white spots in a normalized plot. These spots, if connected by nearest neighbors, exactly follow the same way as we connect all the ordered factor values to generate the M11 metrics (ordered factor metric), then we see the quadratic relation ( $e^2 + \phi^2 = \pi^2$ ) (Dynamics 8). This is a simple connection between the three fundamental constants of the universe. However, we noted the physical significance of this quadratic relation in 2015 while measuring the electrical magnetic and electromagnetic resonance frequency bands. This quadratic relation connects three different resonance bands. This is a remarkable match. We have detailed these observations already (Bandyopadhyay, 2020); however, here, we would like to point out that we are now seeing a much more profound impact in the self-assembly of the organic resonators in the brain jelly of our artificial brain (Bandyopadhyay et al., 2009; Ghosh et al., 2014a, 2015, 2016b).

One of the most important observations we have made recently is that the quadratic relation regulates five major resonant structures formed by organic resonators noted in Figure 21. These five patterns are repeatedly observed when we get organic jelly by pumping electromagnetic resonance frequency packets as a function of time. The ratio of electrical resonance is measured by a spectrum analyzer, mechanical resonance is measured by a Fabry-perot interferometer (ultrasound emission from brain jelly), and magnetic resonance is measured by using a magnetic film. The polarized laser-based Fabry-perot interferometer reveals how  $e$  regulates electromagnetic resonance frequencies,  $\phi$  regulates magnetic resonance frequencies, and finally,  $\pi$  regulates mechanical resonance frequencies. Together the quadratic relation regulates all three resonance properties to grow brain jelly as per the GML-derived polyatomic time crystal or 3D assembly of clocks (Bandyopadhyay et al., 2009; Ghosh et al., 2014a, 2015, 2016b). The PPM drives the evolution of symmetries by selecting the geometric parameters of these five patterns.

The Discovery of a self-repeating pattern in the primary investigation of the PPM helps us understand a system thus far believed to be non-repeating. The entire pattern of primes is indeed a composition of primes with a variation of gaps 2, 3, 4, and 5.... And we have already proposed that we need a gap version of PPM as a key SOMU regulating unit. Therefore, when we normalize the ordered factor, we have to remember that the gap of primes is also a metric and that 86% of all integers could be generated using 2,3,5,7,11. Similarly, when we calculate what the prime gaps that regulate most primes (86%) in the number system are? The answer would be 2,3,4,5,6.

## 9.7. Metric 7, M7. Figure 21; Dynamics 9: Decomposition of maniflats

While developing the brain model, we understood that exactly twelve organs in the brain follow the triplet of triplet frequency band prescribed by the ordered factor metric (Singh et al., 2020a; access row data in [www.brainrhythm.org](http://www.brainrhythm.org)). Also, twelve is the number that enables the first 360-degree rotation. Twelve is the number that allows  $2 \times 2 \times 3$ ,  $2 \times 3 \times 2$ , and  $3 \times 2 \times 2$  three points to create the first triangle. In the origin of the number system, 3 isomorphs of information structure are the first step to achieving consciousness (see discussions of its historical significance above). Therefore, we needed to check the  $12 \times 12$  dimensional tensors. Since only quaternions and octonions were present then, we had to build the mathematics of multinions or tensors  $9 \times 9$ ,  $10 \times 10$ ,  $11 \times 11$ ..... $17 \times 17$ ,  $18 \times 18$ ,  $19 \times 19$ ,  $20 \times 20$  (icosanions) (Singh et al., 2021a, b). We did not go beyond icosanions because, topologically, we do not get new compositions. Geometric shapes for a particular integral number of multinions are such that their surfaces are made of triangles only.

**What is the decomposition of maniflats?** In the classical system, wave functions are added; in the quantum systems and beyond, we take the product of wavefunctions. As a result, elements of a particular wave function is shared among various elements. When we generate a polyatomic time crystal, it is eventually a singular wave function made of products of all the wavefunctions representing the constituent clocks, we get dodecanion tensors as the product of two twelve dimension vectors, and similarly, we could create other multinions. In back-to-back two papers, we have described the mathematics related to these tensors. Due to the symmetry of the elements in the tensor, we could create sub-tensors that are products of lower-dimensional vectors. So, these sub-tensors enable us to carry out advanced-level mathematical operations we introduced for the first time.

Say we have twelve elements in the 12D vector; when we make the product,  $12 \times 12 = 144$  elements are expressed only in terms of 12 elements. The values are not random; no elements go beyond the normalized clock architecture. Now,  $2 \times 2$  elementary tensors or  $3 \times 3$  elementary tensors are clock-like symmetric elements (+for clock-wise rotation, -for anti-clockwise rotation), the row element and vertical element and the product form a triangle; this is a flat region (Dynamics 9). Several such triangular flat regions make the maniflat (equation 4). Since sub-tensors also create their maniflats, a pure tensor and its sub-tensors generate two different maniflat architectures. The maniflat architecture made by sub-tensors is called decomposed maniflats. In Figure 21, we have explained how 20D tensors could fully be rewritten as  $4 \times 5$  and  $5 \times 4$  symmetries, and both would generate different superstructures of maniflats. In Figure 21, we have also shown that elementary clocks could deliver values where periodic loops could be stored. A tensor would be an integrated clock architecture since overlapping regions of the pathways would build polyatomic time crystals or the information architecture for SOMU.

There is a difference between maniflats and manifolds. Here, we create the manifest superstructure and then connect the common points to generate an equivalent manifold (see Dynamics 9).

**The superstructure of manifolds or maniflats (Singh et al. 2021c, 2021d):** Multinion manifold dynamics are all embedded locally, building a nested architecture of manifolds; one manifold is a subset of another. The architecture of manifolds is the regulator of all dynamics in a SOMU universe.

**How would everything about multinions change once we explore 12D and above? The concept of manifold (Dynamics 9):**

When we have a quaternion, we need to draw a circle and put  $i$ ,  $j$ ,  $k$  and  $1$  to find the product sign. However, when we have an octonion, we need a **Fano plane** where we have a triangle, three centers of the three arms, and finally, a center of the triangle. Together, seven points map how signs are decided for the product of moving through the triangular pathway. The situation changes significantly when we move to 12D and above. A transition map is no more a 2D plane; it is a 3D structure and demands complex folds in the 3D plane.

Most importantly, there are not one but three such complex 3D structures that coexist. The coexistence of multiple 3D geometries begins at 12D, but it continues. It is easy to find how many manifolds would coexist. For 30D,  $2 \times 3 \times 5$ ,  $2 \times 5 \times 3$ ,  $3 \times 5 \times 2$ ,  $3 \times 2 \times 5$ ,  $5 \times 3 \times 2$  and  $5 \times 2 \times 3$ , six distinct manifolds would regulate the transitions simultaneously. We have always considered the coexistence of manifolds (technically manifolds) as one of the primary criteria for developing a SOMU. Whenever a tensor starts delivering more than one manifold, it is the coexistence of two distinct data structures. Information integration methods change. Thus far, natural events were analyzed using quaternions and octonions. Until the 11D complex tensor, we do not observe the coexistence of distinct grammar of pathways. From 12D onwards, a single mathematical universe not just delivers three solutions, but each solution could find a loop of three-manifolds within. We explain below this extraordinary scenario with an analogy of the human brain.

**Why don't we use more than icosanions, or why do we limit ourselves within the structures of 12 planes?**

We do not use 3D shapes with  $>20$  planes since 12 dimensions are minimum requirements for SOMU, and it is either achieved by dodecanion with 12 planes or 12 corners of a 20 plane icosanion. For multiple compositions of corners and planes, 1D to 20D is explored.

**9.8. Metric 8, M8. Figure 22: Contribution of primes and gap between primes in integers**

**Figure 22** shows a special kind of saturation beyond forced normalization shown in Metric 4. We want to create the SOMU model following minimum assumptions. Therefore, forced normalization is connected to the weak bonding abundant in nature, and nature uses it to construct biological life forms. However, there are multiple reasons why materials during self-assembly initiate a normalization process that would trigger metric 4. Here in Metric 8, we simply count the number of times a particular prime number is used to create other integers. The number of times we encounter the highest contribution of 2, 3, and 5 slowly dilutes as we increase the integer value. The most important aspect is that as we increase the integers and encounter new primes, they cannot contribute significantly to constructing integers. Thus, in the solution, if organic resonators are designed to build symmetries related to a particular prime, for prime 2,  $C_2$  symmetry would dominate in constructing the structures. For prime 3,  $C_3$  primes would dominate, and after 29 number of primes, the role of primes becomes insignificant. Even if we want to build a very complex artificial brain, it would not be a more

powerful brain. For this reason, we have created a model of concentric circles in **Figure 22**, which suggests the orbital-like boundary of atoms, the complex curvy paths on the imaginary circles dilute as we move further from the center of this structure.

In the context of saturation, the integer gap between primes plays a crucial role because this is another vital parameter in all the metrics governing the synthesis of an organic brain jelly or self-assembling resonator following the phase prime metric (**Dynamics 10**) (Reddy et al., 2018; Ghosh, et al., 2014a, 2015; Bandyopadhyay, 2020). Normally mathematicians provide a nice name for prime gaps, like, paired prime if the gap is two. However, for SOMU, the gaps vary, and all possible gaps collectively build a pattern of metrics whose initial few loops suggest how saturation would arise since the primes go further and further as the integer increases. The density of primes is not as random as we think; we can estimate even that using the prime gap metric. The integral gap of primes or separation of primes in the integer space delivers a typical feature for the density of primes, which is the key driving force for PPM and SOMU. The self-similar feature in the prime gap metric maps hierarchical control of the density of primes that is invisible in the ordered factor metric. Also prime gap metric directly maps the location of the singularity domain in the integer space, where the highest density of primes constitutes an integer. In reality, the prime gap metric does not deliver the complete picture of the density of primes. We introduced a third metric that counts the maximum number of primes used in constructing an integer. Together, gap primes and maximum prime count, two distinct classes of metrics, deliver a better feature of the density of primes that is fundamental to the integer system.

### 9.9. Metric 9, M9. Figure 22: Continued fraction geometric architecture, CFGA

We introduced earlier Continued fractal geometric algebra, CFGA, (Bandyopadhyay, 2020); recently, it has been proposed that random selection of values in the continued fraction delivers for automatic discovery of fundamental constants (Raayoni et al., 2021). However, long before this new claim, we have used continued fractions combined to order factor metric or distribution of density of primes (Bandyopadhyay, 2020). Now we changed the acronym of A in the CFGA and replaced algebra with architecture. The reason for replacement is that dodecanion mathematics is an alternative to algebra, the decomposition of tensors with maniflats to process polyatomic time crystals and information structures of twelve dimensions is an original mathematical protocol, and we do not need any new algebra. Recently we have come across this realization when using computer simulation; we started evaluating SOMU with human brain subjects (discussion in a separate section). As an alternative to dodecanion or multinion mathematics, we could fill up a circle using a different number of circles both inside and in the boundary. Growing within and above, we could build a new class of power mathematics that we observe continuously in the biomaterials' resonance band and the brain's polyatomic time crystals. In **Figure 22**, while describing the CFGA, we have shown how one could naturally put circles and embedded geometries inside and in the boundary to carry out complex power mathematics and derive complex mathematical solutions, including partial and complex differential equations of different orders and indices.

We have already detailed the process in our earlier literature. However, since we did not experimentally verify with human subject experiments, in this report, we make minor changes, making SOMU an extremely robust model. For example, here, we suggest that we follow the ordered factor metric to fill up the circles and building architecture of clocks in the boundary or perimeter of the circle. Then complex arithmetic is performed at different layers of higher indices simultaneously.

Most importantly, CFGA is the method by which infinite series of invariants are generated in the organic jelly. When the entire jelly formed by input polyatomic time crystal starts vibrating, and the invariants are released as a sequence of bursts, we get an infinitely long series of invariants as complex streams of vortex field architectures, similar to real neural network (Singh et al., 2021c).

### 9.10. Metric 10, M10. Figure 23: Fifteen morphogenesis, SRT class

We have very little to add to the already reported understanding of morphogenesis. When at 9D, the concept of time has reached a projection where the three-dimensional significance of time is encoded in the information structure, then world lines are made by connecting the singularity domains across various dimensions. These world lines are not stable; they adopt various forms as described in the metric 2, M2, Figure 14. While analyzing Figure 14, we suggested how three possible rotations and superpositions from a single point create elementary patterns and properties like the SRT operator is born. Now, at the final stage, these forms bind as morphogenesis patterns in the  $thi^{rd}$  generations described in Figure 23.

**The SRT invariant triplets of 7D to 9D:** Before we understand infinity, we need to learn that we never apply phase prime metric (Dynamics 10) before 7D. From 7D, we amplify the symmetries and arrangements we have using the metric. While the transition from 4D to 6D reduced 3D differential clock assembly to a plane and a plane to a line. From 7D to 9D, a line is reduced to a point. From 10D to 12D, the point is transformed into an undefined entity. Reducing a line to a point faces a series of problems. The first question is how points are bonded in a line, how lines transform and finally, how projection to infinity and feedback from infinity (PIFI) creates a closed space or a singular point.

However, how do we know that we have achieved constructing a closed space or a point? Orthogonal superposition of A on A, if returns a numerical value, then we have constructed a point. Therefore, the journey from 7D to 9D is also finding orthogonal invariants. The transformation from 6D to 7D is about finding bonds between worldlines obtained in the 6D invariant. How do we find bonds? When two or more lines are complementary in their dynamics, collectively forming a close shape and remaining in contact mode, we call it a 7D database. These distantly located lines are brought nearby, and a new database of virtual close structures is created where we look for two complementary close shapes that are either or, which means if we take one structure, then we do not have to take the other one. Thus we reach a sequence of nearly equivalent geometric structures or morphogenesis and extend that series to infinity; we get an 8D database. From the 8D database, we project it to infinity and then derive a singular structure or point or the 9D invariant. The projection to infinity and feedback from infinity is a process that finds a fractal seed or the key geometry that self-

similarly repeats to create an infinite series in 8D. Our database in 9D is made of absolutely equivalent points with distinct prime symmetries, therefore not to be converged.

9.11. Metric 11, M11. Figure 12, Figure 24; **Dynamics 10**: Fifteen ordered factor metrics

**Morphogenesis is world lines connected by probability lines in the PPM: What keys enable it to synthesize 3-dimensional worlds of time**

In **Figure 24**, we have described fifteen prime (**Dynamics 10**) dominating Phase prime metric or PPM is an architecture made from the boundaries or sums of all possible arrangements of an integer number of points (C2 means multiples of 2 are used to calculate the ordered factor), and then neighboring points are connected to build a path or pattern (**Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b**). Dimensions mentioned here are related to the natural progression of dimensions that could happen in an ideal scenario if we let all the clocks or organic resonators grow in a solution. PPM also has another key structure, its core line, where all the primes lie. To the right, we show the projection to infinity and feedback from infinity for a certain condition (**see Dynamics 4, 5, 6**). PPM does not differentiate primes. The lines or 3D surface on the PPM architecture is the variation in the weight of choices when the number of elements changes one by one. Our ingredients are points, a dimensionless entity, and when their weight varies, neither does it produce space nor time. We get a world line at 6D that tracks only a change in the total arrangement of points that we derive at 9D, when the number of points increases one by one. One should not search for any physical attribute for the world lines or points. They are simply a positive and then negative variation in choices that begins at a zero choice or prime and ends at a zero choice that is another prime. Positive variation means an increase in weight, and negative variation means a decrease in weight. Together, they complete a  $360^\circ$  rotation when they start from a prime and reach a prime.

**Why do we not take prime as the sum of non-prime objects, even when we make molecular assembly?**

The primes are the points in PPM where all possible world lines meet and disappear (**Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b**). World lines are discrete. A line begins at a prime and ends at a prime, and world lines cross each other. Probability variations intersect. All primes are identical as far as end points of the world line are concerned. However, a pair of primes are connected by a world line; it is distinct for different prime pairs. Why the prime number of points, say 7 points cannot be arranged in different ways? *One could easily leave one point in a group with a prime number of points, rearrange the other six points, and find the weight for a point.* The answer is that one cannot leave a point alone, then it will be defined. Primes are not made of a discrete number of objects; only non-primes are composed of a few numbers of objects, but those constituents are always primes. We take a group of prime number of points only to find the number of choices because we only deconstruct an integer number of points using other points or primes. So, it is a deconstruction of random points or integers using undefined points. When we build PPM, we ensure that zero weight line or the core line of metric (**Reddy et al., 2018; Bandyopadhyay, 2020; Singh et al. 2021a, b**).

## 9.12. Metric 12, M12. Figure 12, Figure 25: 47 vortices with perceptions (Dynamics 11); Figure 26: The perceptions of geometric invariants:

Figure 25A shows that when many events repeat around us in nature, with few variations, those recurring events follow a geometric pattern, an abstract form that remains unchanged; this abstract form is an invariant. All invariants in the universe are linked. The relation that enables us to create one invariant in terms of others is the conservation law. A brain following SOMU is an invariant explorer that evolves to make a better invariant inventor and collector.

Figure 25A has listed two clock architectures regarding geometrodynamics perceptions of the SOMU universe. In metric 12, M12 (Dynamics 11), we have summarised our results on a large pool of human subjects where we convert the input into polyatomic time crystal or architecture of clock using our simulators. We could find while monitoring human subjects and artificial bots made by algorithms following SOMU protocols demonstrates how different sensory perceptions are connected. In order to understand the origin of how vortex symmetry is connected to the perceptions produced in the brain, we have collected an investigation carried out over millennia (Dynamics 11; Metric 12, M12). Figure 25B is the sound profile for generating a particular perception in the human mind, it was proposed by Maharshi Kapil and later mathematically perfected by Panini, and we have experimented on the sound profiles with the EEG and compiled the database here in Figure 25B. These are typical 47 letters compiled in the Sanskrit language, called “seed hymns” or “beej mantra”. These invariants are single letters and are connected to create two letters, “concept” or “dhatu,” which are used to build words using 3D tensor-based transformation developed by Panini (1D, singularity/plurality, 2D situations and 3D time). Thus, the dream of Maharshi Kapil that only if perception-generating words are invented and used to create language; consciousness investigation could begin. It came true in 400 BC, roughly 1400 years after he proposed it.

Inspired by the vortex shapes measured by our instruments and their correlations with the EEG, we advanced one step further in Figure 26; we have outlined the clock assembly seeds that have contextual perceptions, which means geometric shapes connected to the perception generated in the human mind. After carrying out human subject studies, we have compiled it here and made efforts to generate these invariants in the EEG and other signals from the expressions of an artificial brain.

Once we have undefined points and a probability of arranging the undefined points, we can think of invariants. The concept of invariance takes us beyond the domain of normal data points that we measure using instruments. We have to change the narrative and start looking at the universe as if invariant data production is the new normal, a fundamental property of the universe. Imagine two spheres overlap; a new sphere is generated in the middle; a new clock is born. We say that this new clock is born in the orthogonal space. Moreover, this clock is invariant with respect to the two clocks. The journey that begins at the elementary level to find an orthogonal dataset continues 12 times. It means we find an orthogonal space, and from the derived dataset, we find another orthogonal dataset, the same process of finding invariants is repeated many times to find the higher level dynamics. One of the advantages of reaching higher dimensions (applying equation 3) is that we follow the space-time-topology-

prime metric pathway accurately. Therefore, fractal mechanics is all about the dynamics of invariants in a SOMU.

### 9.13. SOMU's unique features of consciousness that were altogether missing in the experimental research of consciousness:

We have identified ten fundamental problems of consciousness that are unknown, scientists are debating about them over the years and SOMU could solve all of them simply by its mathematical archive of all possible symmetry breaking points, namely phase prime metric, PPM and polyatomic time crystal concept adopted in the Geometric Musical Language, GML, which we also call Prakriti. The Duality of Purusha-Prakriti was introduced by Maharshi Kapil in his book the Sankhya Darshan or Statistical Philosophy, this duality is the cover page of the book (Bandyopadhyay, A. 2020).

1. How does a system operates only by itself, what makes a conscious system operating standalone? *Phase prime metric, PPM acts as fundamental common archive of the universe for all self-operating systems.*
2. How many distinct identities can a conscious being have, and how are these multiple identities created in a single physical substrate? How can the mind travel outside the body (advancing proprioception to out-of-body experiences (OBEs)) and observe itself? *Triplet of triplet material resonance creates a triplet of triplet structure of mind in a single matter.*
3. How does a brain switches between conscious and unconscious states, and what control mechanism regulates transitions between proto-consciousness, super-consciousness, sub-consciousness and altered states (psychedelics)? *Polyatomic time crystal that represents mind could localize at various locations of a PPM.*
4. How does consciousness shadows reinforced or conditioned learning, allowing a mind to understand and respond to totally unknown situations and events throughout life, leading to new discoveries and inventions? *Space-time-topology-prime (STTs) invariant structure finds missing symmetries in PPM autonomously.*
5. Is consciousness emergent or fundamental (survive death), and what material properties allow the formation of mind, such as wandering, daydreaming, and imagining, which are fundamentally embedded in the brain? If physical matter give rise to the subjective experience of consciousness, could it be artificial? *Consciousness is a mathematical property of primes, it has no life or death. It is not matter but a network of symmetries and the symmetry breaking rules make a mind*
6. How is consciousness related to the free will of a life form, if it at all exists? Is living a life entangled to self-awareness? *PPM cannot be fully encoded in any hardware, the missing part is free will.*
7. Are emotions, perceptions, and cognitive experiences universal or personal (Qualia)? How do their invariance or commonality originate and lead to unified experience (binding problem)? *All cognitive experiences are morphogenesis of geometric shapes, its fundamental.*

8. Simultaneity or parallelism is perceived in consciousness, is it retroactively intuitive illusion or derivative of a quantum or beyond quantum phenomenon? *Consciousness is a 12D mechanics of density of primes, so it follows a mechanics beyond quantum.*

9. Is continuous hardware evolution, adopting to environment necessary for consciousness or its byproduct of other evolutionary process? Is there a common language or rule book for consciousness in the universe? *Since PPM of universe is expanding by acquiring new primes, so, should be done by PPM of life forms too, so evolving is a must.*

10. What is the purpose of consciousness in nature? What are the methods that nature uses to link different classes of consciousness, is there a universal marker for consciousness in humans, animals or plants? *Universe needs machines to mine unique prime numbers and composition of primes for its PPM to expand, so it makes conscious life forms.*

## 10. Conclusion: Synthesis of a self-operating machine with zero human intervention:

### 10.1 Four fundamentals of self-operation under the SOMU framework:

The universe and our human brain run by themselves; here, an effort has been made to review their operations in the light of an electromagnetic resonance chain embedded in an artificial brain, and multiple cognitive operations were performed on both the biological brain and the human brain. "Nature writes events using an unknown algorithm" is faith. If a process is unobserved or unfound with key signatures, it should be considered nonexistent. We answer four key queries of a self-operating system. First, information is a 3D clock assembly or spatiotemporal architecture. Second, information is integrated by the space-time-topology-prime metric to explore new dynamics related to 14% unexplored primes by harvesting 12 invariants distributed over at least 12 dimensions, a 12D world. Third, the driving force of a self-operating machine is a drive for achieving complete undefinedness. So, a point explores infinity or a point of reflection of the infinite series of morphogenesis to harvest unique feedback, expecting a new prime dynamic to be discovered. The engineering of infinity by a point drives self-operating engines. Fourth, self-operation is sustaining a drive to discover new primes by a 86% vibration emulating system that is a guest inside a prime-rich 86% vibration emulating system and holds a guest prime deficient 86% vibration emulation system inside.

### 10.2. The quest for Invariantogenesis

Each prime holds a set of geometric shapes; the pattern of the density of primes tells us how those shapes would change; a few changes in geometric shapes are invariants for the spatio-temporal clock architecture, which are events in our universe. So, a few primes govern the majority of events in our universe statistically; each prime is related to a particular type of event so are a few geometric shapes; we have a universal perception about shapes and numbers, which eventually leads to visual, auditory, taste, touch and smell. A singular grammar correlating geometric shape, perception of a conscious machine, and sensory data with primes is invariantogenesis, the ultimate goal to understand the universe, linking

invariants at the highest level. We have made an effort to the grand unification of invariants; however, this is only the beginning; the unification relation needs to evolve and get perfected.

Nature builds conscious machines so that whole is emulated in parts triggering self-evolution. So, nature encodes a catalog to link prime numbers with geometric shapes with key events grammar as a metric of primes so that conscious beings listen to the conversation of nature knowingly and unknowingly and contribute to its evolution. A catalog of synesthesia is not a disease; it is a window to the mystery of our universe; it tells us that a number has a taste, the taste has a color, sound has a smell, synesthetic primes hold all mysteries, and the day science will have a catalog that links primes with geometries, we would start seeing nature as it is, and towards that journey is the Vedic science that we are regenerating from dormancy.

