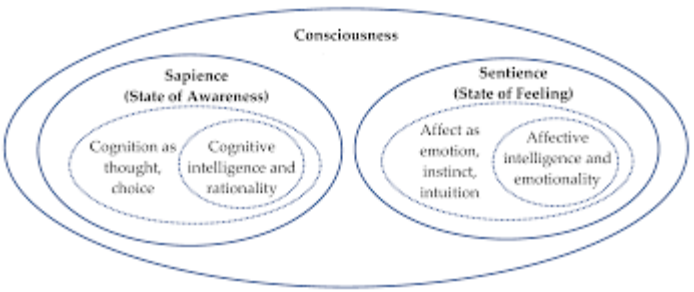
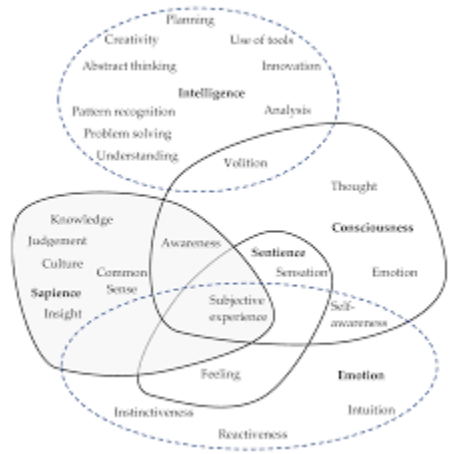
Emergence: Sentience, Consciousness, and MetaMathematics

AlephTalks

23 November 2023

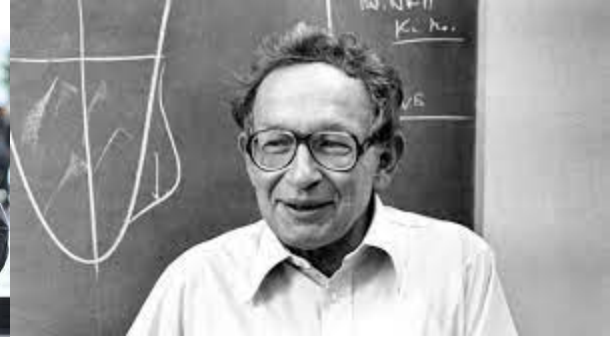




Outline

- Emergence
- Sentience
- Consciousness
- MetaMathematics: Langlands Program
- The Singularity (Vernor Vinge)
- The Body Electric
- Microtubles and Quantum Mechanics

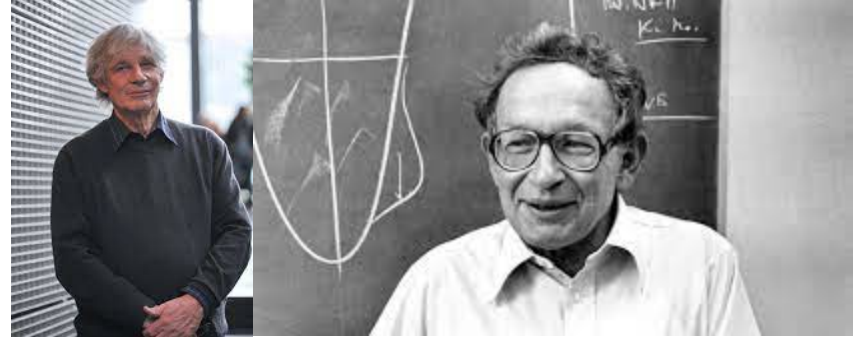
Emergence



- In philosophy, systems theory, science, and art, **emergence** occurs when a complex entity has properties or behaviors that its parts do not have on their own, and emerge only when they interact in a wider whole.
- Emergence plays a central role in theories of integrative levels and of complex systems. For instance, the phenomenon of life as studied in biology is an emergent property of chemistry and quantum physics.
- In philosophy, theories that emphasize emergent properties have been called emergentism.