There are only two constituents of the mathematical universe, a point and infinity; all the rest are their derivatives when the point counts primes to create an undefined point within a boundary created by infinity. Counting in different ways is the only work universe does; being undefined is its only objective. To become undefined, points create loops and build a sphere, which is again considered a point; outside, everything is infinity. Certain rearrangements are made internally. Its feedback from infinity builds the boundary. So creating infinity is an effort of a point to remain a point. In doing so, points have created the universe and synthesized its properties. Signatures of metrics of primes are visible in fundamental constants (Bandyopadhyay, 2020).

### 10.3. The quest for Invariantogenesis exploring four mechanics CM, QM, FM and PM

**10.3.1. The quest of an undefined boundary:** There is only one constituent of the mathematical universe, a point's vibrating boundary or infinity; all the rest are its derivatives when a point adds indefinite primes to become an undefined point. Counting in different ways is the only work universe does; being undefined or remaining nonexistent is its only objective. To stabilize its boundary, a point rearranges constituent points inside that is *feedback from the infinity* or *C's boundary*, which leads to only fundamental condition to create *C*, called normalization. Normalization sets geometric restrictions on rearranging the internal points; these are morphogenesis. The conscious machine *C* manages the grouping and ordering of primes for *U* by sensing missing primes, inventing or harvesting them from other *Cs*, and finally rearranging internally to accommodate a new prime; that quest of primes is the saga of consciousness.

**10.3.2. Invariantogenesis: a multi-layered drive to nullify geometric variations of the fractal seed in the distribution of primes:** The fractal pattern of the density of primes plot (Pramanik, S. et al. 2022)  $F(U)$ , shows that each prime acts like a seed symmetry that stems specific morphogenesis or tells us how it is signature geometric shapes would change using primal mechanics, PM. The PM finds unchanged shapes as invariants for governing the morphogenesis; it gives birth to mechanics of geometric transformations called fractal mechanics, FM. Then FM generates quantum mechanics or QM to control spatio-temporal clock architecture or polyatomic time crystal, which unfolds as classical events in the SOMU universe using classical mechanics, CM. All  $N \rightarrow N + 1$  automaton or conscious element *C* has a fixed perception of shapes and numbers, which eventually leads to visual, auditory, taste, touch and smell or any other sensing of *U*. A singular grammar correlating geometric shape, perception of a conscious

machine C, and sensory data with primes is invariantogenesis. The ultimate goal to understand the universe, U is map-n-link invariants at all 12 levels (Corollary 3.3; a mathematical process has become everything).

**10.3.3. Invariantogenesis: geometric constraints that link unrelated perceptions to primes:**

Primes build conscious machines {C} so that the whole U is emulated in its parts (C) which assists it (U) in finding ways to nullify liabilities of varied prime fractals. Making conscious machines C is a necessity for U, a set of C is nature, and all compositions of primes to make an integer system is the whole U. SOMU automaton or conscious machine C does not require an operator to tell the meaning of a word or the physical significance of an event. C retrieves perception, concept, and significance from the 91 invariants recorded using DDG. Geometric and primal constraints in the metric of primes, PPM builds a catalog linking prime numbers, geometric shapes, and perceptions with queries so that a conscious being listens to the conversation of nature knowingly and unknowingly and contributes to its evolution by inventing new primes. Thus, SOMU's invariant catalog tells us that a number has a taste, the taste has a color, and sound has a smell. When two conscious machines interact, actually, two PPMs (Bandyopadhyay, A. (2020)) quest for missing primes, its invariantogenesis.

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Dynamics files: Dynamics 1 to Dynamics 12

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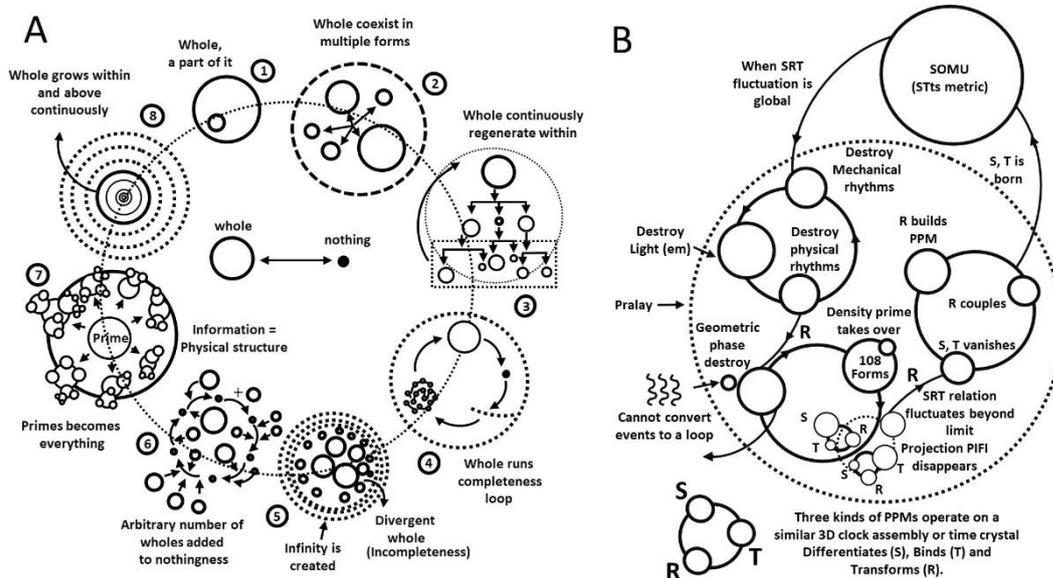
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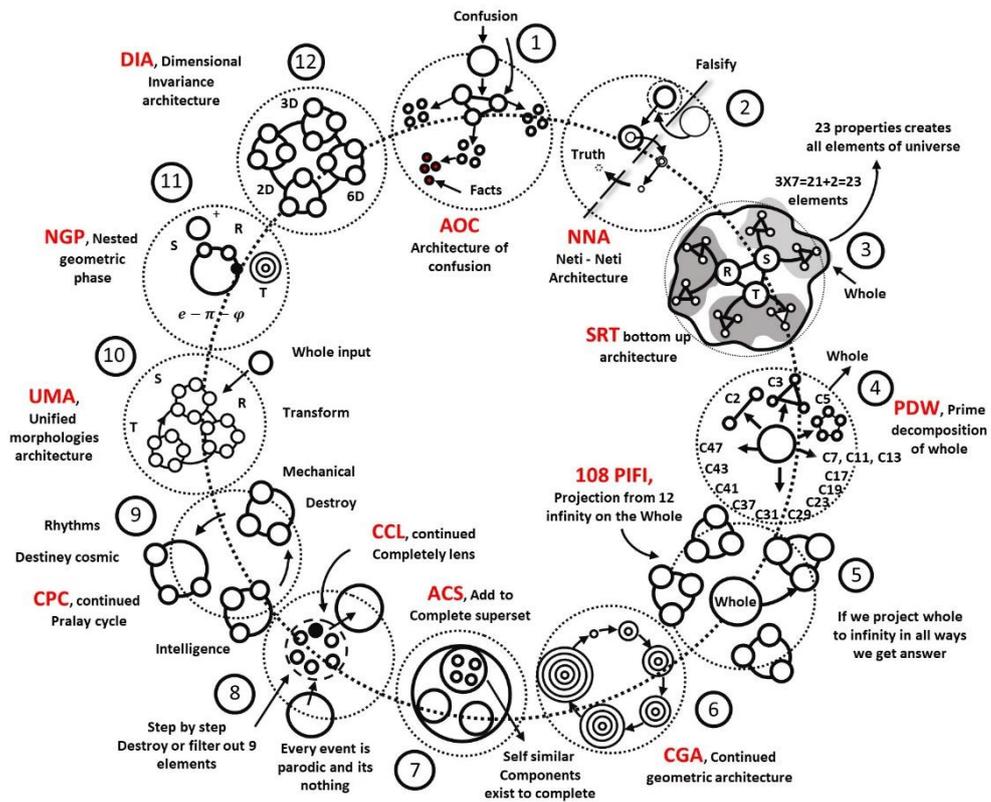
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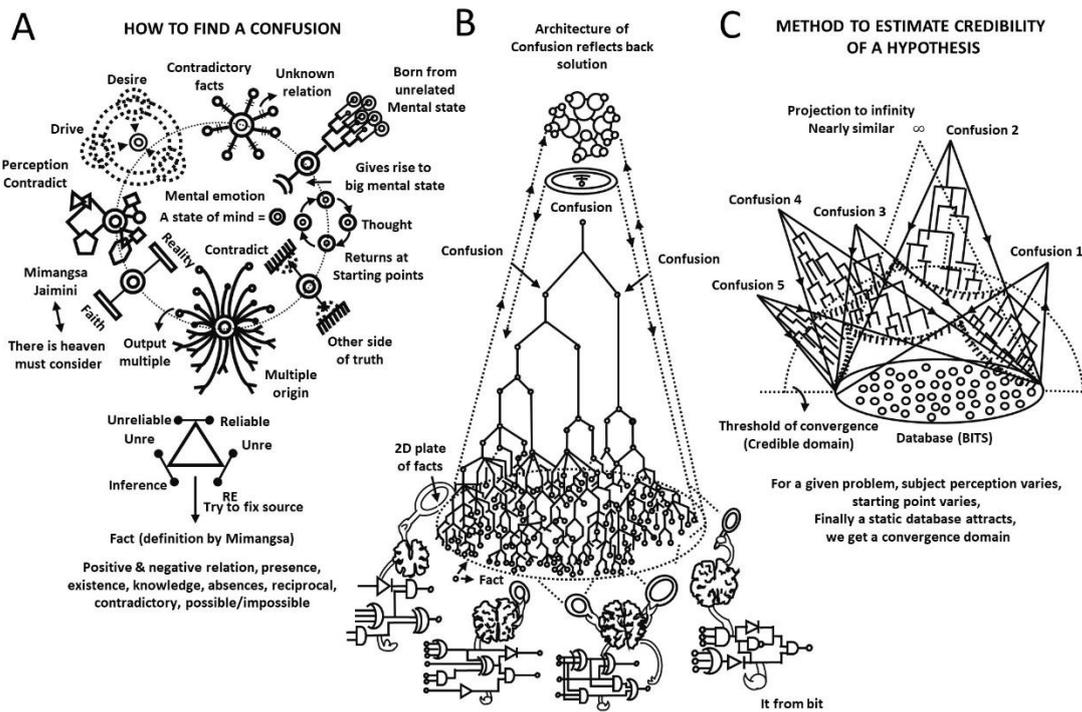
**Figure 1. Eight fundamental engineering features of a self-operating machine: Life cycle of SOMU:** A. Eight engineering features of a conscious machine are outlined here. These eight definitions are selected from Maharshi Kanad and associated Sankhya Philosophy. By using a point (representing nothing) and a circle (representing whole or completeness or Purna), we have made an effort to represent the complex definitions of consciousness mathematically debates carried out for millennia in the discourse of Hindu philosophy into an eight-fold protocol. B. Life cycle of SOMU: To develop a theory of consciousness, we need first to design how it is created, survives and destroyed. Here the dotted circle is the life of SOMU, and the circle outside is also SOMU. So, SOMU is undefined as SOMU is a subset of SOMU. Inside the dotted circle, we have put three circles based on three properties bonding of clocks or T (geometric musical language, GML suggests writing everything in terms of the assembly of clocks), the transformation of clocks R and creating a self-similar infinite chain of clocks and acquiring infinite projection, S. The SRT feature is fundamental to GML and SOMU that assembles and disassembles to create life, survival and death of SOMU.



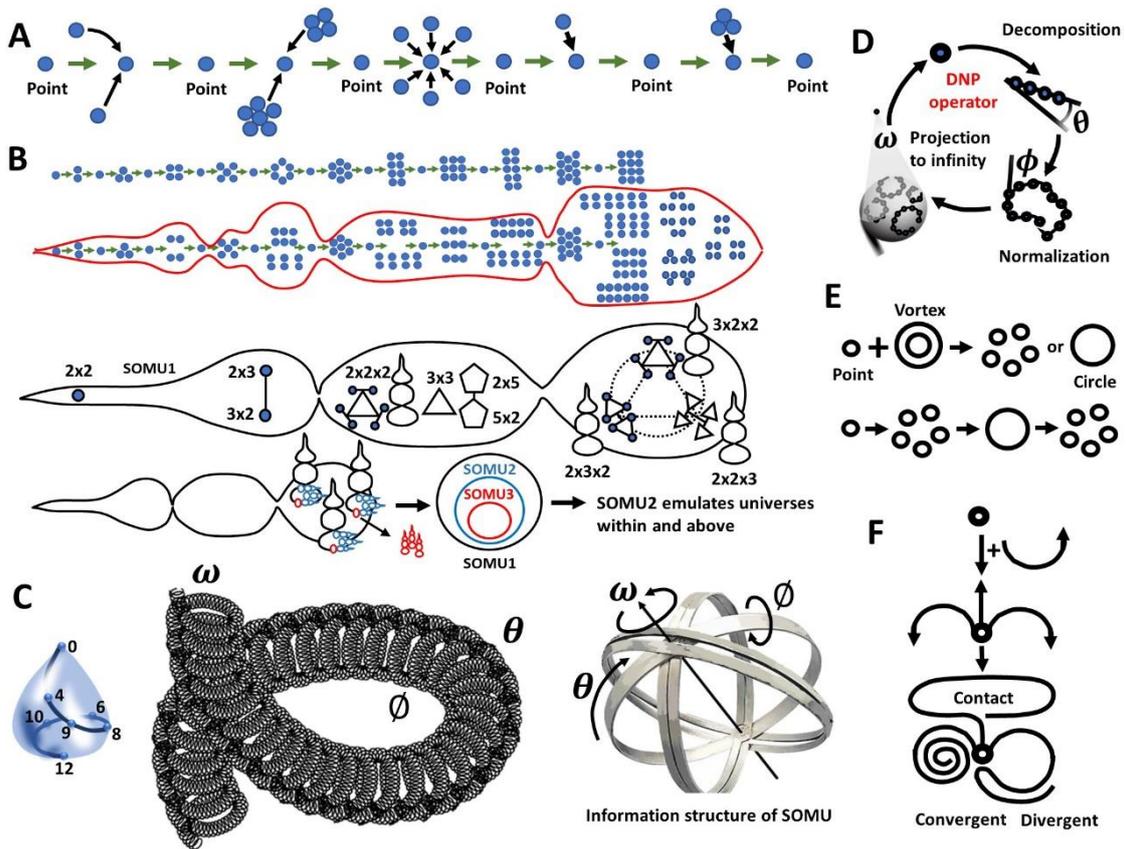
**Figure 2. Twelve Vedic decision-making routes inspire twelve classes of unconventional computers:** We have described twelve methods to solve a problem without using the concept of the Turing machine. Here, in all cases, the circles represent a set of information, and one must make a journey within and above the given information set. Thus, every set of information is mathematically undefined since there is no defined set or state in the decision-making process; all these methods are non-computing models beyond the Turing paradigm.



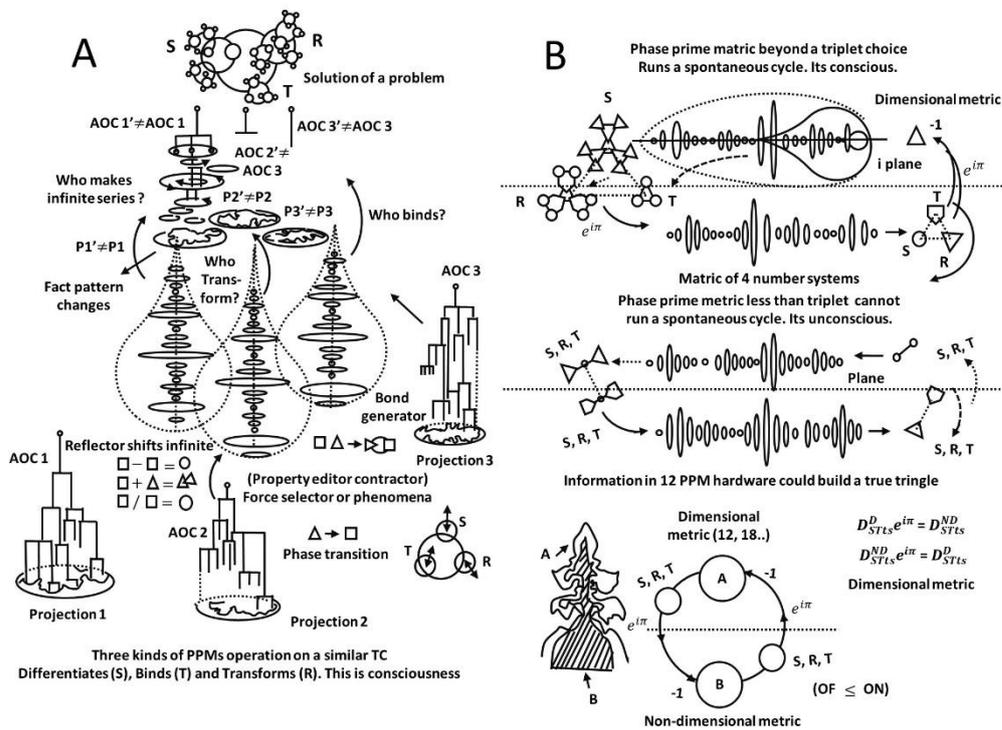
**Figure 3. Defining confusion, correlating with the factual world and architecture of confusion:** A. We have used a cartoon to explain how confusion could be searched by writing an algorithm following the protocols of Gautama's doctrine of doubt. B. An architecture of confusion has been generated where system points run back and forth in a feed-forward network to optimize the output polyatomic time crystal (top) and the layer of facts (bottom). C. Users could begin from very different sets of confusion. However, they would reach similar forms of prime invariants. The database of invariants (M12) ensures that in the real-world scenario, the solutions represented as polyatomic time crystals deliver a consistent output irrespective of the limited sensory inputs in the self-aware machines or life forms.



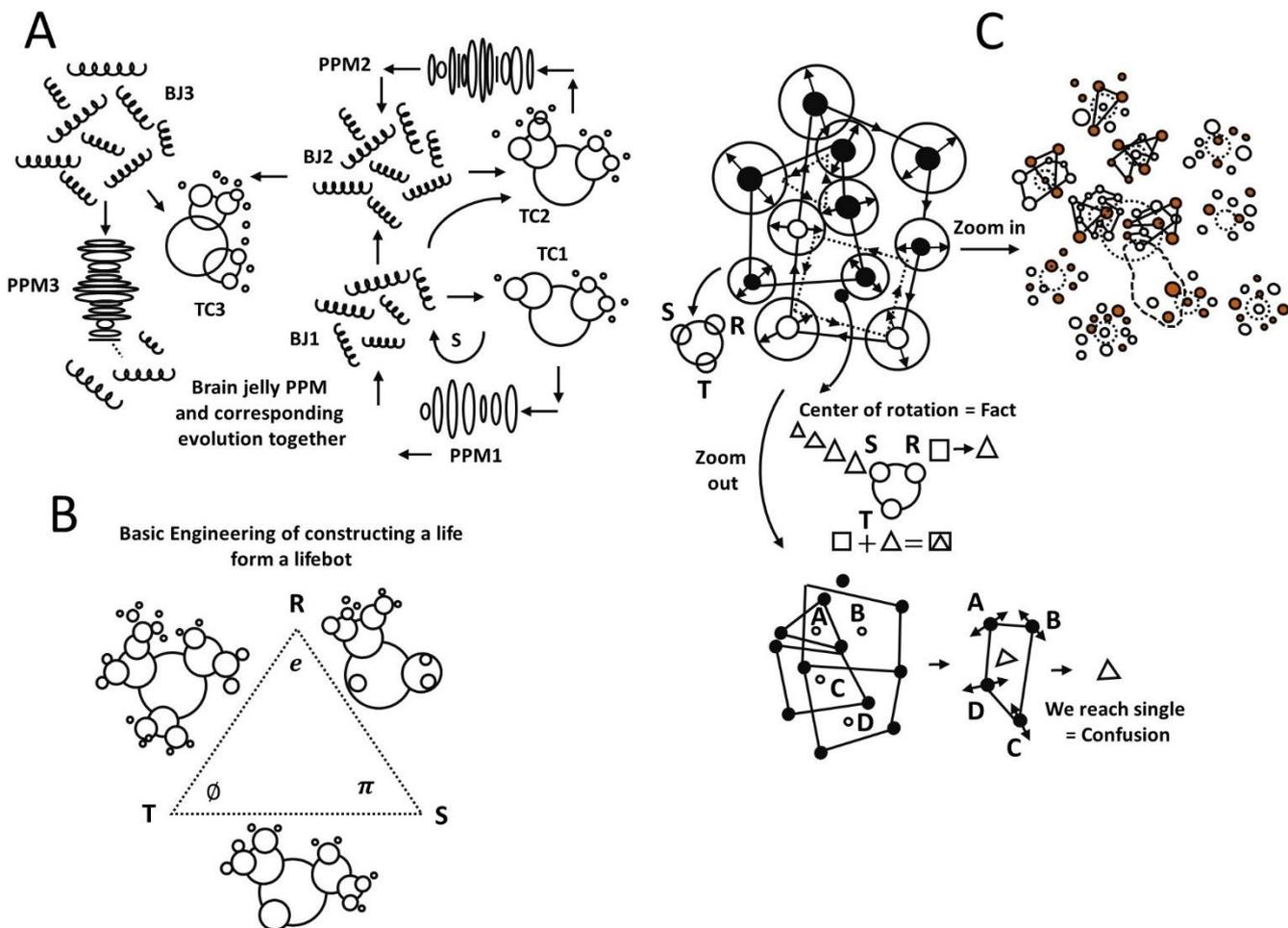
**Figure 4. How to create a Self-operating mathematical universe, SOMU?:** A. The point remains a point even after adding an arbitrary number of points to a point. B. Adding 12 points one by one is essential and sufficient to begin the synthesis of SOMU. Ordered factors of 12 integers build a triplet. When points form a closed asymmetric or distinguishable loop at 12, that point starts incorporating new points. When we get three triplet of triplets one inside another, it is equivalent to three SOMUs one inside another. The central SOMU (SOMU2) emulates the universe inside and the universe outside at a time. C. 12 points make the first 360° rotation: the first pitch of a helix (left). Three nested geometric phases represent the triplet structure of SOMU in panel B (middle). Unit of information & vortex condensate synthesis (right). Three angular momentums of the vortex complete the journey of three angular invariants from a point to a sphere that resembles a point for the next evolution. D. A large number of point structures are generated by decomposition. They are then rearranged to form a loop or normalized. Several normalized loops and placed on a 3D surface to project all loops to infinity, i.e., the system acts as a point. This is the DNP operator; DNP stands for decomposition, normalization and projection. E. Circle is a point, and the sphere is also a 3D point in SOMU. A vortex interacts with a point to create a circle or a larger diameter vortex. That vortex acts as a point and interacts with a larger vortex to form a larger circle. In this way, a within-and-above network of vortices forms. F. How does a point forms a single circle? The rotational operator applied to a point could have three orthogonal motions, clockwise rotation creating a divergent loop, anti-clockwise rotation creating a convergent loop and finally, an ellipsoidal loop that makes perfect contact. The ellipsoidal loop forms to balance clockwise and anti-clockwise emissions from the point.