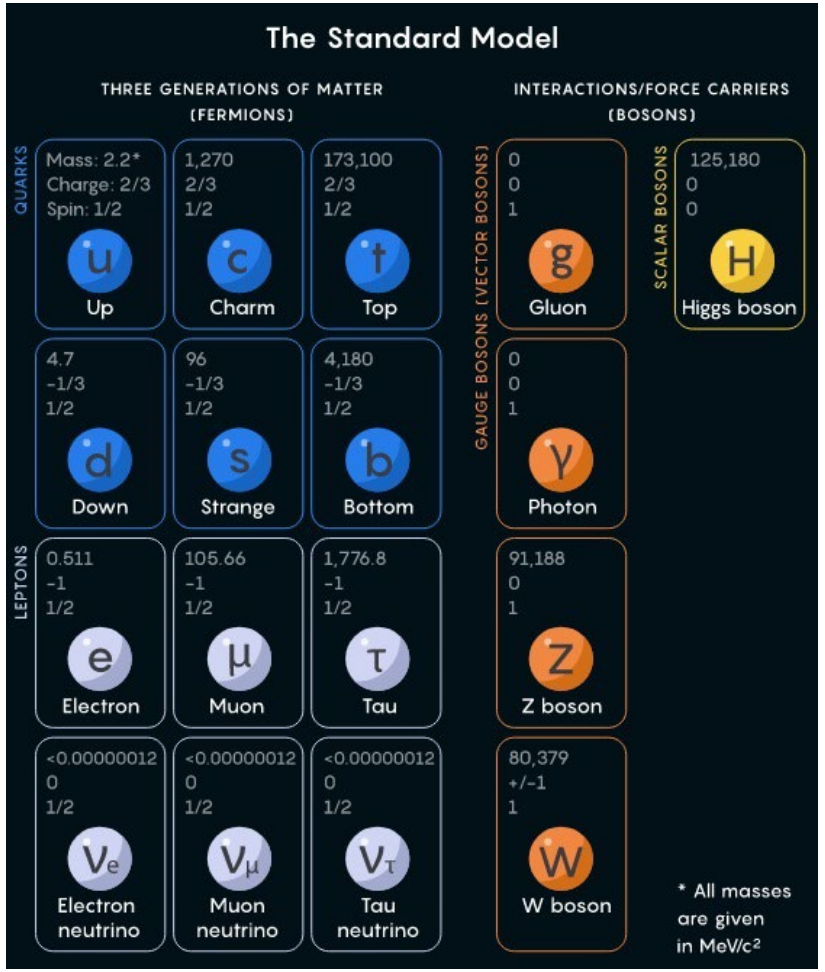
What Is Emergence?

Weak Emergence



- In terms of physical systems, weak emergence is a type of emergence in which the emergent property is amenable to computer simulation or similar forms of after-the-fact analysis (for example, the formation of a traffic jam, the structure of a flock of starlings in flight or a school of fish, or the formation of galaxies).
- Crucial in these simulations is that the interacting members retain their independence. If not, a new entity is formed with new, emergent properties: this is called strong emergence, which it is argued cannot be simulated, analysed or reduced.
- Some common points between the two notions are that emergence concerns new properties produced as the system grows, which is to say ones which are not shared with its components or prior states. Also, it is assumed that the properties are supervenient rather than metaphysically primitive.

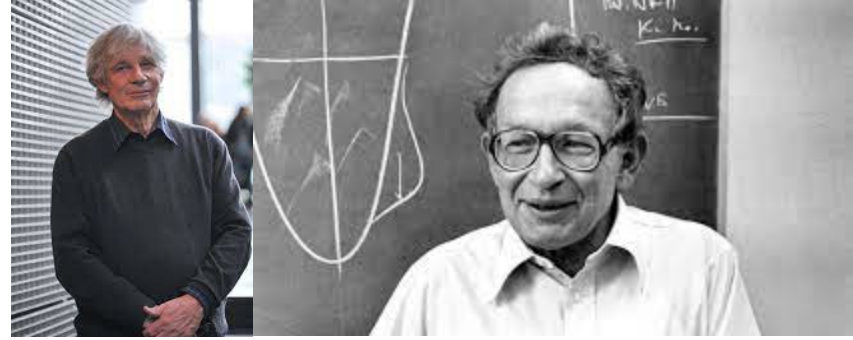
Standard Model of Particle Physics



Standard Model of Particle Physics Is Emergent

- Three holes in six dimensional Calabi Yau compactified subspace results in three resonances for electron, neutrino, quarks, resulting in four particles and twelve including resonances
- Three holes in six dimensional Calabi Yau compactified subspace results in photon having two other resonances
- The electron emerges from ten strings resonating; the quarks result from subquarks
- Higgs Boson is emergent: arises to provide nonzero mass to all particles

Strong Emergence

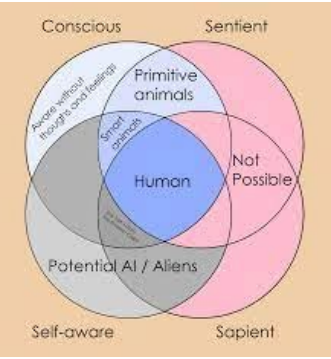


- Physics lacks well-established examples of strong emergence, unless it is interpreted as the impossibility *in practice* to explain the whole in terms of the parts. Practical impossibility may be a more useful distinction than one in principle, since it is easier to determine and quantify, and does not imply the use of mysterious forces, but simply reflects the limits of our capability.
- Although strong emergence is logically possible, it is uncomfortably like magic. How does an irreducible but supervenient downward causal power arise, since by definition it cannot be due to the aggregation of the micro-level potentialities? Such causal powers would be quite unlike anything within our scientific ken. This not only indicates how they will discomfort reasonable forms of materialism. Their mysteriousness will only heighten the traditional worry that emergence entails illegitimately getting something from nothing.

Emergence in Physics

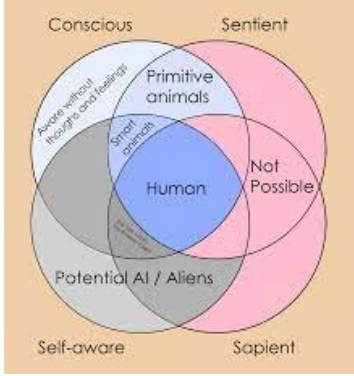
- In physics, emergence is used to describe a property, law, or phenomenon which occurs at macroscopic scales (in space or time) but not at microscopic scales, despite the fact that a macroscopic system can be viewed as a very large ensemble of microscopic systems.
  - An emergent behavior of a physical system is a qualitative property that can only occur in the limit that the number of microscopic constituents tends to infinity.
  - Superconductivity is an example of an emergent physical theory
- According to Laughlin, for many particle systems, nothing can be calculated exactly from the microscopic equations, and macroscopic systems are characterised by broken symmetry: the symmetry present in the microscopic equations is not present in the macroscopic system, due to phase transitions. As a result, these macroscopic systems are described in their own terminology, and have properties that do not depend on many microscopic details.

Sentience



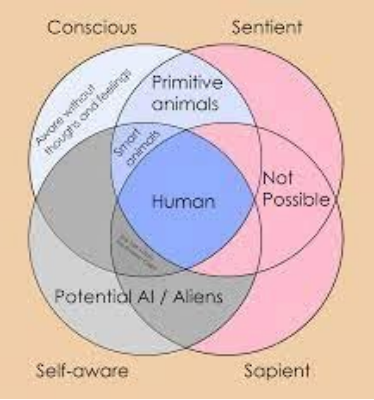
- **Sentience** is the ability to experience feelings and sensations. The word was first coined by philosophers in the 1630s for the concept of an ability to feel, derived from Latin *sentiens* (feeling), to distinguish it from the ability to think (*reason*).
- In modern Western philosophy, sentience is the ability to experience sensations. In different Asian religions, the word "sentience" has been used to translate a variety of concepts. In science fiction, the word "sentience" is sometimes used interchangeably with "sapience", "self-awareness", or "consciousness".