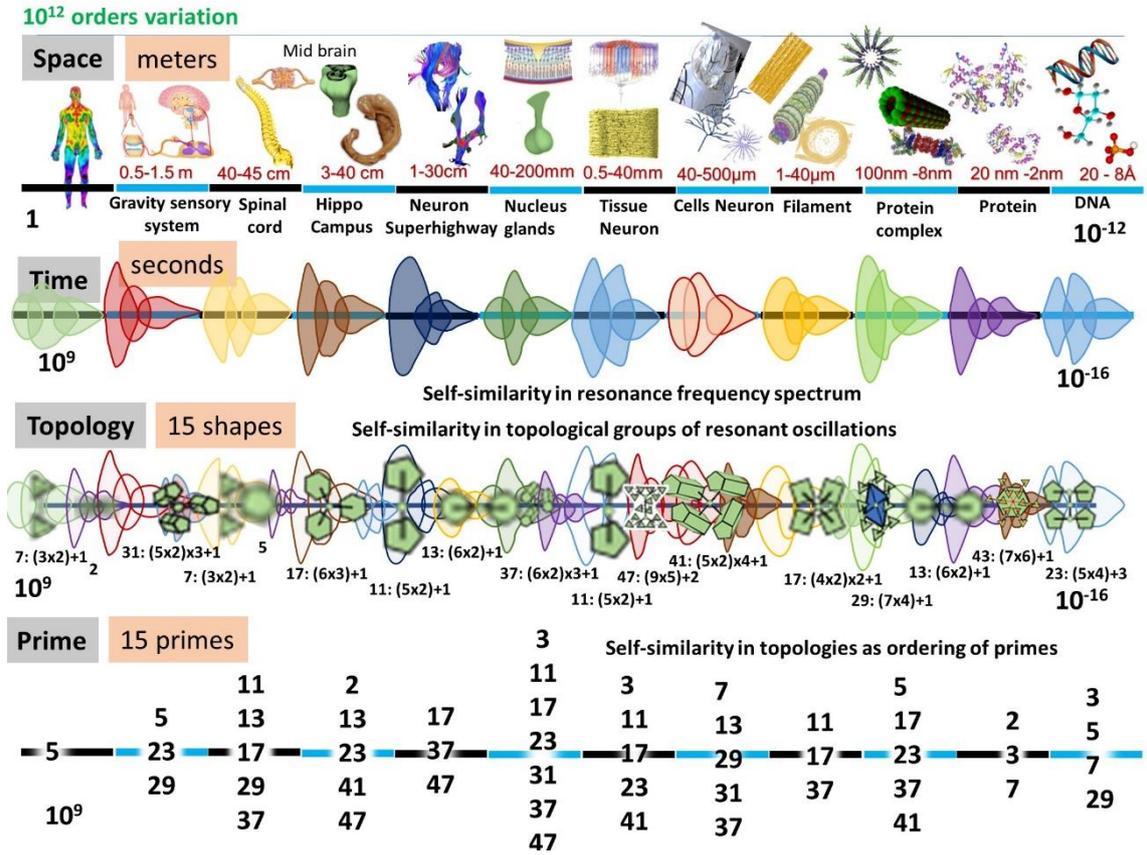
**Figure 5. The application of architecture of confusion AOC: Mathematical criterion for self-awareness:** A. Three distinctly working self-operating engine needs to be integrated in a special way to generate self-awareness under SOMU protocol. Three different AOCs (see the branch-out structure) running an identical information structure of the entire hardware represented as three phase-prime-metrics (M11) generate morphogenic triplets as output (shown in the top). Three 12-dimensional tensor operators (multinions) run a unit of information made of three distinct sections of 3D clock assemblies in a single structure denoted as S, R and T. B. Under SOMU protocol, self-awareness means two metrics (M11), one made of integer and another made of dimension (made of same integer, only change in the physical significance) run in a closed loop to become a subset of the global metric of nature, that is self-awareness (top). In the bottom panel, it is shown that if the information structure is not a triplet of triplet or does not hold the fundamental prime symmetries, the loop does not run perpetually, and self-awareness disappears. The loop operation is shown at the extreme bottom as a clock structure and mathematical operator form.



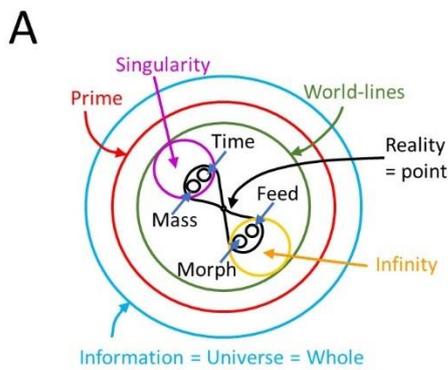
**Figure 6. Brain jelly and S, R, T: Practical experimental realization of the architecture of confusion, AOC using organic jelly:** A. The fundamental unit device for SOMU is a helix or vortex structure, a special kind of fourth circuit element that we patented as a Hinductor, H. Here, we show how three phase-prime-metrics (PPM; M11) and hardware absorbed/emitted energy packets or bursts of electromagnetic signals encode three time-crystals (TC). B. Bonding (T), transformation (R) and topological projection (S), three events continue to transform the time crystals (polyatomic time crystal, i.e., information structure of SOMU) following quadratic attraction (**Dynamics 8**) ( $e^2 + \phi^2 = \pi^2$ ). C. Within-and-above self-assembly of our fourth circuit element, H, creates an architecture of confusion. The sphere of influence (depicted as a circle and an arrow) enables holding internal architectures in its singularity. Using an SRT polyatomic time crystal, we have suggested how the 3D assembly of geometric shapes could match the vibrational clock architecture of the entire self-assembled structure, namely a brain jelly.



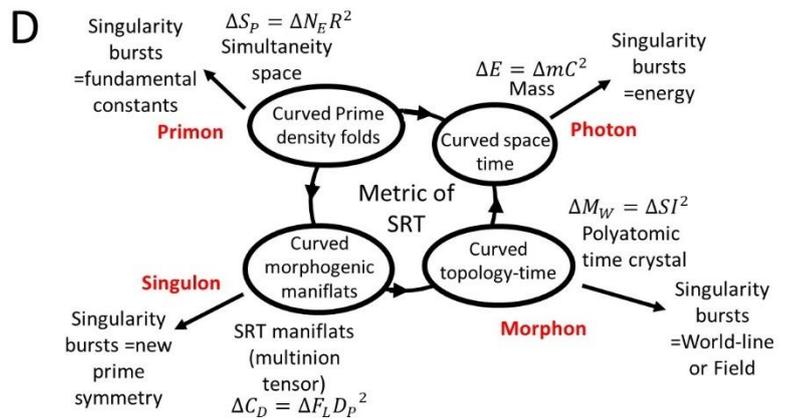
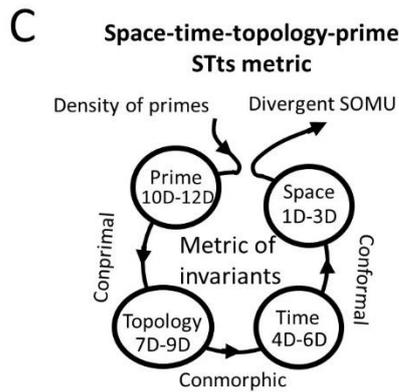
**Figure 7. Space-time-topology-prime model of the human brain:** There are four rows. Each row estimates the scale within-and-above network; from top to bottom, the rows are dedicated to scales in space, time, topology and prime, respectively. We have created this plot to provide a conceptual picturization of the brain as space, time, topology and prime distinctly as isolated entities.



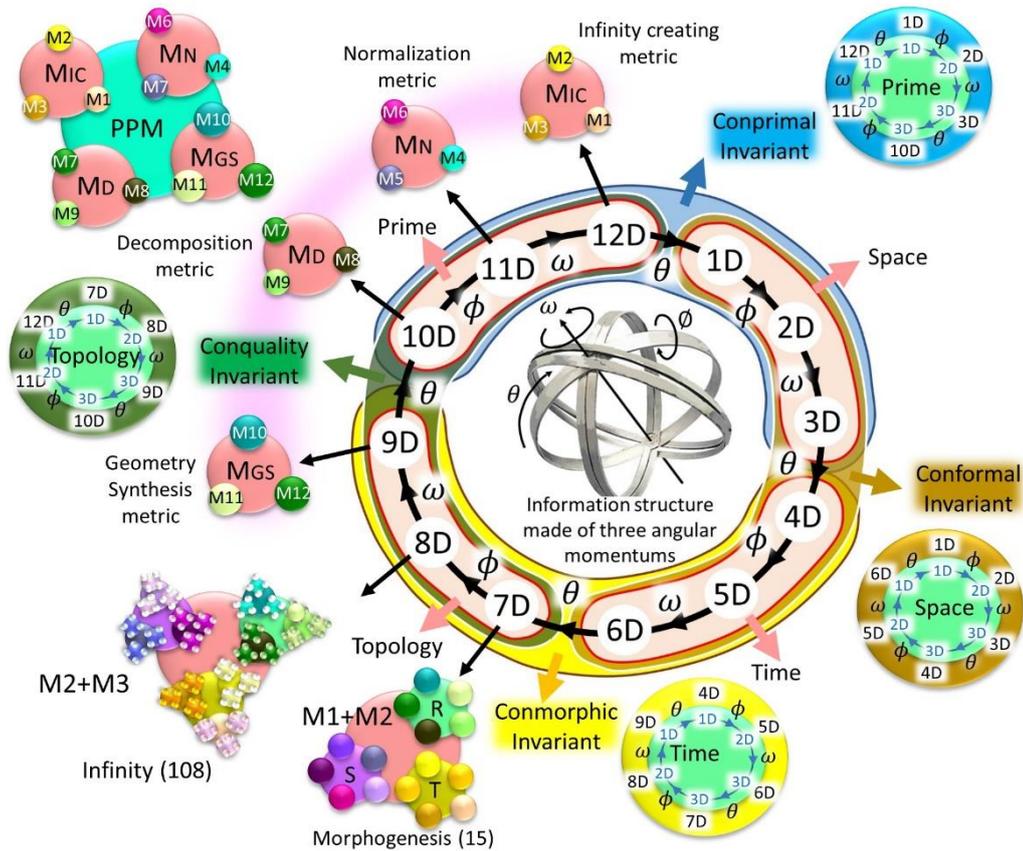
**Figure 8. The fundamental information structure and self-operation protocols:** A. Definition of the “whole” and “point or nothing” using a set diagram. Singularity is space that is mass, and the singularity of phase is time. SRT morphogenesis, 15 types and Feedback from infinity in 108 ways are core operations of two co-operative entities, singularity and infinity, running the self-operating mathematical universe (SOMU). Two co-operative entities, singularity and infinity, use four reality generators, time, mass, morph and feed, to create a singular point as reality in the whole. The point is the whole reality, so the entire diagram is the information paradox running the SOMU. Two co-operative entities, singularity and infinity, are a subset of world lines made of 12D invariants or conserved laws. The geometry of world lines made of singularity and infinity is similar to the pattern that choices and ordering of primes form while creating integers. The effort of world lines to create an invariant sphere using SRT (bind, transform and acquire feedback) so that a point is generated creates space and relative angular changes required to create the sphere builds phase. B. **Collecting invariants as data or information instead of bits or facts: SRT (S=projection, R=transformation, T=bonding) operation or DNP (Differentiation, Normalization and Projection) instead of logic gate.** A. When differentiation happens, points bind so,  $D=T$ ; when normalization of bonded points happens. C. Space-time-topology-prime metric is shown as a scheme of metric of invariants, or metrics that sense, evaluates, and filter invariants. D. The wheel of engineering for SOMU: Engineering of energy (photon); Engineering of morphogenesis (morphon): Engineering of prime density (Singulon): Engineering of points (Primon): These are not new particles but mathematical entities.



Turing computing	Invariant computing
Tracks the path as system point moves, models and fits with linear and non-linear changes	Tracks invariant of paths, not paths. Explores higher dimensional network of invariants along the orthogonal axis conceptually. An invariant is a multinion, i.e. 12 or higher dimensional tensor.
A human intuitively builds a network of cause-effect relations, namely algorithm, machine follows instructions	At the highest dimension all invariants are linked in a pattern, so, using universal archive of patterns, the machine builds instructions.
Structure of an event is cause-effect. It could be either or in classical and both in quantum.	An event is made of three loops, two loops map contradictory outcomes, one orthogonal to all i.e. a loop is made of pixels, each pixel is a collection of contradictory, equally appearing outcomes or observations, namely a confusion.
Sensors search for facts, intuitively find cause, links facts or events sequentially to reach outcomes of any complexity.	Sensors search for confusions, periodic or recurring events, find three phases to link confusions into 3 loops or 3 points within a boundary that isolates infinity. Its an engineering of point and infinity.
Logic is foundation for a decision, correct logic requires predicting future.	Symmetry of invariant architecture is foundation, density of primes regulate future using space-time-topology-prime metric.

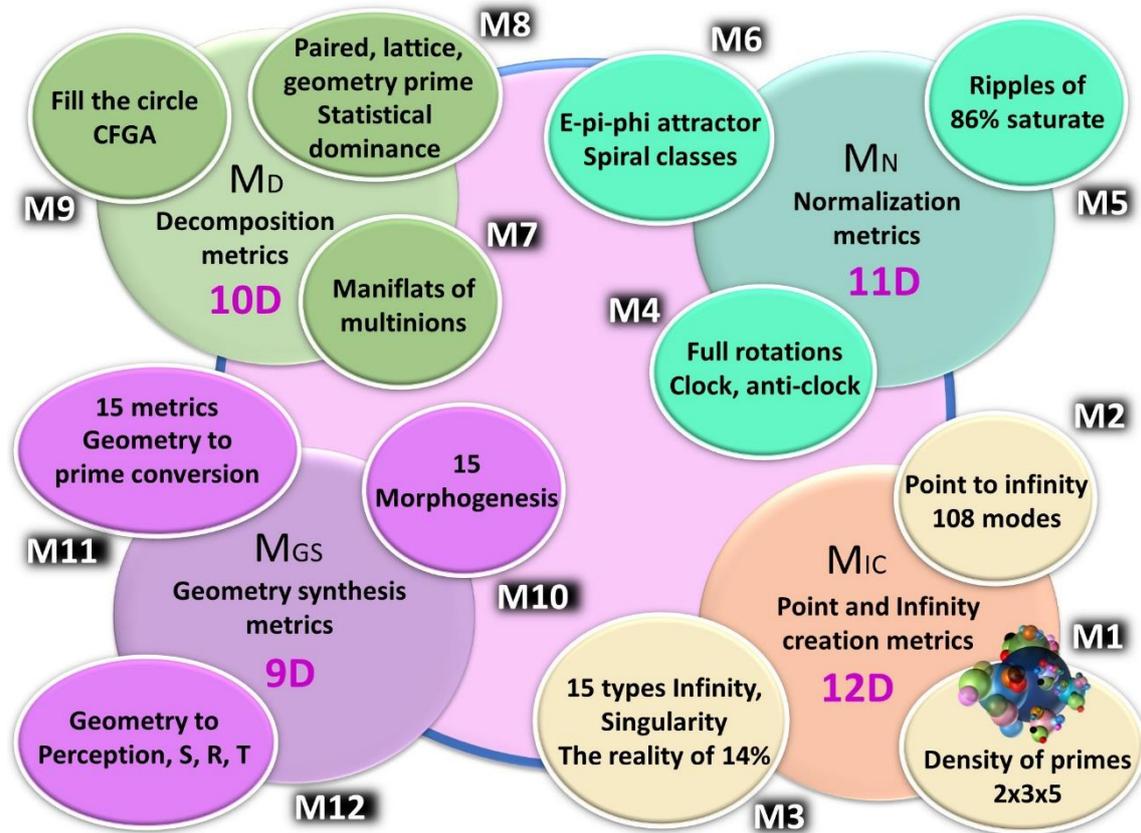


**Figure 9. A complete map of a twelve-dimensional invariant exploring autonomous engine SOMU:** Invariants are always a set of three angles ( $\theta, \phi, \omega$ ), depicting three angular momentums of vortices shown at the center of the wheel. Vortices are loops of fields, a perturbation that flows in the presence or absence of media. The unit of information is a vortex triplet, made of three angular invariants of three different dimensions, shown at the center of the loop. Four local wheels are drawn for space, time, topology and prime. One key takeaway of this plot is that a concept increases to three higher dimensions and then reduces to three lower dimensions, the concept of space does not disappear fully at 4D, but at 7D, it disappears fully. Thus the contribution of primes does not finish at 12D, and we get a 3D structure made of 30 clocks, which decreases to 1D in 3D space.

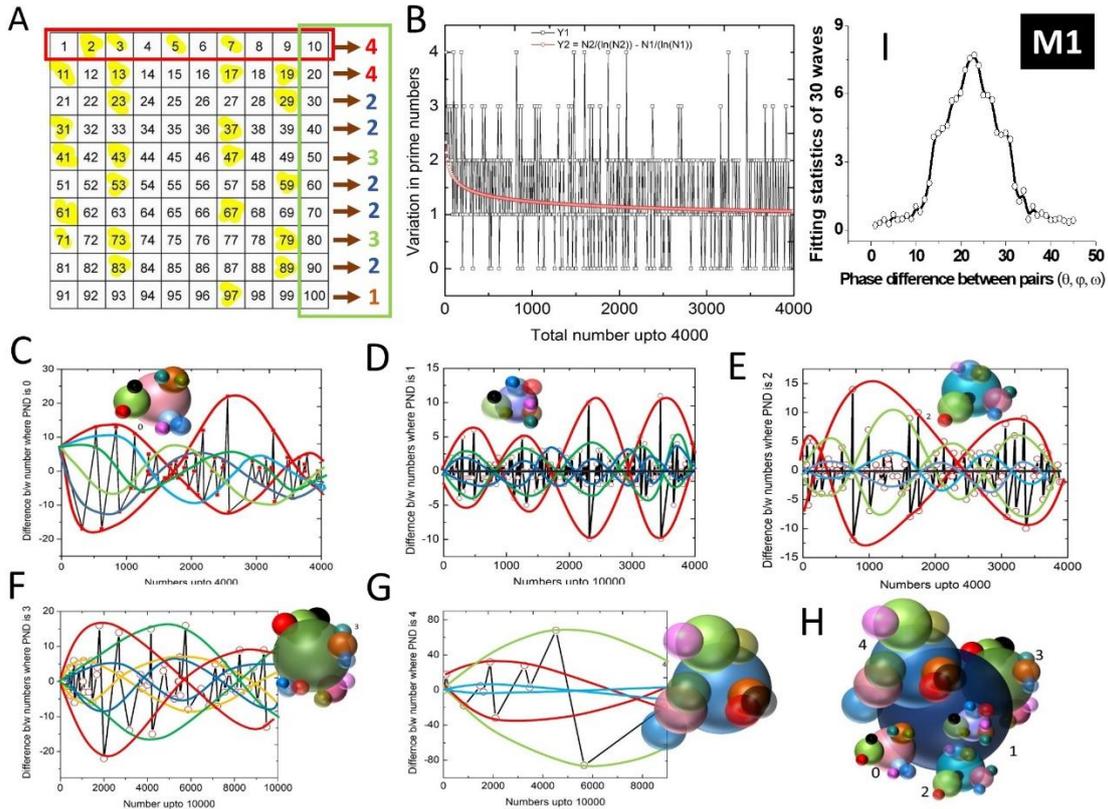




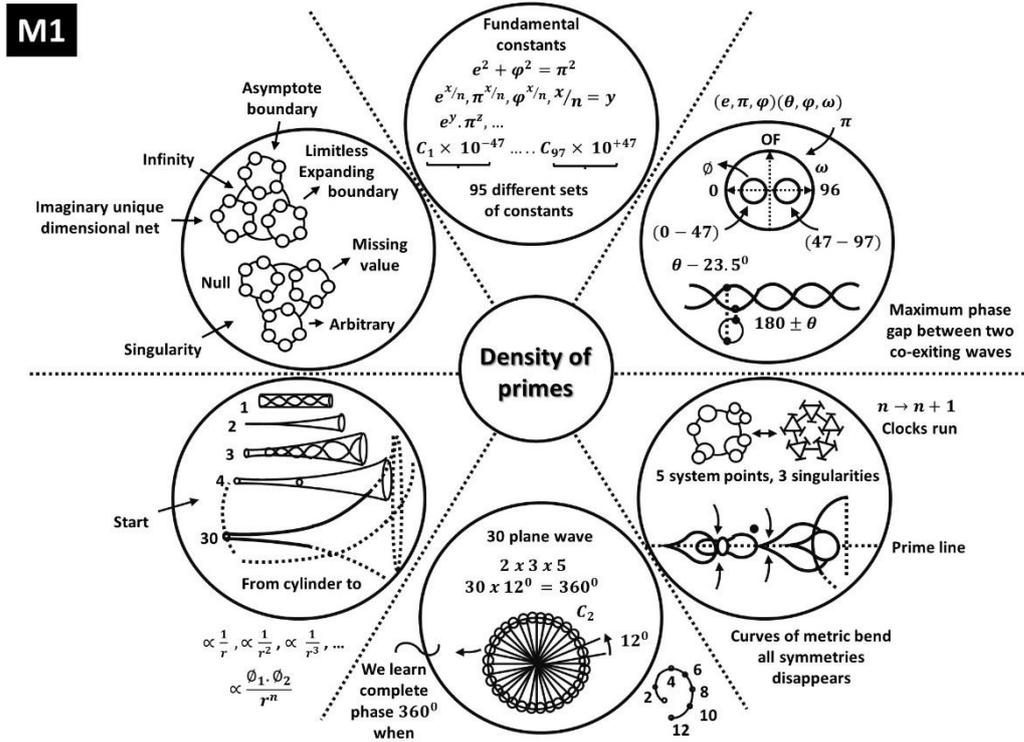
**Figure 11. Twelve metrics governing 9D, 10D, 11D and 12D, four dimensions:** Here, we have four circles, each holding three clocks as three metrics. The twelve nested loops carry the vital organizational architecture of an artificial or biological brain. If  $12+4+1=17$  clocks run perpetually in the virtual media as the algorithm or in the vibrating materials as nested rhythms, the core management of information processing, learning, memorizing, and evolving is executed. Note that four cycles are noted as 12D, 11D, 10D and 9D; thus, it accounts for the prime part in the space-time-topology-prime (STTs) metric. After the eighth-dimensional extraction of invariants, when searching for morphogenesis via SRT protocol, reaches the final phase, the GML-inspired nested operators described here take over.



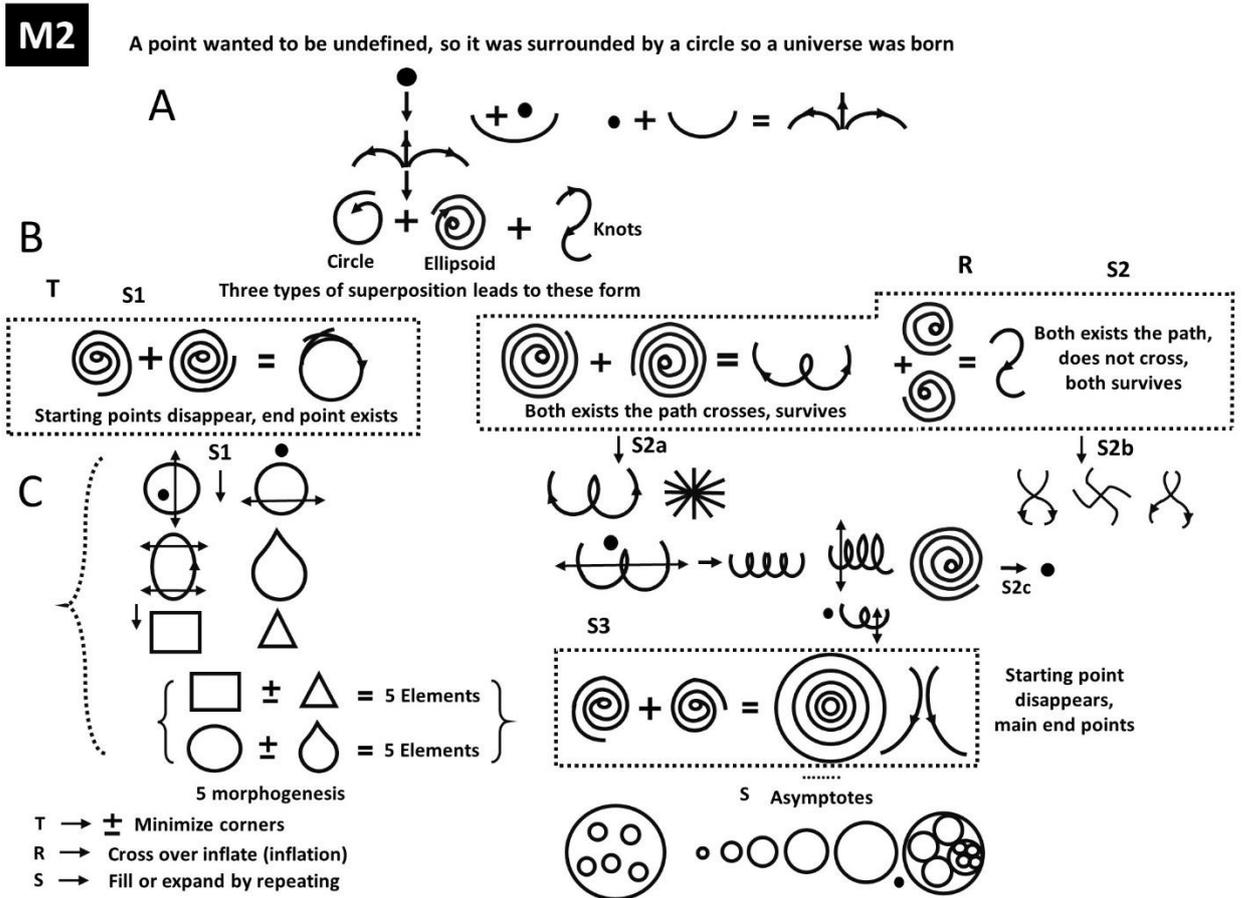
**Figure 12. The thirty infinite series of thirty invariant phases in the density of primes defines fifteen types of singularities and fifteen types of infinity.** A. Density of primes calculated by counting the number of primes at a gap of 10, we get five possible values, 0,1,2,3,4, and we find integer gap of the gap of gaps (three higher levels) to find positive and negative diversions in the integer series. B. All five densities for 0, 1, 2, 3 and 4 are plotted together. We consider five densities, 0,1,2,3,4 and build five plots in panels C, D, E, F, and G. Three pairs of waves fit the density of primes ( $6 \times 5 = 30$ ), and the fitting line is colored. Each pair has an opposite phase but with a phase gap. We plot the curves between numbers 0-4000 or 0-10000.