Eastern Tao Views on Sentience



- Eastern religions including Hinduism, Buddhism, Sikhism, and Jainism recognise non-humans as sentient beings.The term *sentient beings* is translated from various Sanskrit terms (*jantu, bahu jana, jagat, sattva*) and "conventionally refers to the mass of living things subject to illusion, suffering, and rebirth (Saṃsāra)".
- In some forms of Buddhism plants, stones and other inanimate objects are considered to be 'sentient'.
- In Jainism many things are endowed with a soul, *jīva*, which is sometimes translated as 'sentience'.Some things are without a soul, *ajīva*, such as a chair or spoon.There are different rankings of *jīva* based on the number of senses it has. Water, for example, is a sentient being of the first order, as it is considered to possess only one sense, that of touch.
- In Jainism and Hinduism, this is related to the concept of ahimsa, non-violence toward other beings.
- Sentience in Buddhism is the state of having senses. In Buddhism, there are six senses, the sixth being the subjective experience of the mind. Sentience is simply awareness prior to the arising of Skandha. Thus, an animal qualifies as a sentient being. According to Buddhism, sentient beings made of pure consciousness are possible. In Mahayana Buddhism, which includes Zen and Tibetan Buddhism, the concept is related to the Bodhisattva, an enlightened being devoted to the liberation of others. The first vow of a Bodhisattva states, "Sentient beings are numberless; I vow to free them."

Western View on Sentience



- Sentience is the ability to experience feelings and sensations.
- The word was first coined by philosophers in the 1630s for the concept of an ability to feel, derived from Latin sentiens (feeling), to distinguish it from the ability to think (reason).
- In modern Western philosophy, sentience is the ability to experience sensations. In different Asian religions, the word "sentience" has been used to translate a variety of concepts. In science fiction, the word "sentience" is sometimes used interchangeably with "sapience", "self-awareness", or "consciousness".
- Some writers differentiate between the mere ability to perceive sensations, such as light or pain, and the ability to perceive emotions, such as fear or grief. The subjective awareness of experiences by a conscious individual are known as qualia in Western philosophy.

Carl Jung 1916 Collective Unconscious

- **Collective unconscious** (German: *kollektives Unbewusstes*) refers to the unconscious mind and shared mental concepts. It is generally associated with idealism and was coined by Carl Jung. According to Jung, the human collective unconscious is populated by instincts, as well as by archetypes: ancient primal symbols such as The Great Mother, the Wise Old Man, the Shadow, the Tower, Water, and the Tree of Life.
- Jung considered the collective unconscious to underpin and surround the unconscious mind, distinguishing it from the personal unconscious of Freudian psychoanalysis. He believed that the concept of the collective unconscious helps to explain why similar themes occur in mythologies around the world. He argued that the collective unconscious had a profound influence on the lives of individuals, who lived out its symbols and clothed them in meaning through their experiences. The psychotherapeutic practice of analytical psychology revolves around examining the patient's relationship to the collective unconscious.
- Psychiatrist and Jungian analyst Lionel Corbett argues that the contemporary terms "autonomous psyche" or "objective psyche" are more commonly used today in the practice of depth psychology rather than the traditional term of the "collective unconscious".
- Critics of the collective unconscious concept have called it unscientific and fatalistic, or otherwise very difficult to test scientifically (due to the mystical aspect of the collective unconscious).
- Proponents suggest that it is borne out by findings of psychology, neuroscience, and anthropology.

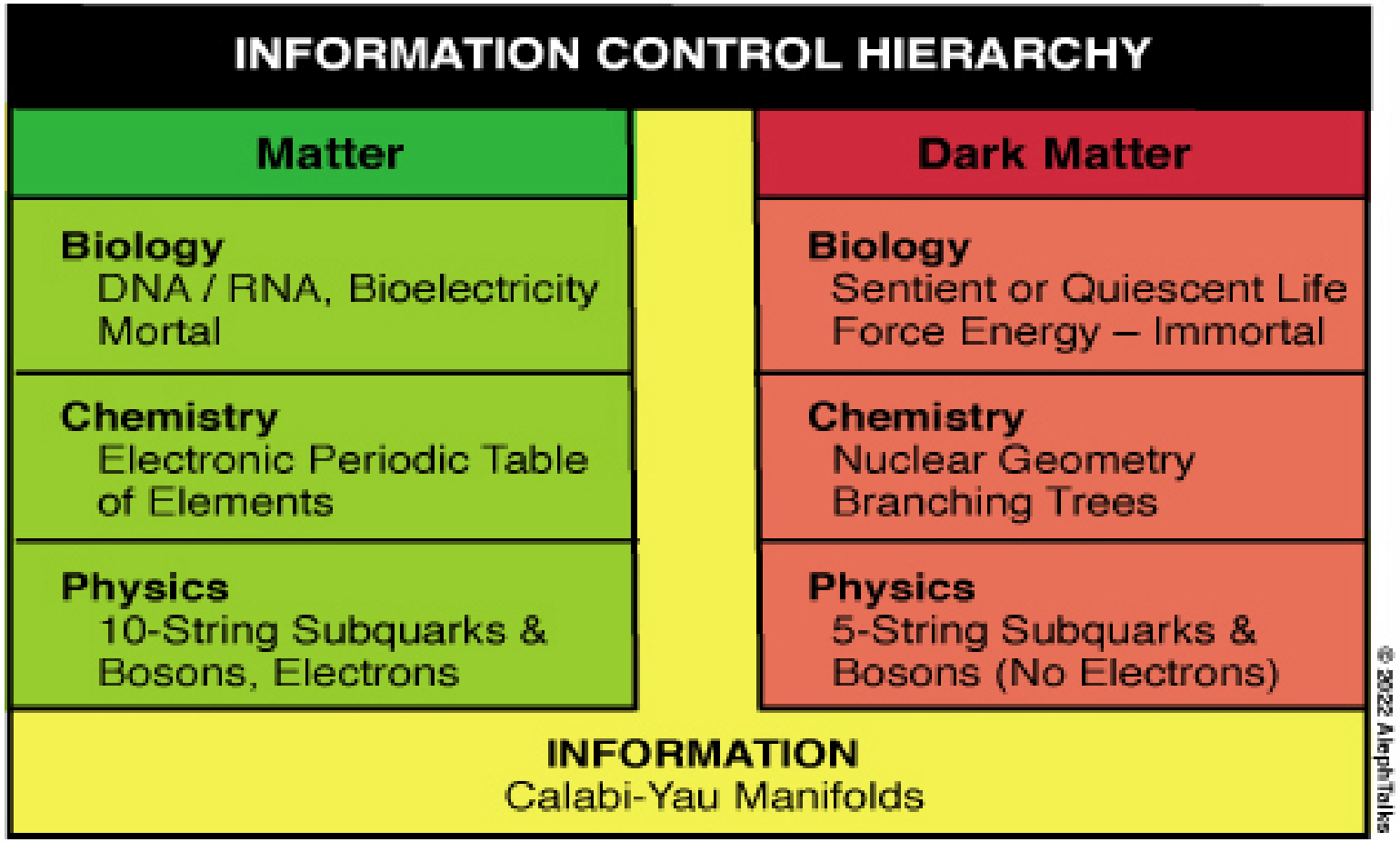
Carl Jung Collective Unconscious 1916, 1929