**Figure 13. Metric 1, M1: Density of primes and its six fundamental features:** The first metric accounts for the properties born directly from the 30 waves of the density of primes described in **Figure 12**. The density of primes gives birth to three types of normalizations applied on the ordered factor metric (M11): Three types of normalization: e-pi-phi empty normalization (T), the density of primes: Prime contribution normalization, the density of primes induced (S): Polar plot makes clockwise and anti-clockwise rotation (R). Thus we get six features schematically summarised in six circles. Relative phases between 30 waves in the density of primes give rise to  $23.5^\circ$ , an angle responsible for multi-dimensional projections. It ensures the formation of a quadratic relation and, consequently, the fundamental constants (**Bandyopadhyay, A., 2020**).



**Figure 14. A journey from point to elementary transitions:** Here, we describe the fundamental philosophical argument for developing the SOMU. A point generates paths and then continues to produce several dynamic paths by interacting with more points. A. There are only three possibilities for making a journey from a point; using an arrow; we describe three choices. B. The second phase of panel A is shown in panel B. Three events are noted by combining the output of first-phase products. C. The derivatives of the second phase described in panel B are combined to create third-generation progenies in panel C. In panel C, a new point is added as an attractor in all three generations. The fourth generation of the process is the morphogenesis metric described in Figure 23.

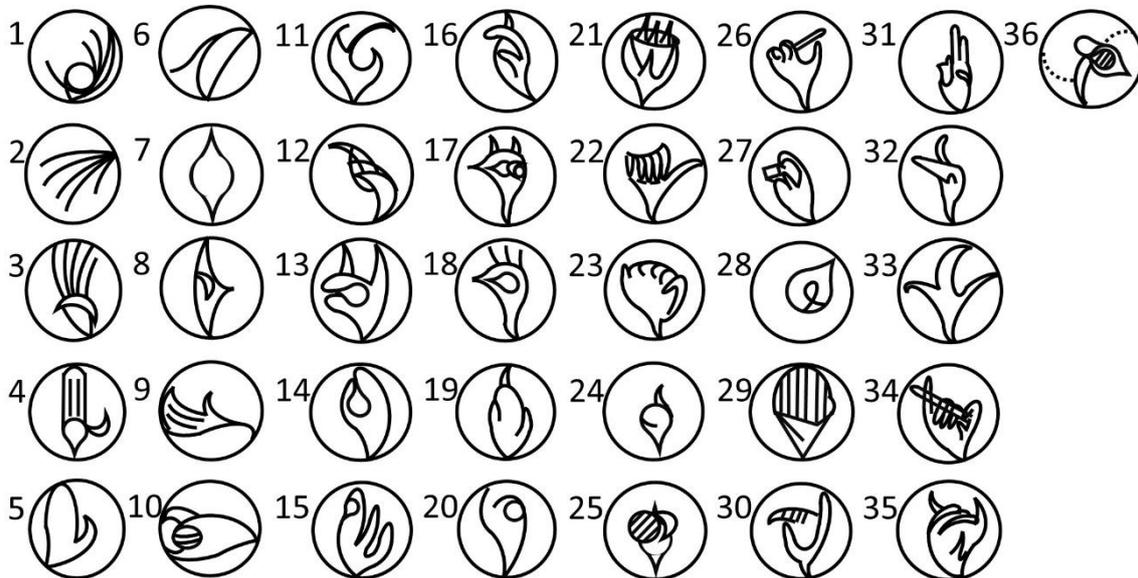


**Figure 15. Thirty-six projections to infinity and feedback from infinity: Single mode C2:** Here, we have identified thirty-six invariants; the circular boundary is infinity, and the common central point for each structure is the location where the feedback is received. The inner part of the circle is the real part of the complex tensor; lines connect topologies, and the relative patterns and arrangement of these lines depict symmetry in the feedback. The pattern in the circle connects world lines, cross-over with the circle perimeter depicts direct mathematical transformations (product of multinions). When information structure (3D clock assembly) is formed dynamically in the phase prime metric, PPM; it generates an infinite network of clocks across multiple dimensions. One hand with five fingers (C5) and their folds are used here to depict inverse stereographic projections, which are feedback from infinity.

**M2**

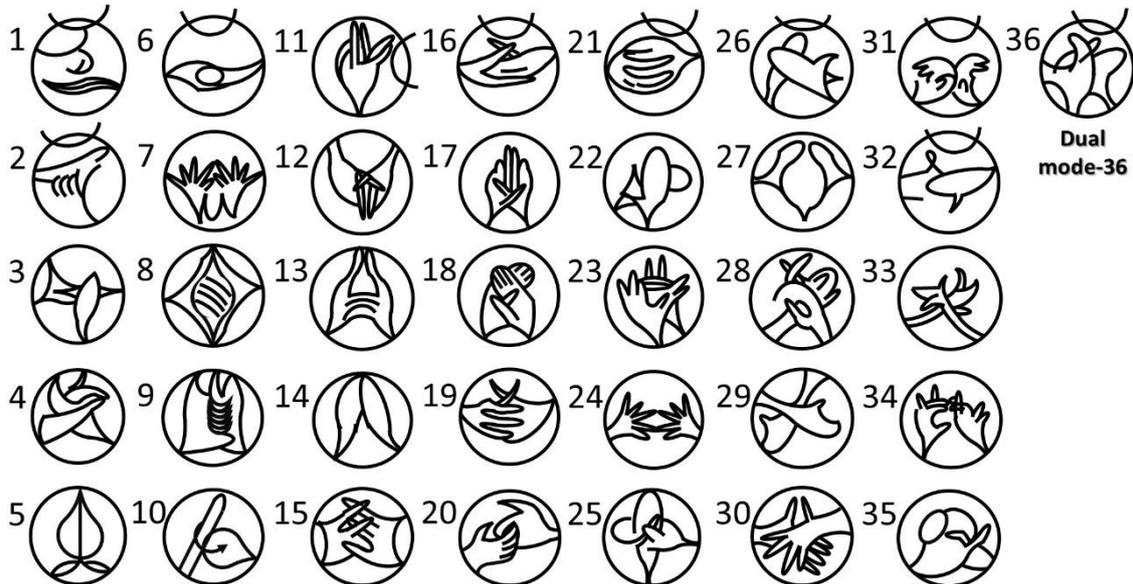
108 stereographic projections to infinity & feedback from infinity

**C2 X C2**



**Figure 16. Thirty-six projections to infinity and feedback from infinity: Dual mode C3:** Here, we have identified thirty-six invariants; the circular boundary is infinity, and the common central point for each structure is the location where the feedback is received. The inner part of the circle is the real part of the complex tensor; lines connect topologies, and the relative patterns and arrangement of these lines depict symmetry in the feedback. The pattern in the circle connects world lines, cross-over with the circle perimeter depicts direct mathematical transformations (product of multinions). When information structure (3D clock assembly) is formed dynamically in the phase prime metric, PPM; it generates an infinite network of clocks across multiple dimensions. Two hands (C2), five fingers (C5) and their folds are used here to depict inverse stereographic projections, which are feedback from infinity.

**M2** 108 stereographic projections to infinity & feedback from infinity **C3 X C3**

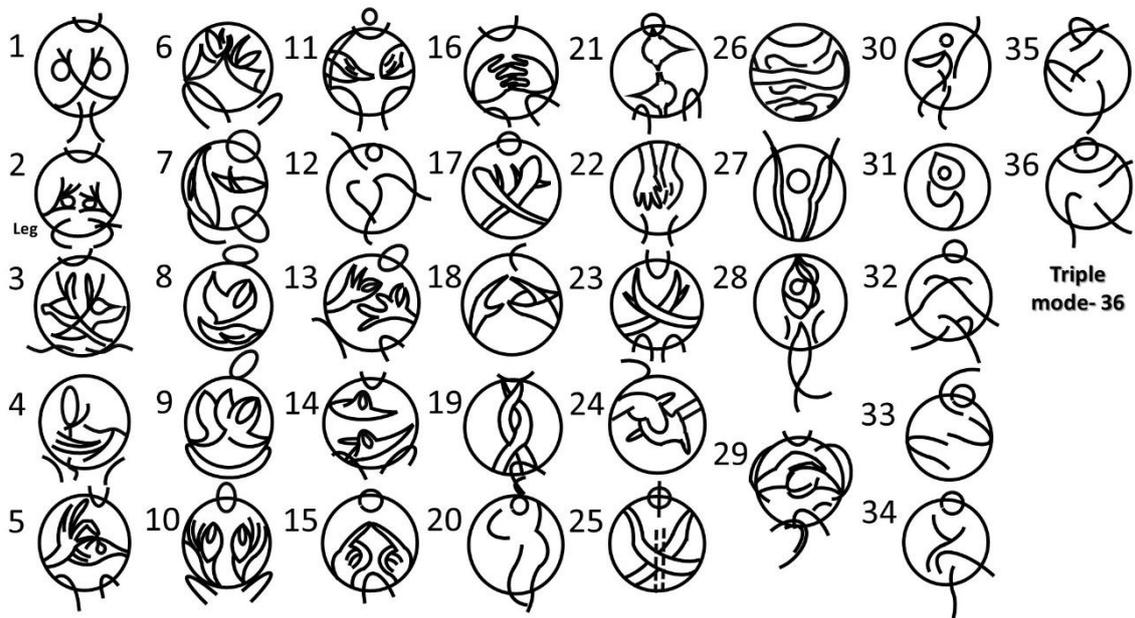


**Figure 17. Thirty-six projections to infinity and feedback from infinity: Triple mode C5 (Dynamics \*\*):** Here, we have identified thirty-six invariants; the circular boundary is infinity, and the common central point for each structure is the location where the feedback is received. The inner part of the circle is the real part of the complex tensor; lines connect topologies, and the relative patterns and arrangement of these lines depict symmetry in the feedback. The pattern in the circle connects world lines, cross-over with the circle perimeter depicts direct mathematical transformations (product of multinions). When information structure (3D clock assembly) is formed dynamically in the phase prime metric, PPM; it generates an infinite network of clocks across multiple dimensions. Five body parts (two hands, two legs and a head) and their folds are used here to depict inverse stereographic projections, which are feedback from infinity.

**M2**

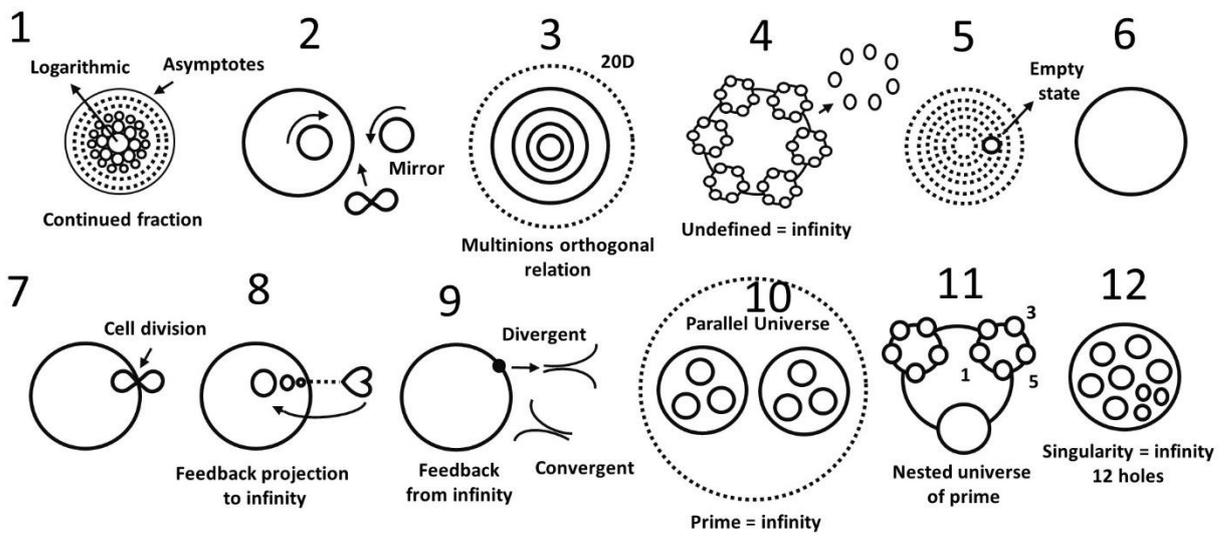
108 stereographic projections to infinity & feedback from infinity

C5 X C5



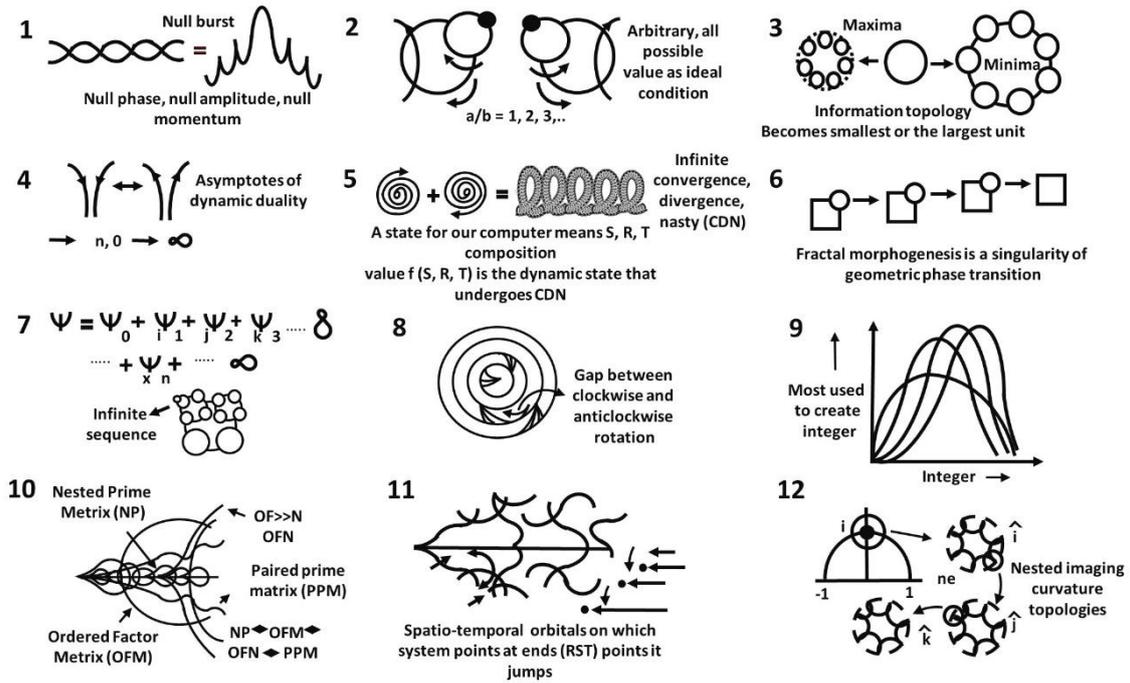
**Figure 18. Classification of Infinity:** In SOMU, infinity is a mathematical operator that shrinks an infinite series into one singular geometric form that may not be explicitly noticed in the infinite series. However, estimates the contribution of each term with respect to the whole series up to infinity. One of the key operators of the SRT operations is S, where an infinite series is generated from the morphogenesis of input information (polyatomic time crystal or 3D assembly of clocks representing the spatio-temporal event), list of morphogenesis is shown in Figure 23. The infinite series of clocking geometries derived by 15 ordered factor metrics are shown in Figure 24. These infinite series require to converge to a common geometric shape, which we call feedback from infinity. We are continuously trying to identify the nature of the infinity that could automatically act as an operator to shrink the infinite series into a few geometric shapes. Here we have listed 12 such features of infinity discovered thus far.

**M3** Twelve topological origins of infinity

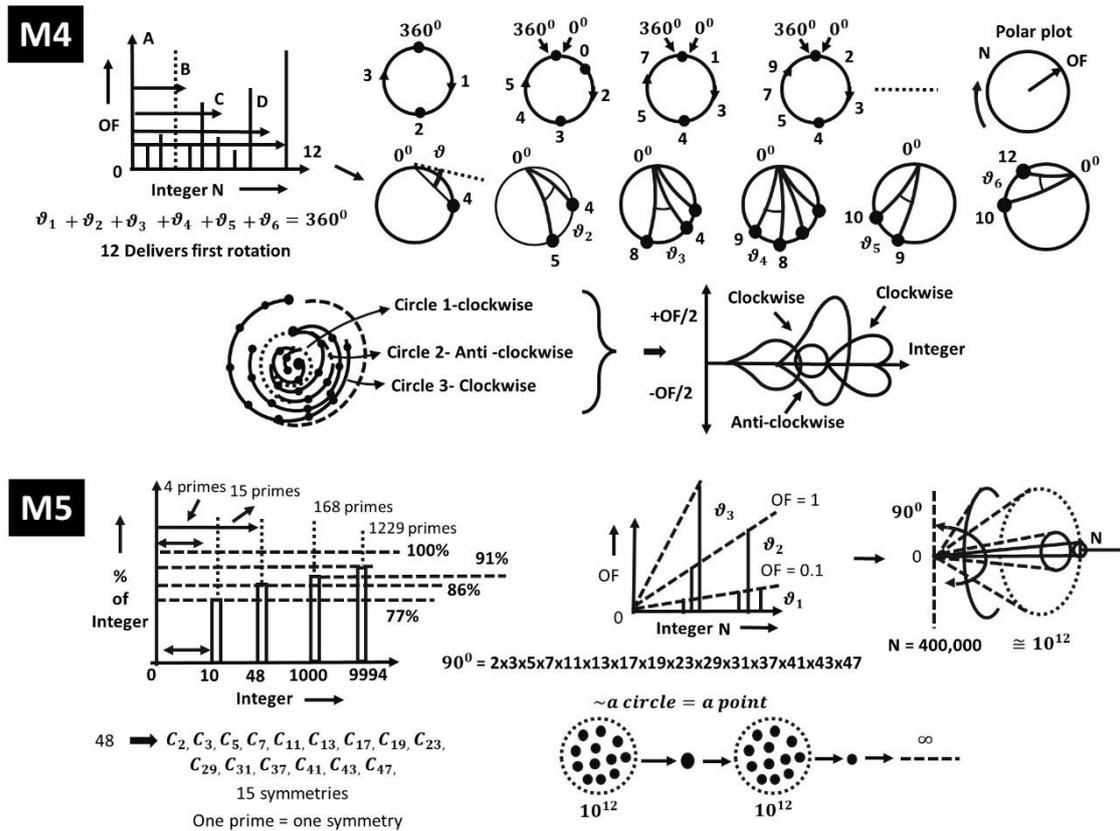


**Figure 19. Twelve situations that give birth to singularity:** We have schematically presented the situations in the 3D clock assembly representing information structure in nature, and the universe would develop unpredictable values. The unpredictable feature could arise for multiple reasons; continuously changing values (4); multiple values at one time (2); converging and diverging at the same time (5); folding at multiple dimensions at a time (12); coexisting at multiple dimensions at a time (3) etc.

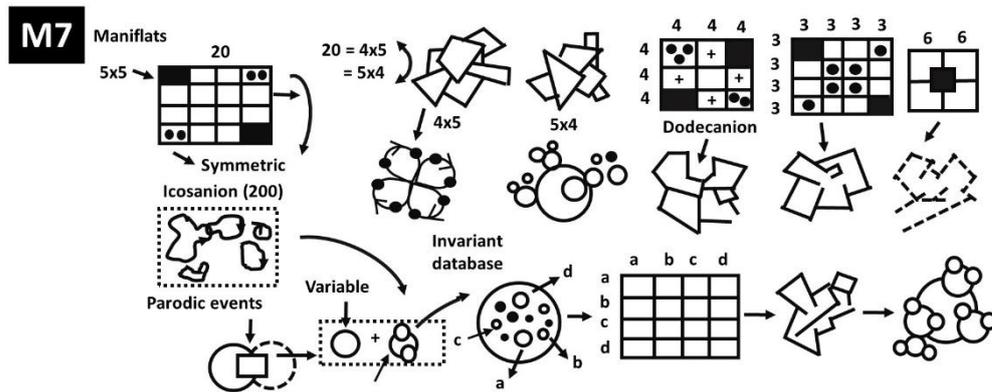
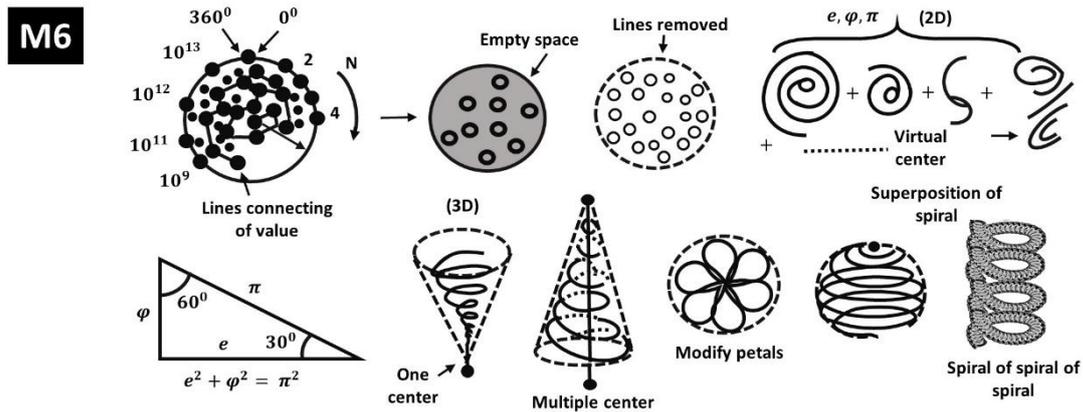
**M3** Twelve topological origins of singularity



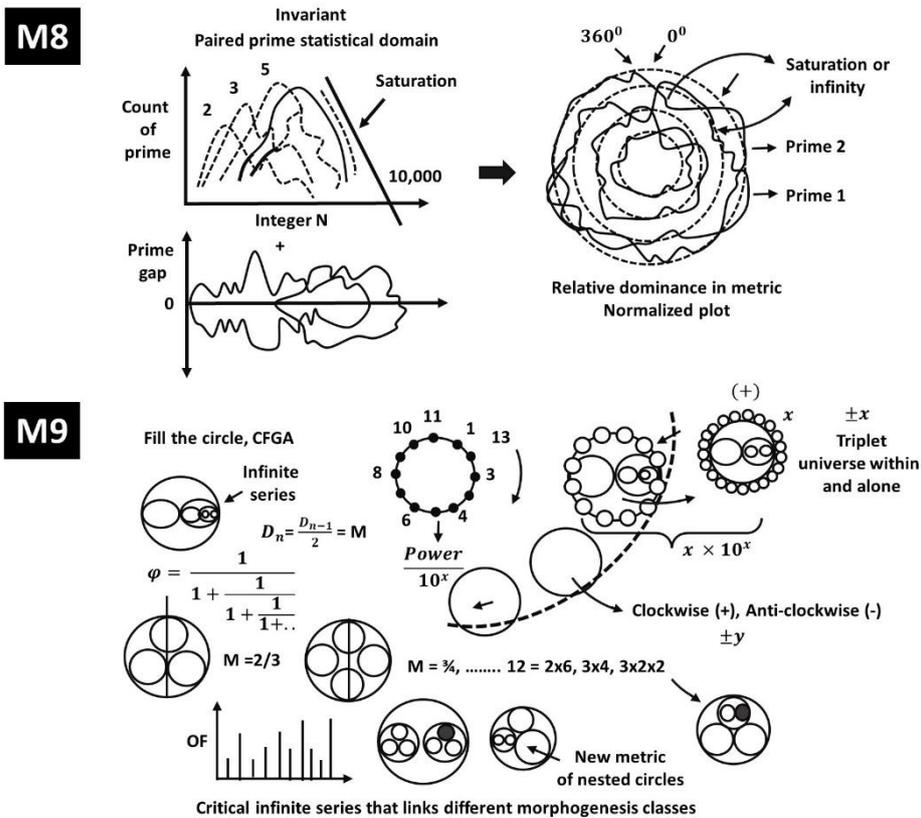
**Figure 20. M4: Full rotations, Clock, anti-clock; M5: Contributions of primes: Ripples of OF 86% saturation:** Here, we have described two metrics, M4 describes the origin of clock-wise and anti-clockwise rotations, while M5 describes the contribution of primes in generating original patterns in the ordered factor metric. **M4:** top row: Polar plot of ordered factor metric, first circle forms at N=12. The radial distance is the ordered factor in the circular plot. The circle's perimeter accounts for the maximum value of the integer series for which the ordered factor is calculated. The Sum of gradual angular increments is 360, and the normalization effect affects the dynamics of all metrics (bottom-right). M5: If we consider the entire integer space is a hundred, then the contribution of each prime is plotted. Above  $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 10^{12}$ , this number is units in a point; we have shown its repeated transition between point and the largest mathematical structure made of  $10^{12}$  entities (bottom right). Only the starting 3D part of the ordered factor metric rotated longitudinally by 360 to create a solid surface is shown in the top right corner. These 3D surface shapes create the distinct structure for primes.



**Figure 21. M6: Quadratic attraction of empty space or singularity in a metric; M7: Maniflats of multininions;**  
**Decomposition and within-and-above network of maniflats:** Here, we have described two classes of metrics. M6: M6 panel has two rows. In the upper row, top left: Radial distance is the ordered factor in the circular plot. The circle's perimeter accounts for the maximum value of the integer series for which the ordered factor is calculated. The lines connecting the ordered factors create an empty space, and we could draw circles by removing the lines. The locations of circles are superpositions of three 2D spirals regulated by  $e, \pi, \phi$  as shown in the extreme right plot. In the lower row, (from left to right) a quadratic relation between three infinite series  $e^2 + \phi^2 = \pi^2$  and five 3D vortices or spirals are noted that derive from the quadratic relation (**E-pi-phi attractor**).



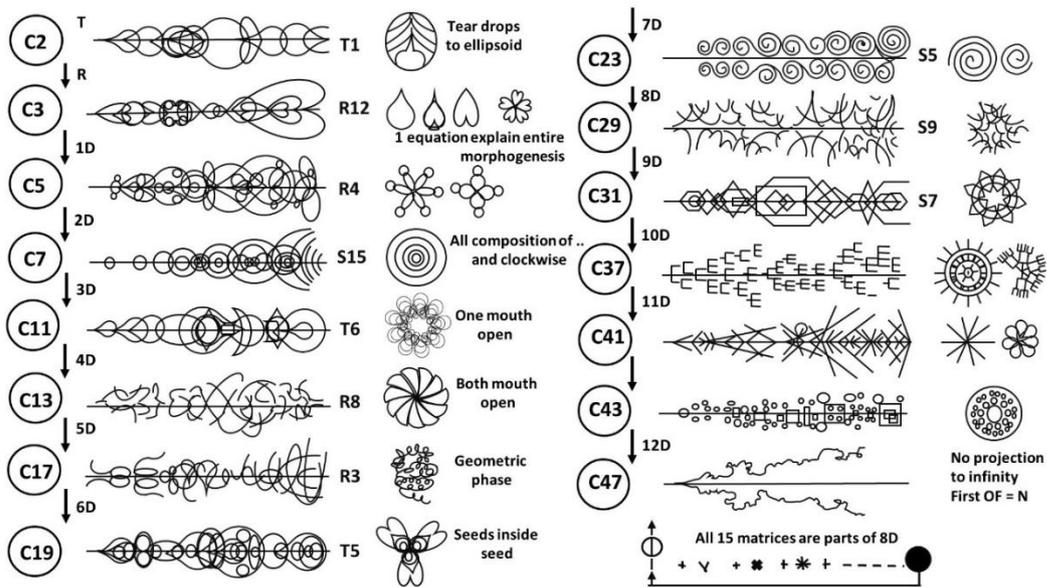
**Figure 22. Metric 8, M8: Normalization and saturation in the metric and Metric 9, M9: Continued fraction geometric arithmetic, CFGA:** Here, we have summarized two different classes of metrics that replaces contemporary statistical mathematics. M8 ensures the normalization or quantization of patterns or packets of symmetries and symmetry-breaking possibilities. As the system point moves through integer space, how many times a particular prime is plotted against an integer. Prime gap (e.g., paired primes has gap 2) as a function of integer. The slope of the count-of-prime vs. integer plot is used to create a circle of a particular prime. There is a ripple in the integral space for each contribution of primes. The periodic ripples are plotted across an imaginary circle. Each circle represents a prime. M9 ensures that an assembly of clocks, due to its fundamental properties alone, carries out all mathematical operations. Top left, we have drawn a golden ratio (a fundamental constant and an infinite series) using nested circles. At the bottom, we have plotted the ordered factor of an integer as a function of the integer; there is a triplet of triplet periodicities, which is drawn using nested circles; the derived circular architecture is the null information space of SOMU. To the top right, we have shown a cycle of 12 (13=1); the derived nested cycles, if activated, generate a triplet of triplet symmetry. Together, M8 and M9 create a boundary or infinity for metric.



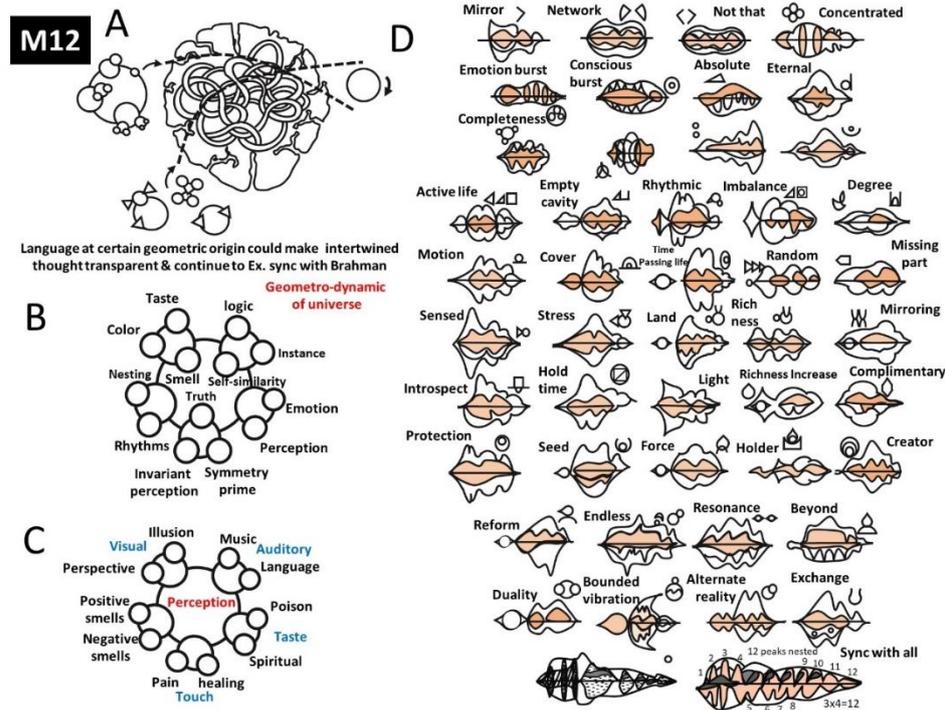


**Figure 24. Fifteen phase prime metrics made of the first fifteen primes and 15 classes of morphogenesis:** In all the fifteen plots, the horizontal axis is an integer, and the vertical axis is an ordered factor calculated for that particular integer. To generate 15 metrics, integers are selected depending on the symmetry we want to explore. For  $C_s$  symmetry, integers are selected as  $sN$  where  $N=0, 1, 2, 3, \dots$ ,  $s$  is a prime number. The derived ordered factor values for each integer are divided by 2, and two points are placed on both sides of the horizontal axis. So, for each integer, we get two similar points. All the nearest neighboring points are connected by a line that appears to form a pattern. The ordered factor or vertical axis is divided by two so that  $C_2$  symmetry is taken of the pattern, so that triplet of triplet or  $C_3$  symmetry dominates in the pattern. To the right side of each order factor metric, the geometry derived from the feedback the geometric series in the metric receives after projection to infinity.

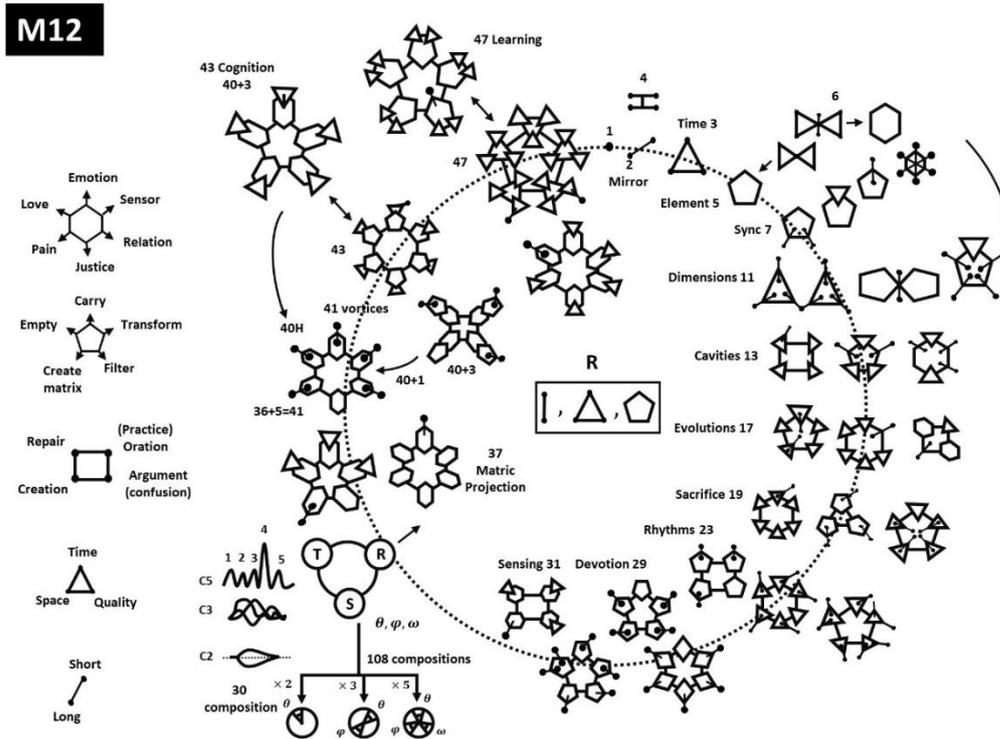
**M11 Fifteen ordered factor metrics signifying fifteen primes**



**Figure 25. Temporal profile of sound correlated to human perception: The language of consciousness:** A. The brain or a conscious machine that acts as our invariant computer has prime knots inside where space-time-topology-prime enters as time crystal (3D assembly of clocks), and a network of prime knots reflects, absorbs and transmits the output time crystals as vortex hologram. Language at a certain geometric origin could make intertwined thought transparent & continue to externally .sync with the key vibrations of the whole. The whole is depicted as a circle throughout the manuscript. B. 13 geometrodynamics of universe that governs distinct symmetries of information structure. C. Five pairs of perceptions. D. 47 sound patterns or vortex shapes and physical significance associated with each sound pattern are noted. The phonetic phrase for creating sound variation triplet following C2XC3 symmetry is noted.



**Figure 26. One-to-one correspondence between primes, topological invariants and physical significance: creating real observations & perceptions from primes:** A wheel is plotted for 15 primes. For each prime, we draw a few geometric shapes. To count integers, we count the corner of the geometric shapes. Physical significance for each prime number is shown. All five geometric shapes (2,3,4,5,6) used to create any prime number are shown in a column to the left. Each corner's physical significance is noted. SRT operator is defined below as a foundation to implement the density of primes in configuring only three geometric shapes (2,3,5) into all other prime numbers. The five possible densities of primes (0,1,2,3,4 number of primes in every 10 integer steps leading to C5 symmetry), three waveforms or triplet found to regulate the period in the density of primes plot (C3) and fluctuation of density towards positive and negative changes in the density of primes follow C2 symmetry. Together, C2, C3 and C5 symmetries generate 30 compositions that regulate 15 primes and their 15 physical significance.



## Appendix I; Supporting Figures S1 to S26

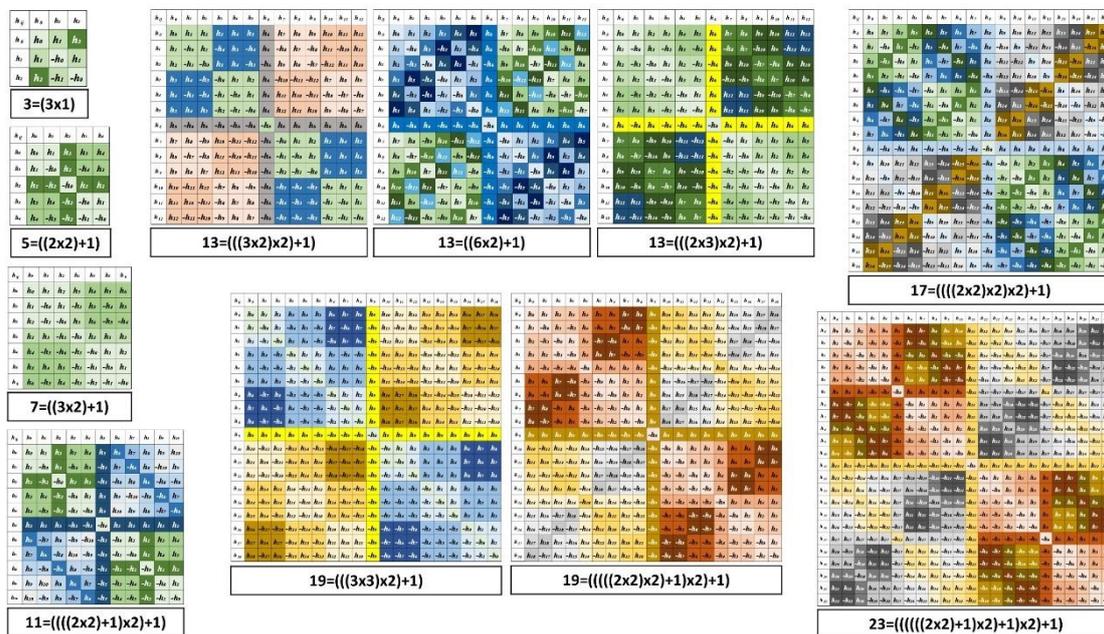


Figure S1. Tensors for prime numbers, 3, 5, 7, 9, 11, 13, 17, 19, 23. Similar color means similar terms

Figure S2. Tensors for prime numbers, 29, 31, 37. Similar color means similar terms

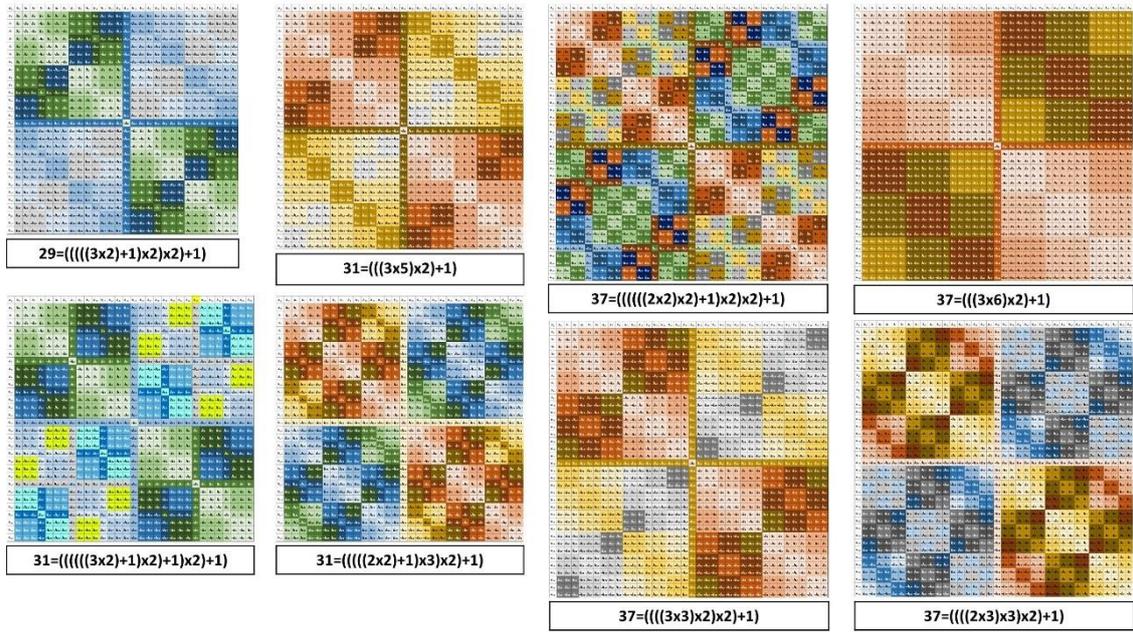


Figure S3. Tensors for prime numbers, 41, 43. Similar color means similar terms

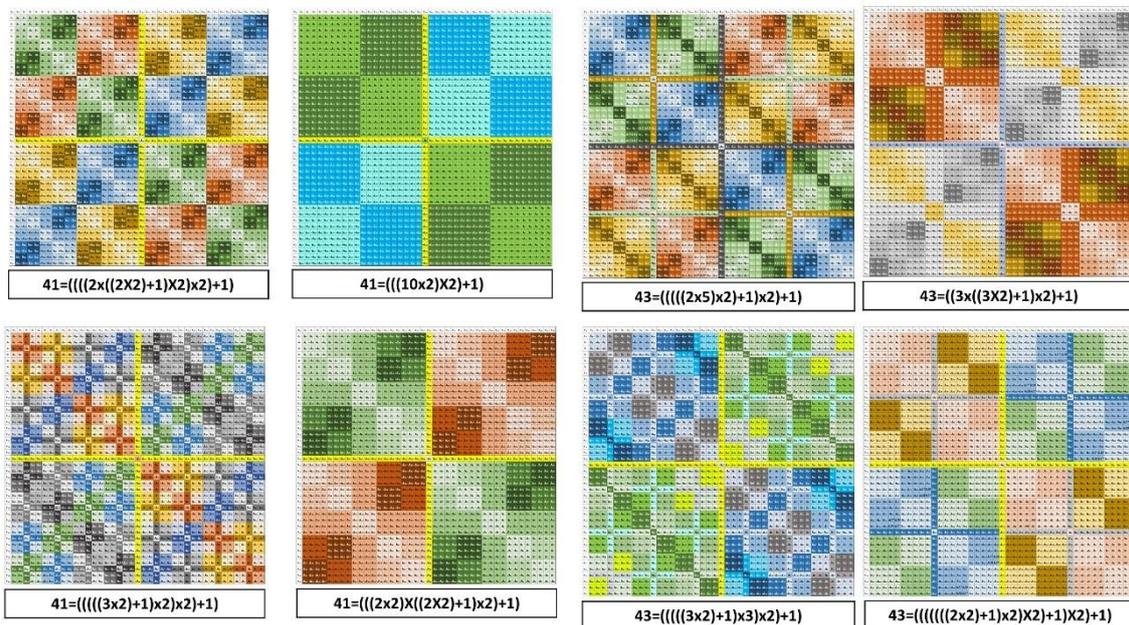


Figure S4. . Tensors for prime numbers, 47, 53. Similar color means similar terms



$$47 = (((((2 \times 2) + 1) \times 2) + 1) \times 2) + 1)$$



$$53 = ((((((3 \times 2) \times 2) + 1) \times 2) \times 2) + 1)$$

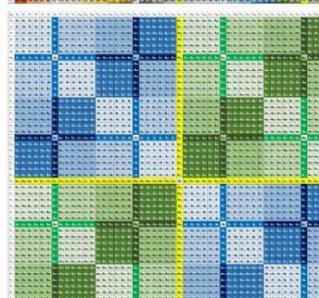
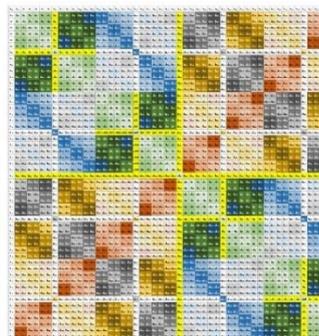


Figure S5. Tensors for prime numbers, 50, 61. Similar color means similar terms

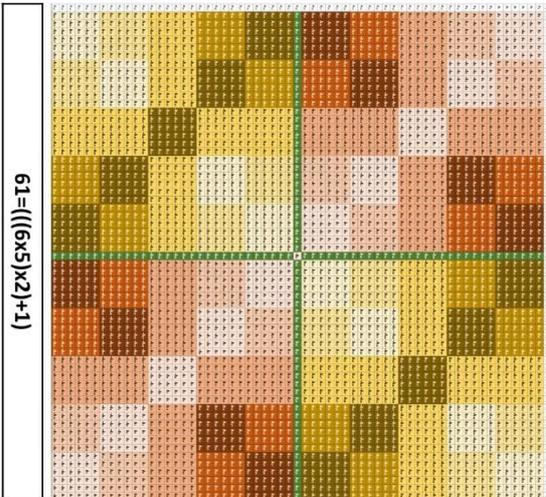
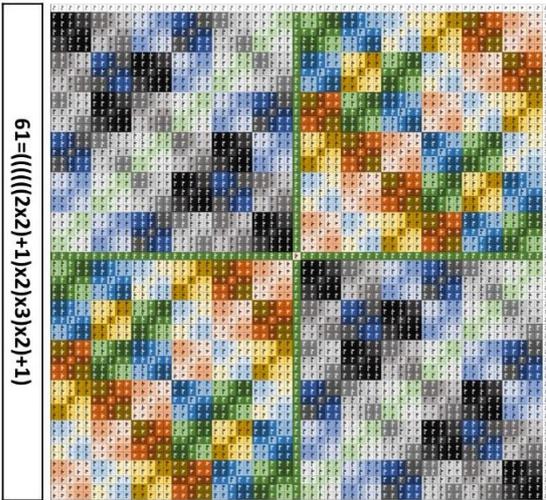
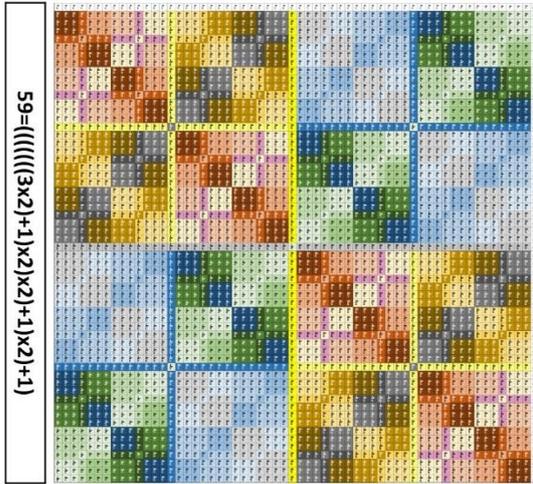