- The term "collective unconscious" first appeared in Jung's 1916 essay, "The Structure of the Unconscious".This essay distinguishes between the "personal", Freudian unconscious, filled with sexual fantasies and repressed images, and the "collective" unconscious encompassing the soul of humanity at large.
- In "The Significance of Constitution and Heredity in Psychology" (November 1929), Jung wrote:
  - And the essential thing, psychologically, is that in dreams, fantasies, and other exceptional states of mind the most far-fetched mythological motifs and symbols can appear autochthonously at any time, often, apparently, as the result of particular influences, traditions, and excitations working on the individual, but more often without any sign of them. These "primordial images" or "archetypes," as I have called them, belong to the basic stock of the unconscious psyche and cannot be explained as personal acquisitions. Together they make up that psychic stratum which has been called the collective unconscious.
- The existence of the collective unconscious means that individual consciousness is anything but a tabula rasa and is not immune to predetermining influences. On the contrary, it is in the highest degree influenced by inherited presuppositions, quite apart from the unavoidable influences exerted upon it by the environment. The collective unconscious comprises in itself the psychic life of our ancestors right back to the earliest beginnings. It is the matrix of all conscious psychic occurrences, and hence it exerts an influence that compromises the freedom of consciousness in the highest degree, since it is continually striving to lead all conscious processes back into the old paths.