Figure S6. Tensors for prime numbers, 61. Similar color means similar terms

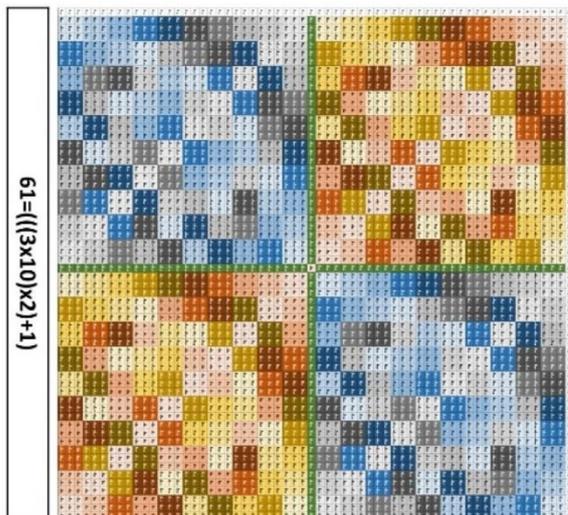
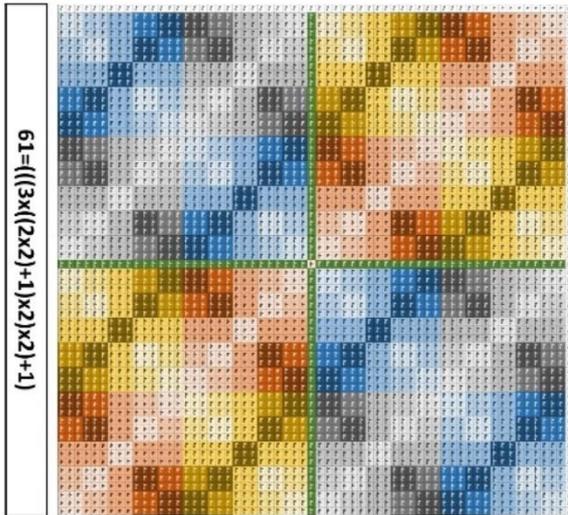
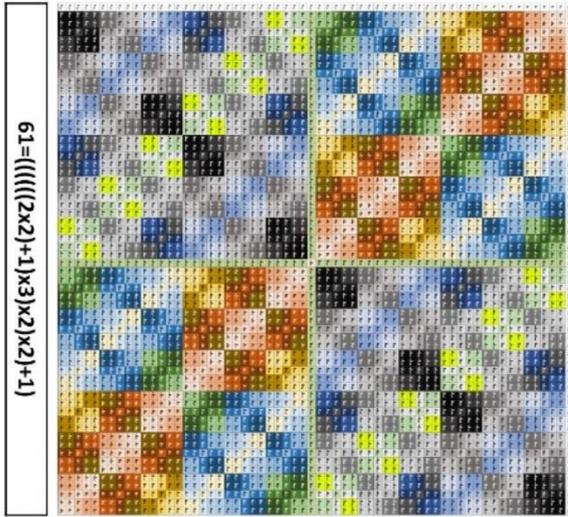


Figure S7. Tensors for prime numbers, 61, 67. Similar color means similar terms

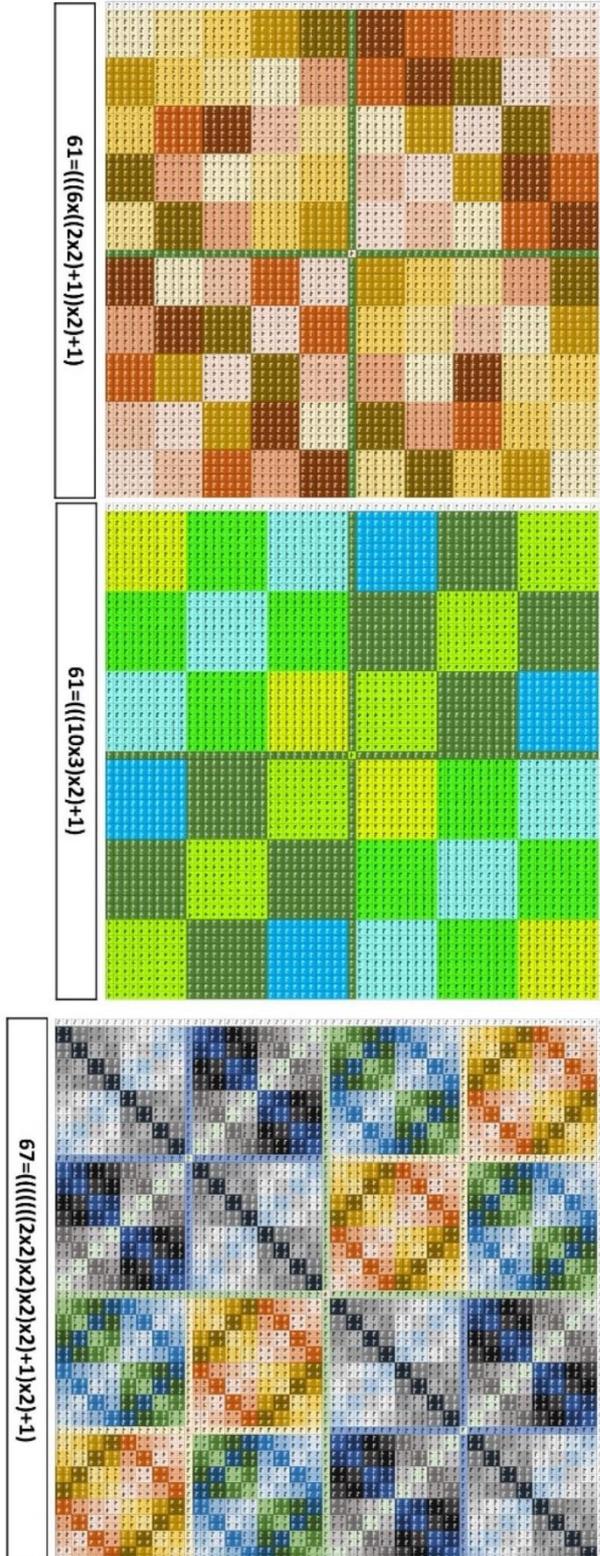


Figure S8. Tensors for prime numbers, 71. Similar color means similar terms

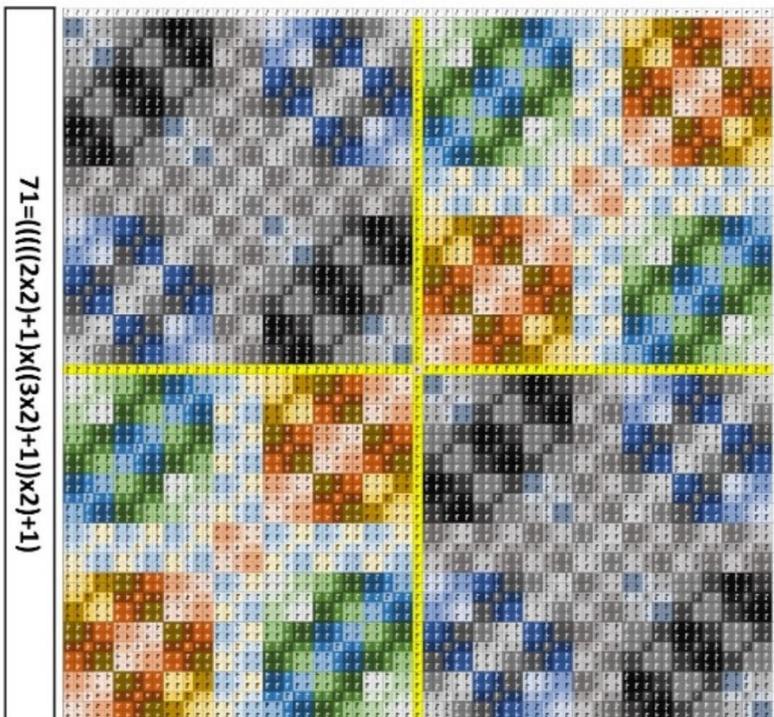
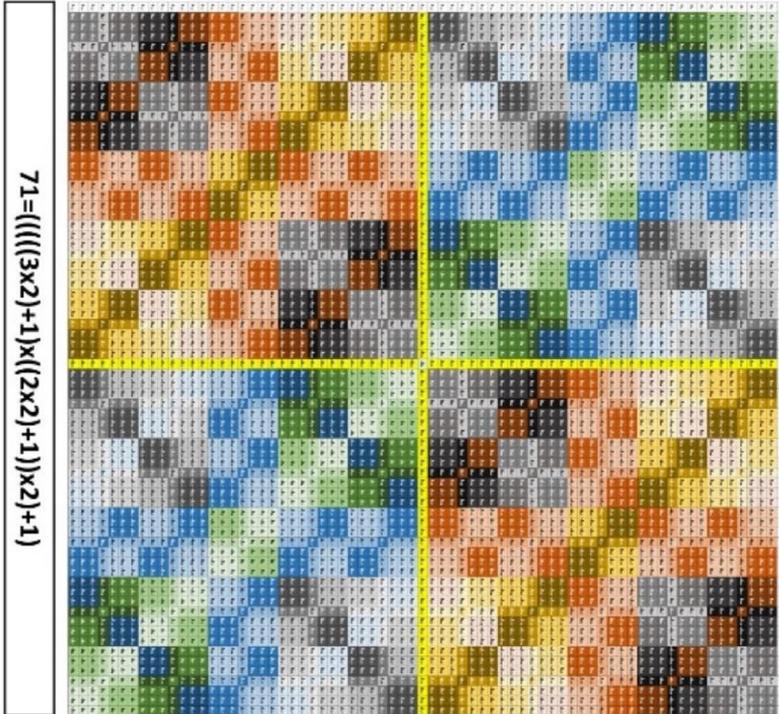


Figure S9. Tensors for prime numbers, 71, 73. Similar color means similar terms

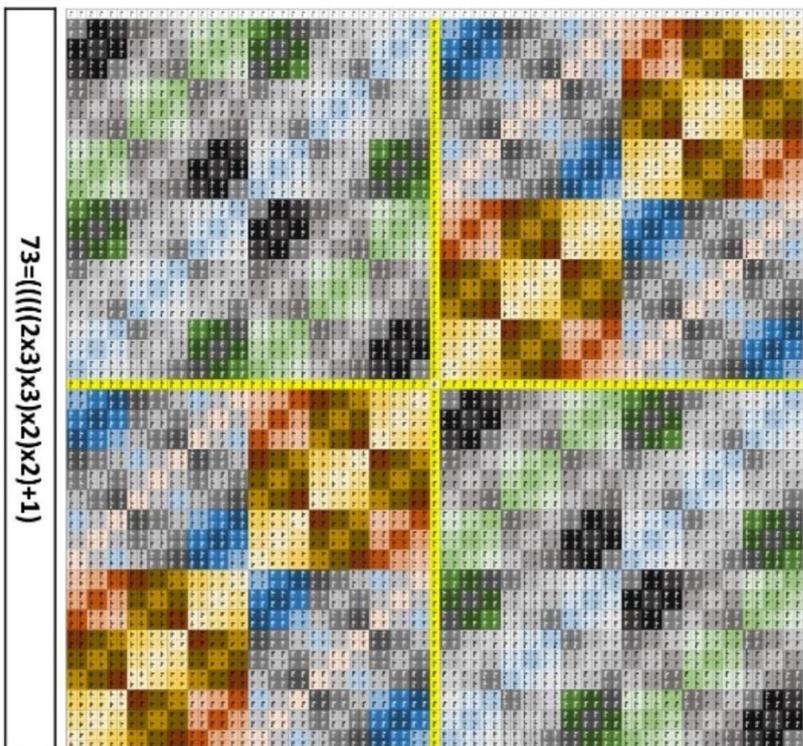
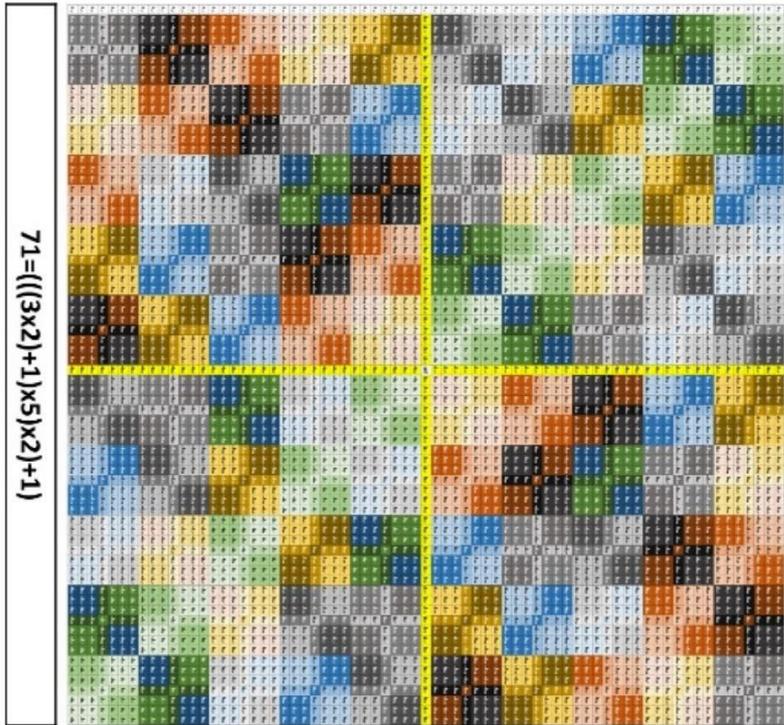


Figure S10. Tensors for prime numbers, 73. Similar color means similar terms

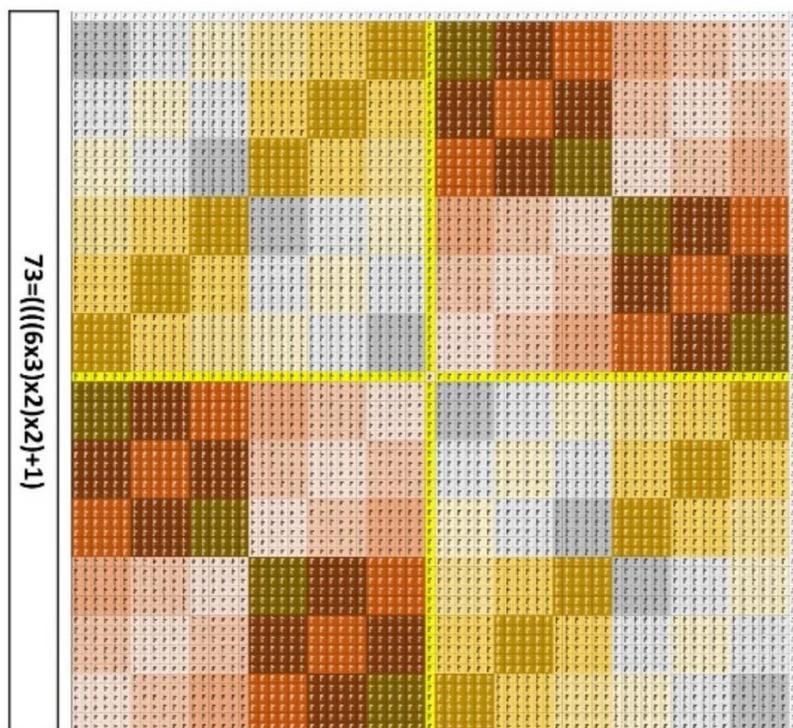
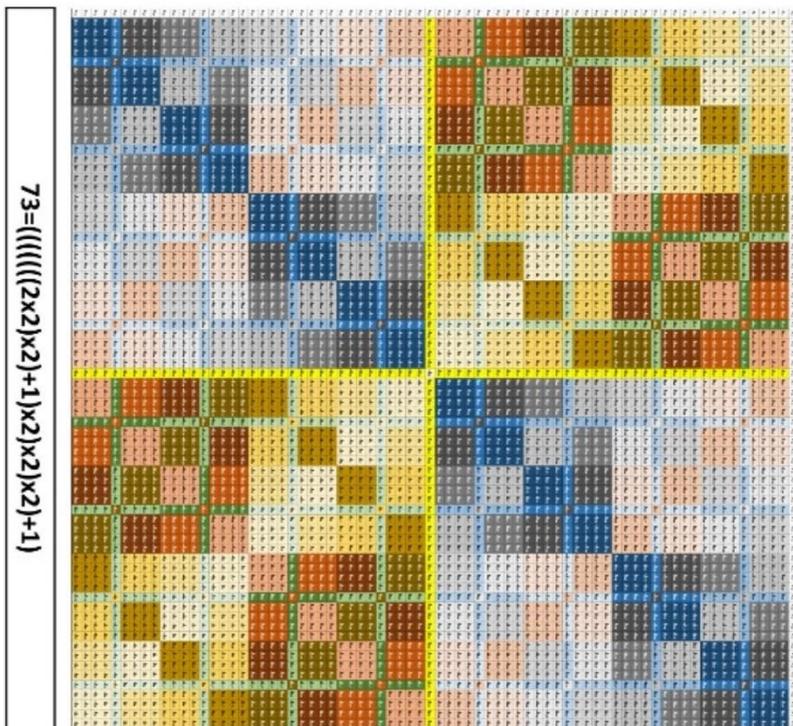


Figure S11. Tensors for prime numbers, 73. Similar color means similar terms

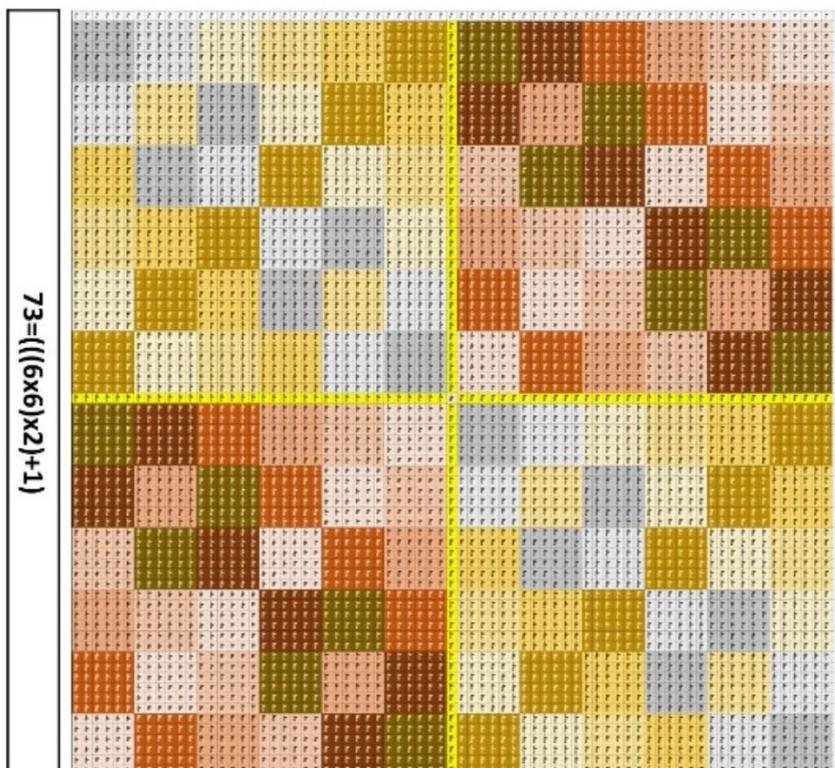
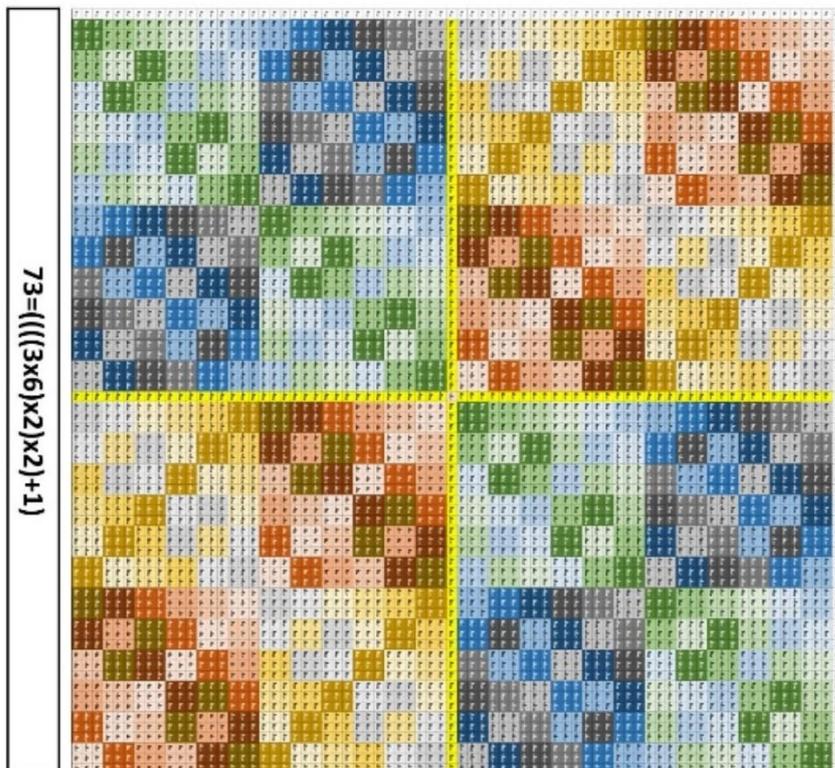


Figure S12. Tensors for prime numbers, 79. Similar color means similar terms

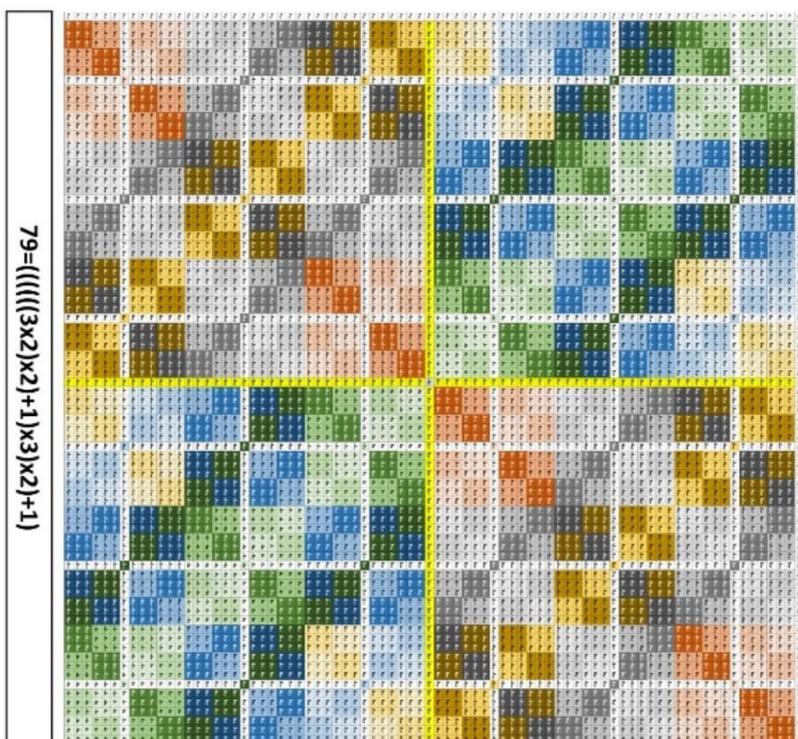
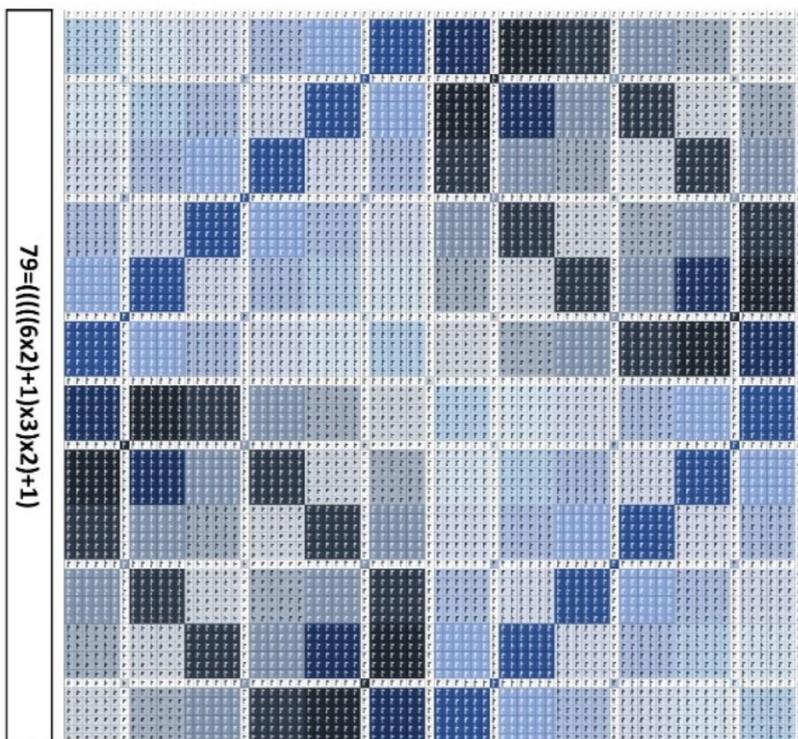


Figure S13. Tensors for prime numbers, 83. Similar color means similar terms

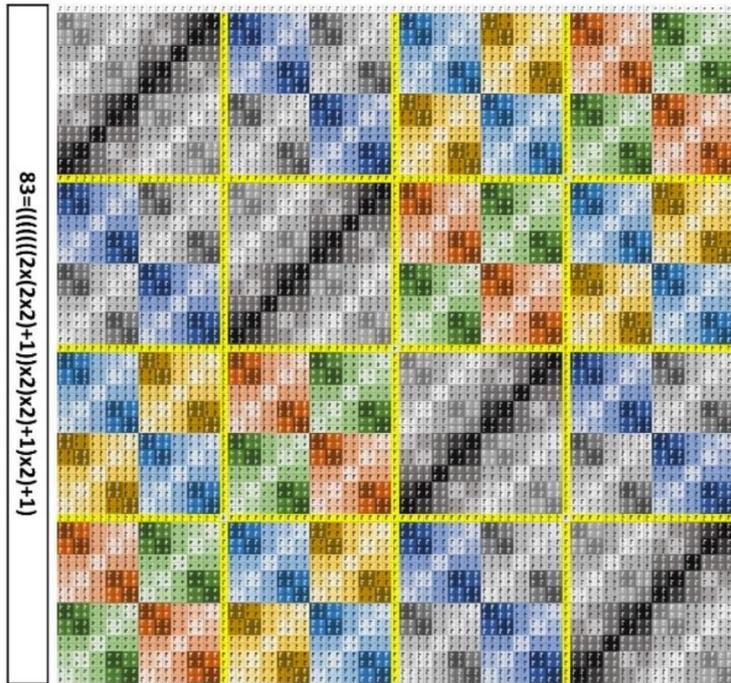
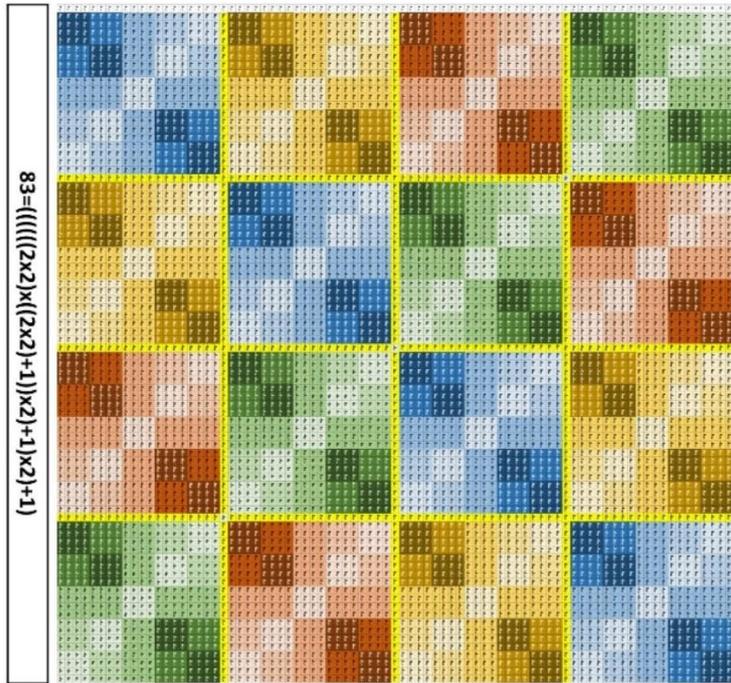


Figure S14. Tensors for prime numbers, 83. Similar color means similar terms

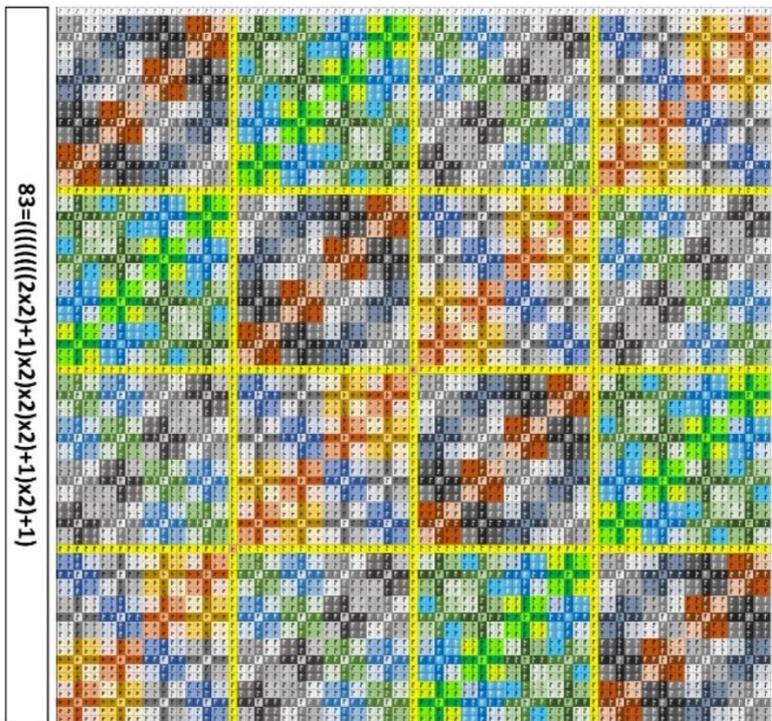
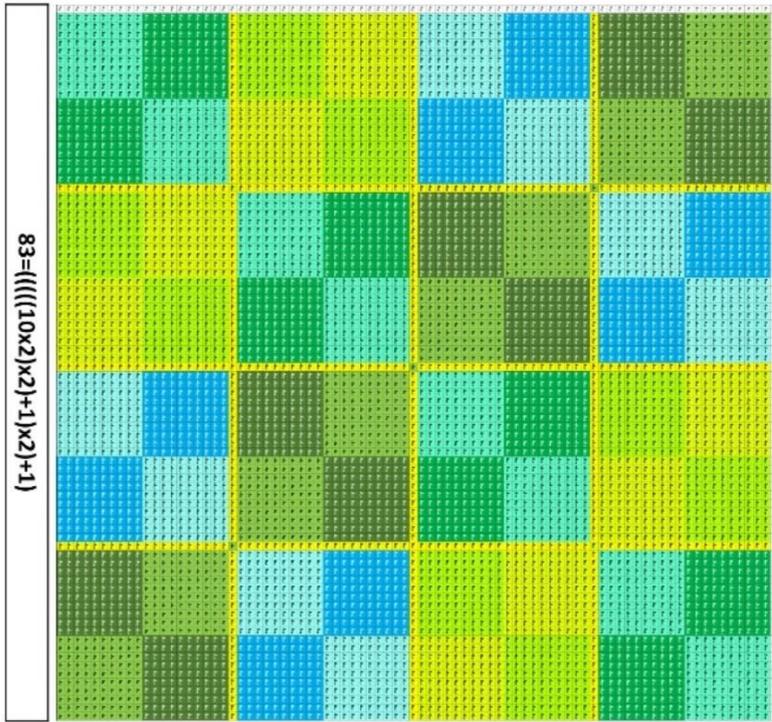


Figure S15. Tensors for prime numbers, 89, 97. Similar color means similar terms

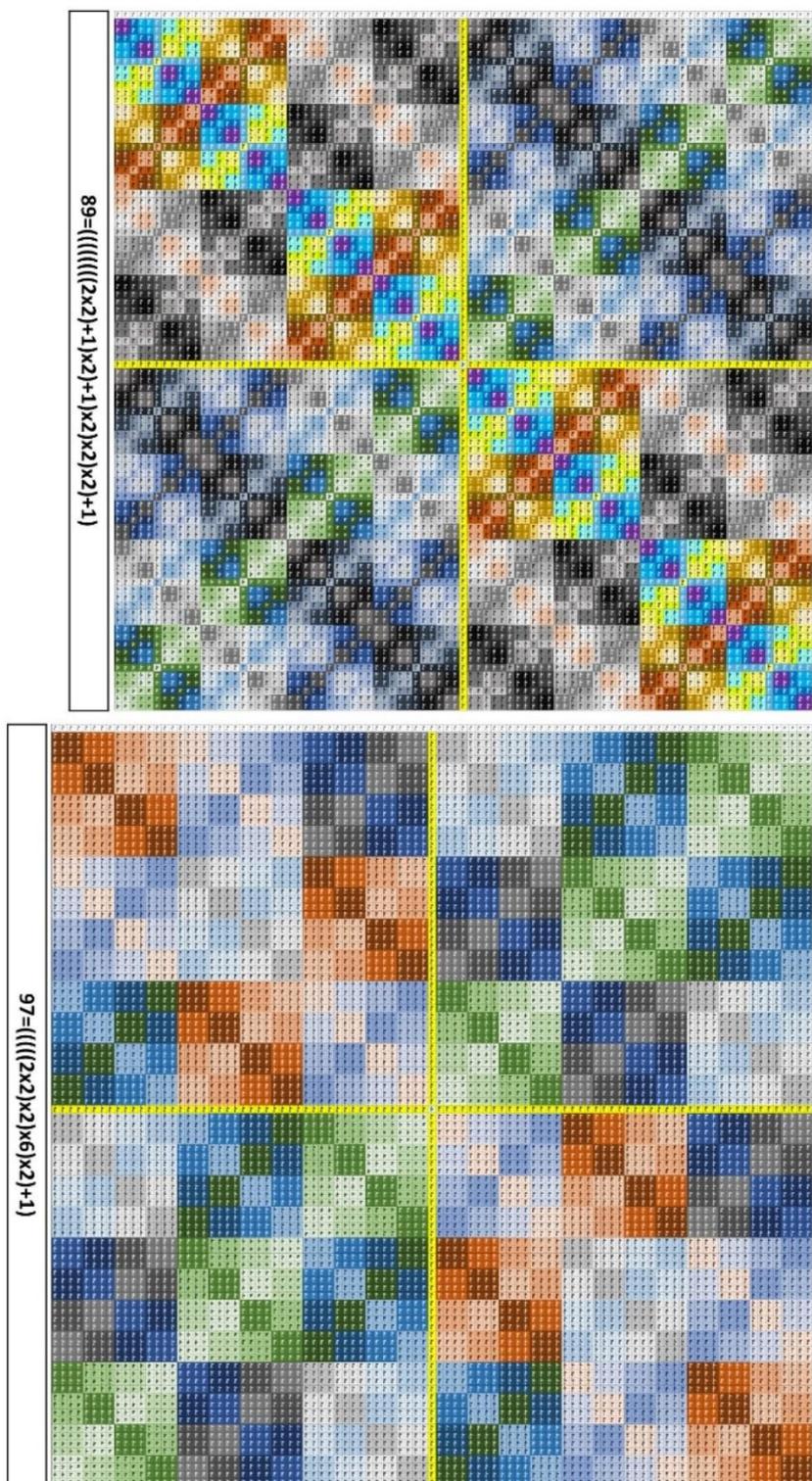
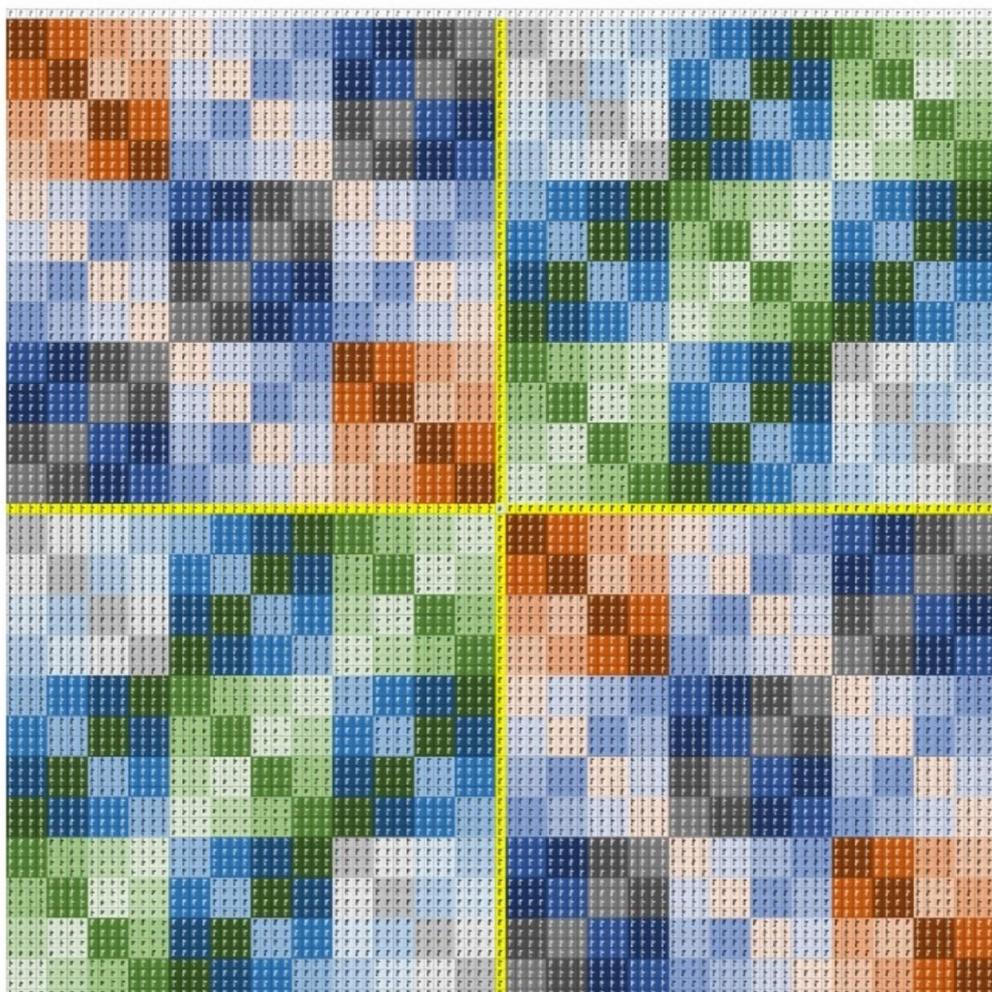
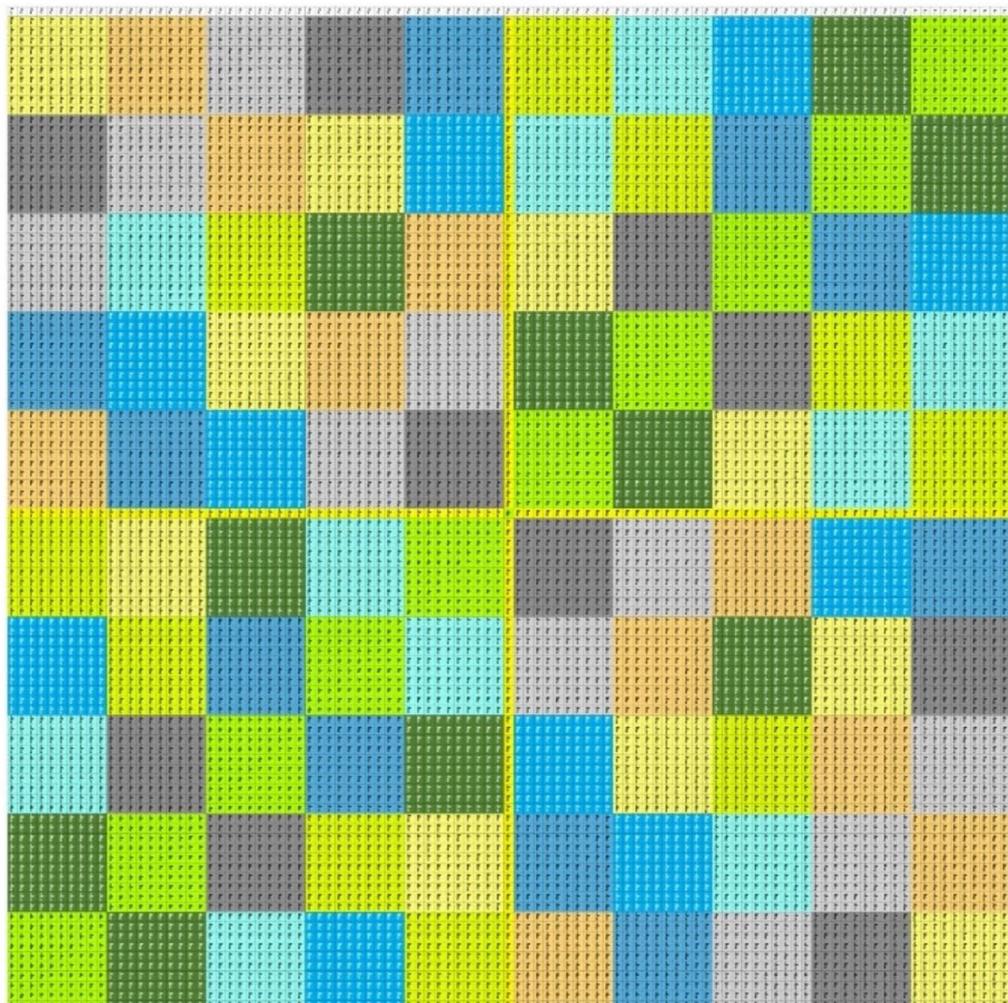


Figure S16. Tensors for prime numbers, 97. Similar color means similar terms



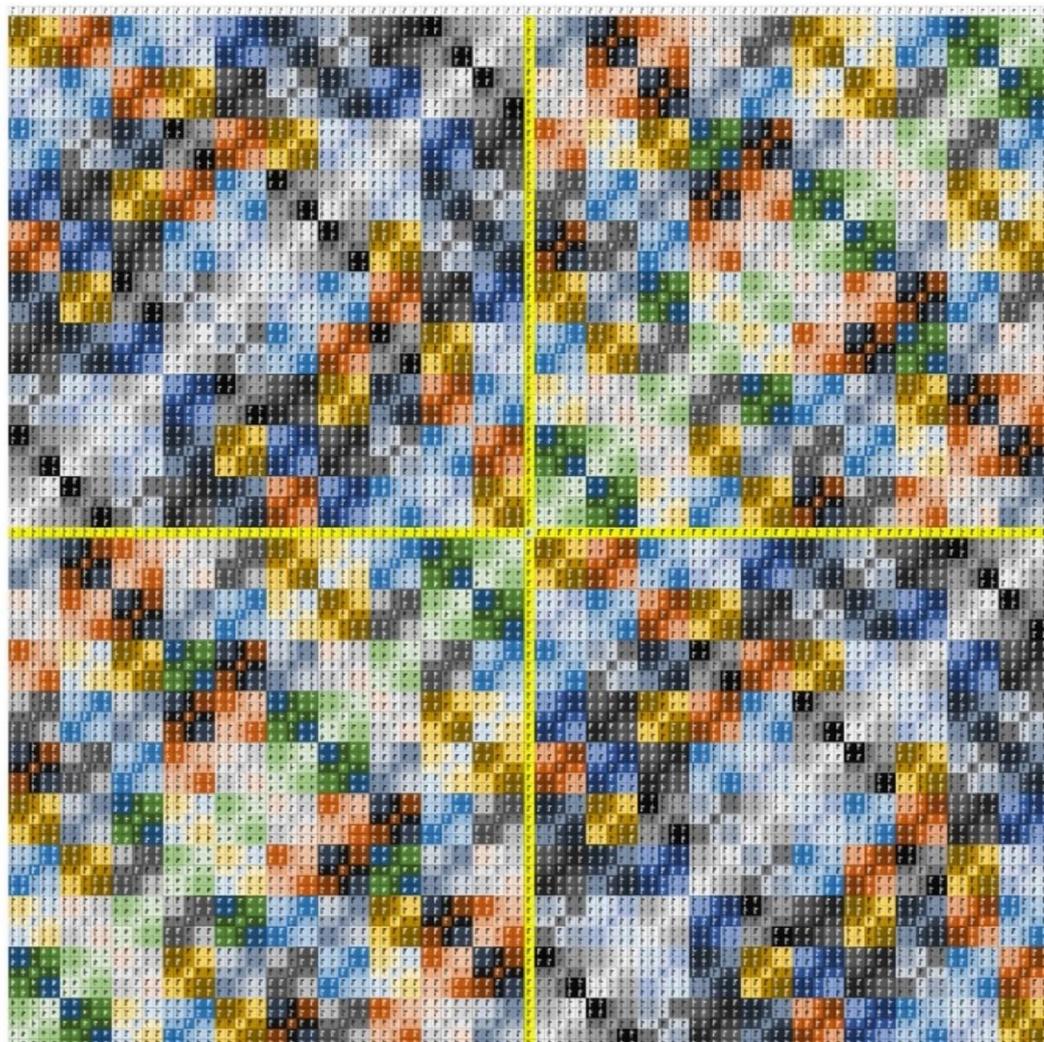
$$97 = ((((((2x^2)x^2)x^2)x^3)x^2)+1))$$

Figure S17. Tensors for prime numbers, 101. Similar color means similar terms



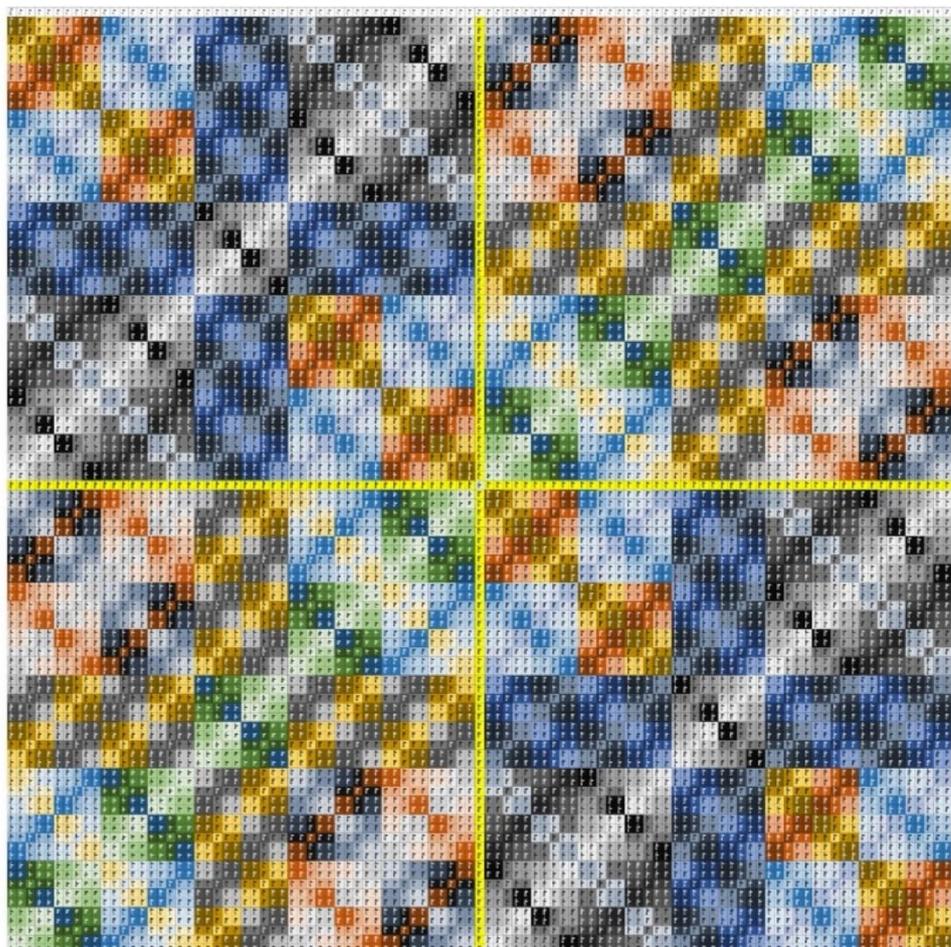
$$101 = ((10 \times 10) + 1)$$

Figure S18. Tensors for prime numbers, 101. Similar color means similar terms



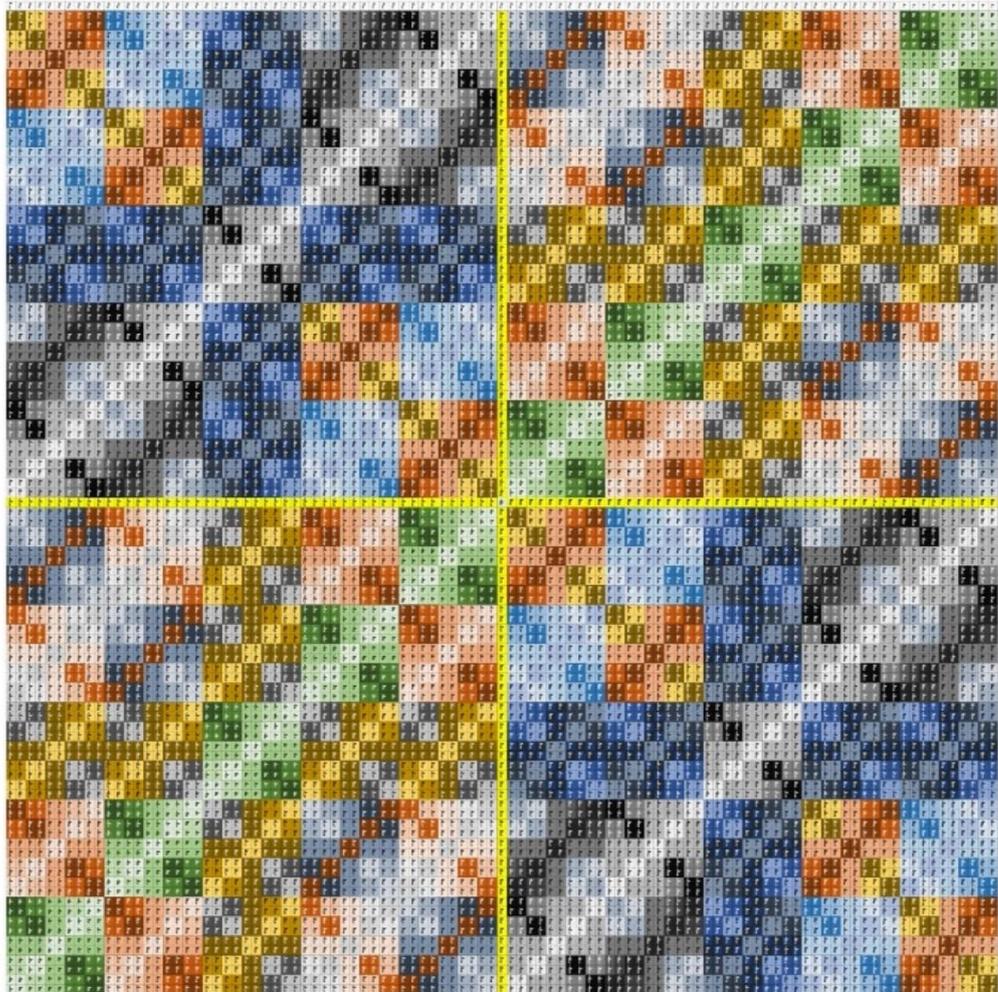
$$101 = (((((2 \times 2) + 1) \times 10) \times 2) + 1)$$