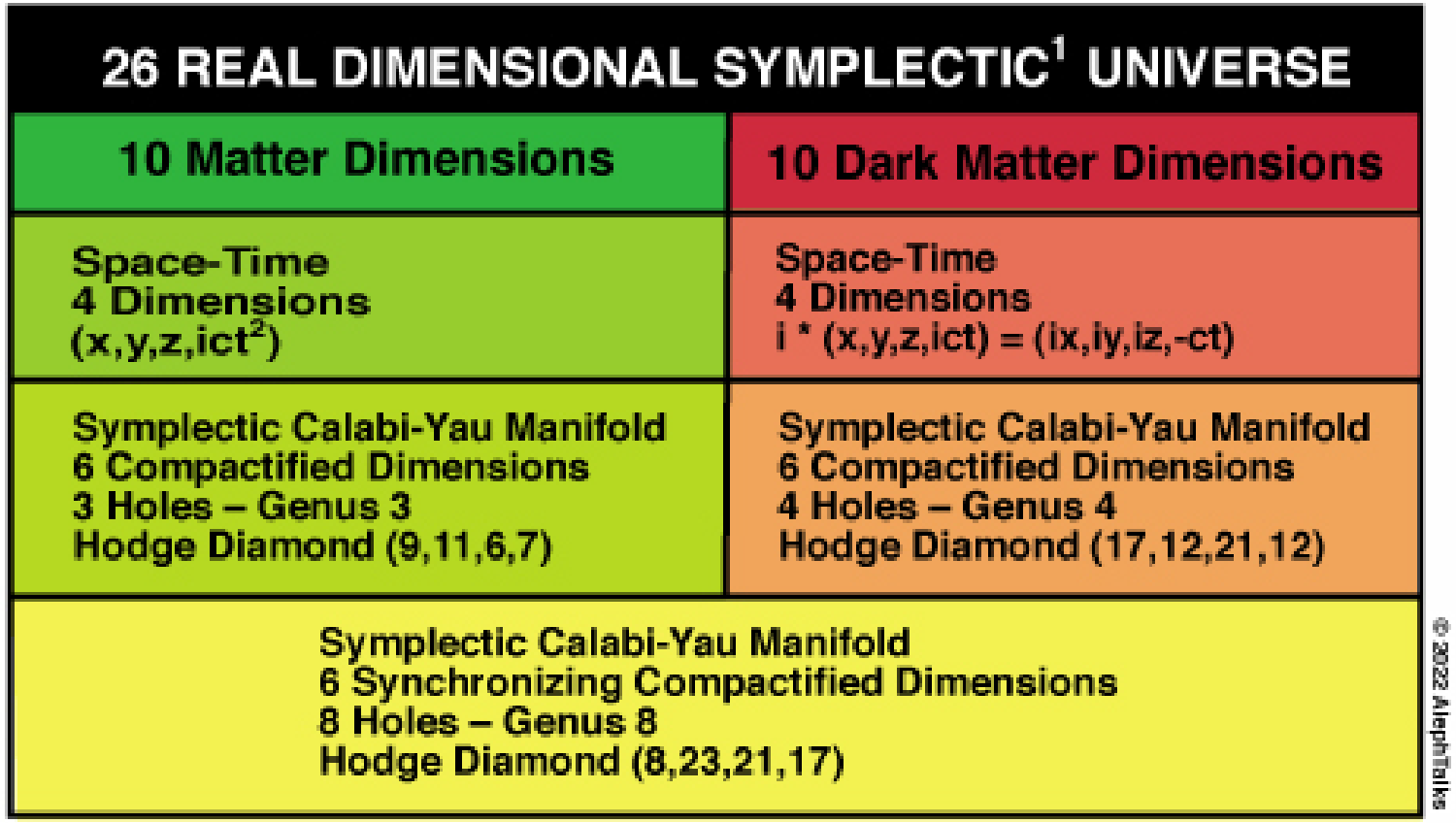
Carl Jung, Collective Unconscious 1936

- On October 19, 1936, Jung delivered a lecture "The Concept of the Collective Unconscious" to the Abernethian Society at St. Bartholomew's Hospital in London. He said:
  - My thesis then, is as follows: in addition to our immediate consciousness, which is of a thoroughly personal nature and which we believe to be the only empirical psyche (even if we tack on the personal unconscious as an appendix), there exists a second psychic system of a collective, universal, and impersonal nature which is identical in all individuals. This collective unconscious does not develop individually but is inherited. It consists of pre-existent forms, the archetypes, which can only become conscious secondarily and which give definite form to certain psychic contents.
- Jung linked the collective unconscious to "what Freud called 'archaic remnants' – mental forms whose presence cannot be explained by anything in the individual's own life and which seem to be aboriginal, innate, and inherited shapes of the human mind".He credited Freud for developing his "primal horde" theory in Totem and Taboo and continued further with the idea of an archaic ancestor maintaining its influence in the minds of present-day humans. Every human being, he wrote, "however high his conscious development, is still an archaic man at the deeper levels of his psyche."
- As modern humans go through their process of individuation, moving out of the collective unconscious into mature selves, they establish a persona—which can be understood simply as that small portion of the collective psyche which they embody, perform, and identify with.

Ron Cowen Observation of Sacred Geometry

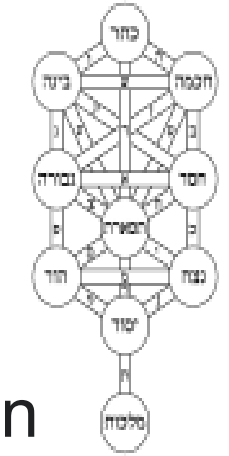


Ronald Cowen 26 Real Dimensional Universe



[1] Symplectic = real and imaginary pairs.
[2] ict = √(-1) * speed of light * time.

Tzimtzum



- The ***tzimtzum*** or ***tsimtsum*** (Hebrew: צִמְצוּם *simsum* "contraction/constriction/condensation") is a term used in the Lurianic Kabbalah to explain Isaac Luria's doctrine that God began the process of creation by "contracting" his *Ohr Ein Sof* (infinite light) in order to allow for a "conceptual space" in which finite and seemingly independent realms could exist.
- This primordial initial contraction, forming a *ḥalal hapanuy* "vacant space" (חלל הפנוי) into which new creative light could beam, is denoted by general reference to the *tzimtzum*.
  In Kabbalistic interpretation, *tzimtzum* gives rise to the paradox of simultaneous divine presence and absence within the vacuum and resultant Creation. Various approaches exist then, within Orthodoxy, as to how the paradox may be resolved, and as to the nature of *tzimtzum* itself.