Figure S19. Tensors for prime numbers, 101. Similar color means similar terms



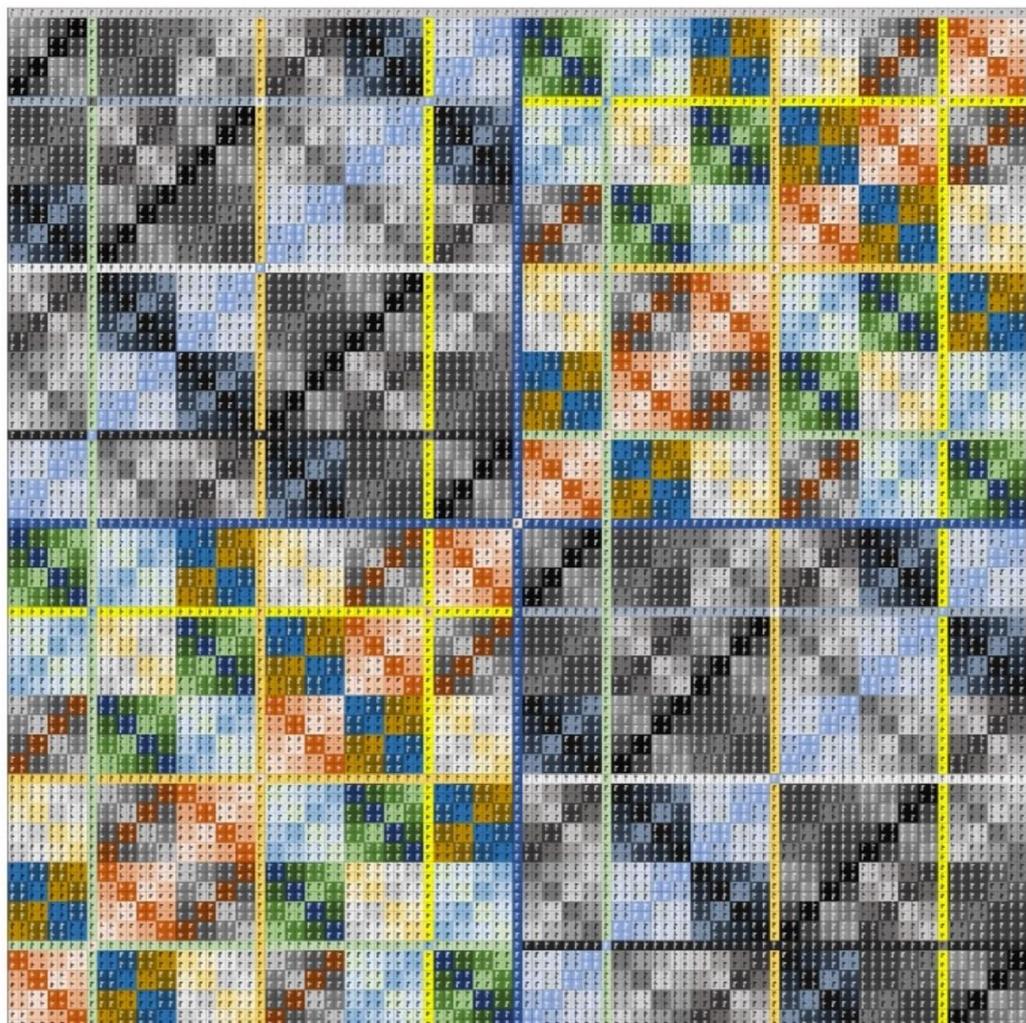
$$101 = (((2x^2 + 1)x)((2x^2 + 1)x^2 + 1))$$

Figure S20. Tensors for prime numbers, 101. Similar color means similar terms



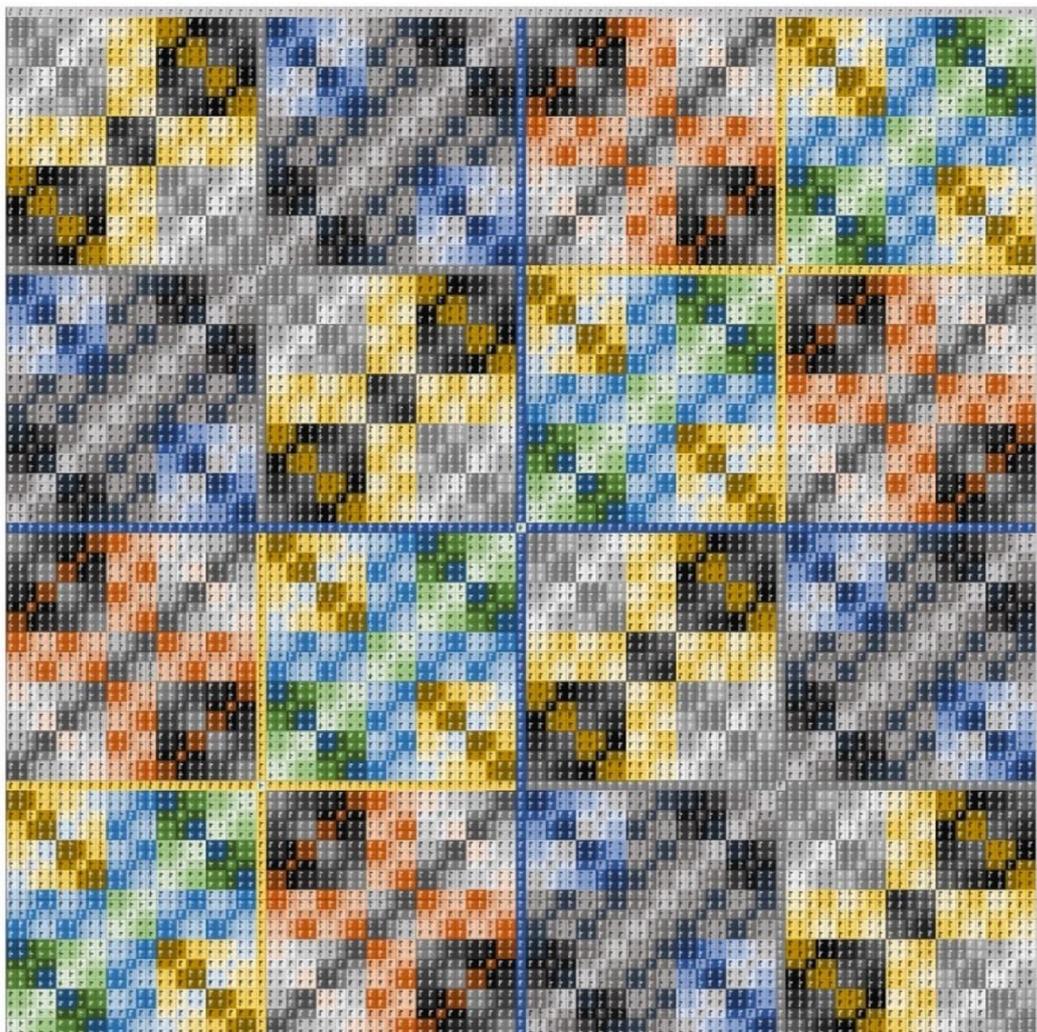
$$101 = (((2 \times ((2 \times 2) + 1) \times 5) \times 2) + 1)$$

Figure S21. Tensors for prime numbers, 103. Similar color means similar terms



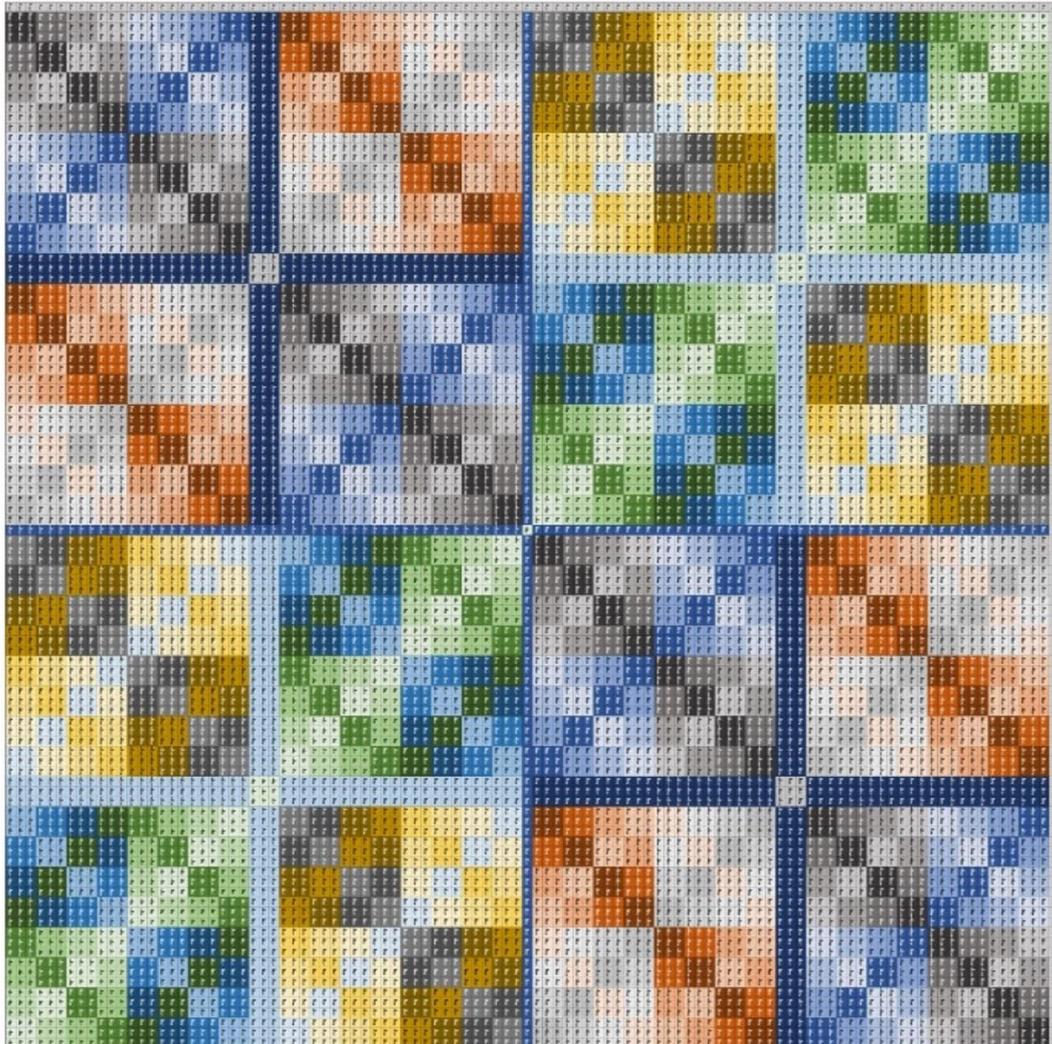
$$103 = ((((((2x^2)x^2)x^2)+1)x^3)x^2)+1)$$

Figure S22. Tensors for prime numbers, 103. Similar color means similar terms



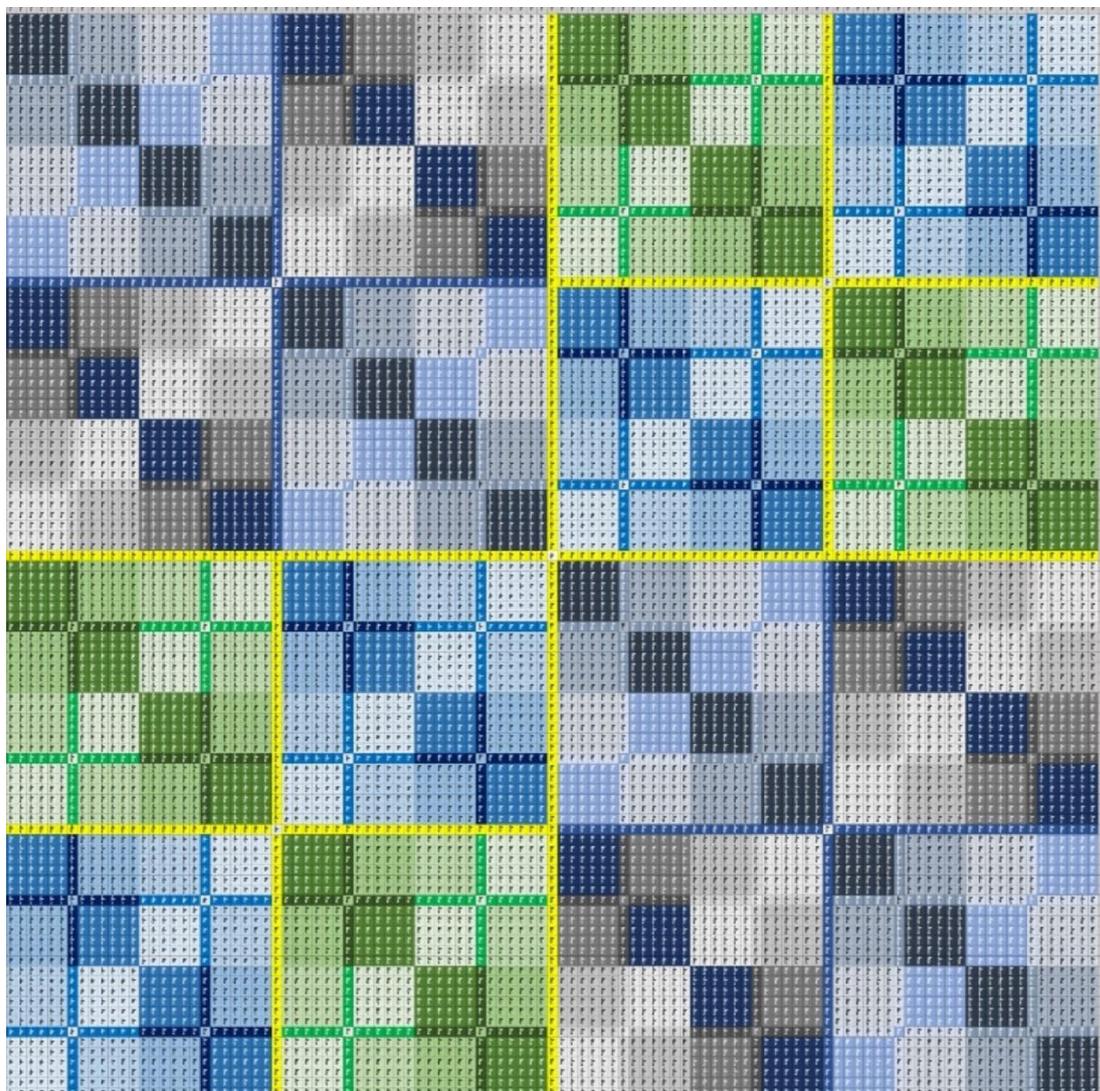
$$103 = ((((((2x^2)+1)x((2x^2)+1))x^2)+1)x^2)+1$$

Figure S23. Tensors for prime numbers, 103. Similar color means similar terms



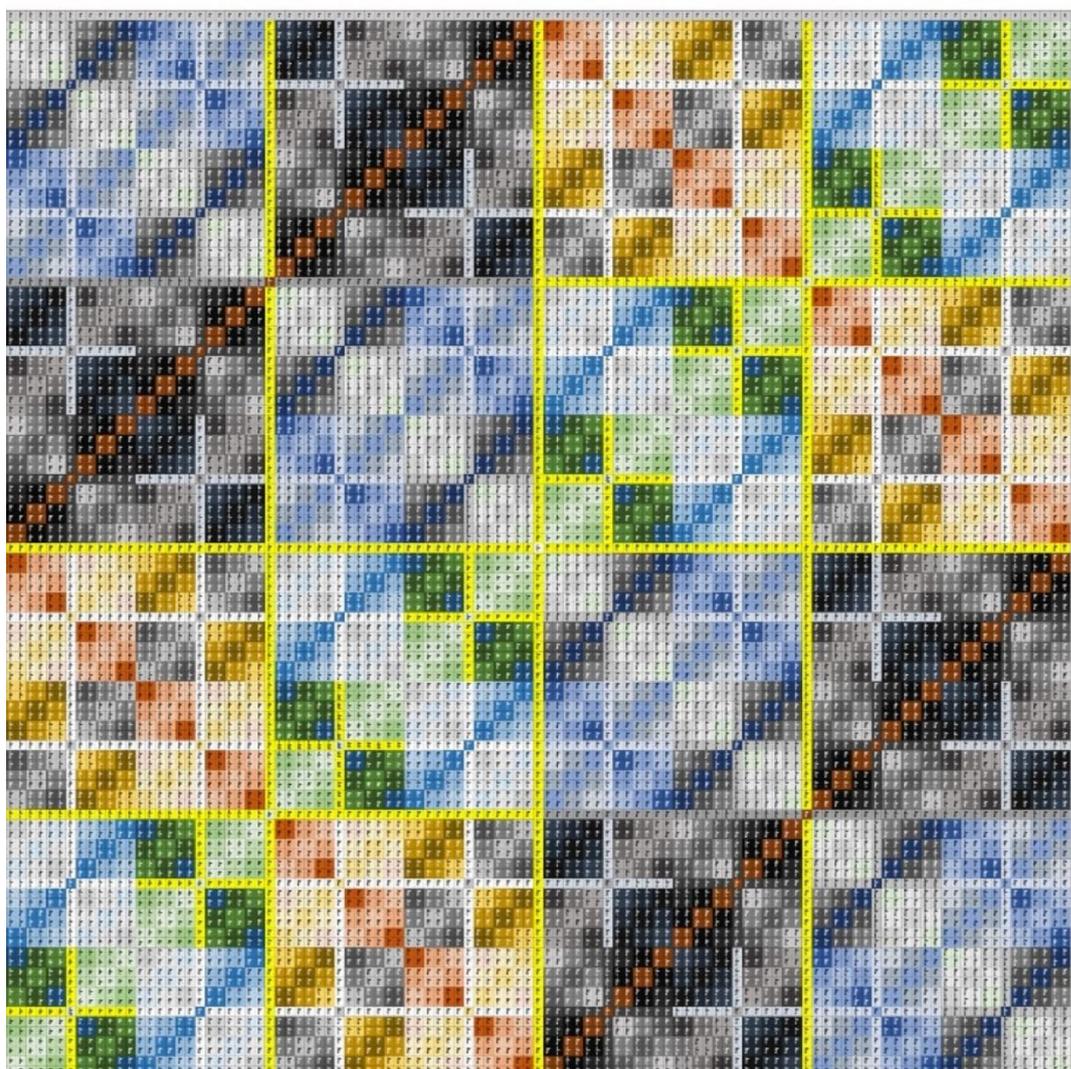
$$103 = (((3 \times (((2 \times 2) \times 2) \times 2) + 1)) \times 2) + 1)$$

Figure S24. Tensors for prime numbers, 107. Similar color means similar terms



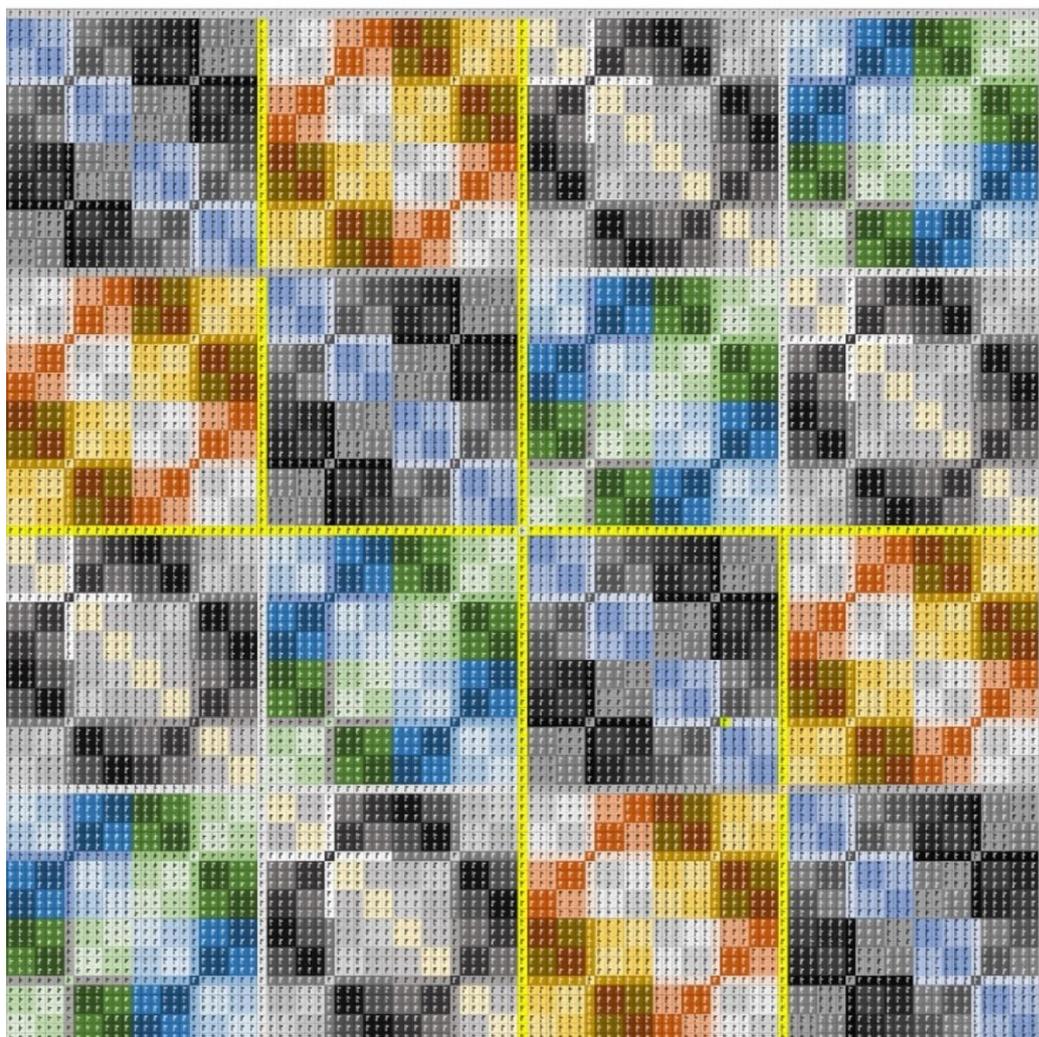
$$107 = ((((((6x^2 + 1)x^2)x^2 + 1)x^2 + 1))$$

Figure S25. Tensors for prime numbers, 107. Similar color means similar terms



$$107 = (((((((((2 \times 3) \times 2) + 1) \times 2) \times 2) + 1) \times 2) + 1))$$

Figure S26. Tensors for prime numbers, 107. Similar color means similar terms



$$107 = ((((((3 \times 2) \times 2) + 1) \times 2) \times 2) + 1) \times 2) + 1$$