Consciousness

- **Consciousness**, at its simplest, is awareness of internal and external existence. However, its nature has led to millennia of analyses, explanations and debate by philosophers, theologians, and all of science.
- Opinions differ about what exactly needs to be studied or even considered consciousness. In some explanations, it is synonymous with the mind, and at other times, an aspect of mind.
- In the past, it was one's "inner life", the world of introspection, of private thought, imagination and volition.Today, it often includes any kind of cognition, experience, feeling or perception. It may be awareness, awareness of awareness, or self-awareness either continuously changing or not.
- The disparate range of research, notions and speculations raises a curiosity about whether the right questions are being asked.

Stephen Wolfram: Consciousness

- People will ask “So what does this mean about consciousness?” And I’ll say “that’s a slippery topic”. And I’ll start talking about the sequence: life, intelligence, consciousness.
- I’ll ask “What is the abstract definition of life?” We know about the case of life on Earth, with all its RNA and proteins and other implementation details. But how do we generalize? What is life generally? And I’ll argue that it’s really just computational sophistication, which the Principle of Computational Equivalence says happens all over the place.
- I’ll talk about intelligence. And I’ll argue it’s the same kind of thing. We know the case of human intelligence. But if we generalize, it’s just computational sophistication—and it’s ubiquitous. And so it’s perfectly reasonable to say that “the weather has a mind of its own”; it just happens to be a mind whose details and “purposes” aren’t aligned with our existing human experience.

Stephen Wolfram: Consciousness

- I've always implicitly assumed that consciousness is just a continuation of the same story: something that, if thought about in enough generality, is just a feature of computational sophistication, and therefore quite ubiquitous.
- But from our Physics Project—and particularly from thinking about its implications for the foundations of quantum mechanics—I've begun to realize that at its core consciousness is actually something rather different.
- Yes, its implementation involves computational sophistication. But its essence is not so much about what can happen as about having ways to integrate what's happening to make it somehow coherent and to allow what we might see as "definite thoughts" to be formed about it.

Stephen Wolfram: Consciousness

- And rather than consciousness being somehow beyond “generalized intelligence” or general computational sophistication, I now instead see it as a kind of “step down”—as something associated with simplified descriptions of the universe based on using only bounded amounts of computation.
- At the outset, it’s not obvious that a notion of consciousness defined in this way could consistently exist in our universe. And indeed the possibility of it seems to be related to deep features of the formal system that underlies physics.
- In the end, there’s a lot going on in the universe that’s in a sense “beyond consciousness”. But the core notion of consciousness is crucial to our whole way of seeing and describing the universe—and at a very fundamental level it’s what makes the universe seem to us to have the kinds of laws and behavior it does.

Stephen Wolfram: Consciousness

- The universe in our models is full of sophisticated computation, all the way down. At the lowest level it's just a giant collection of "atoms of space", whose relationships are continually being updated according to a computational rule. And inevitably much of that process is computationally irreducible, in the sense that there's no general way to "figure out what's going to happen" except, in effect, by just running each step.
- But given that, how come the universe doesn't just seem to us arbitrarily complex and unpredictable? How come there's order and regularity that we can perceive in it? There's still plenty of computational irreducibility. But somehow there are also pockets of reducibility that we manage to leverage to form a simpler description of the world, that we can successfully and coherently make use of. And a fundamental discovery of our Physics Project is that the two great pillars of twentieth-century physics—general relativity and quantum mechanics—correspond precisely to two such pockets of reducibility.

Stephen Wolfram: Consciousness

- The universe in our models is full of sophisticated computation, all the way down. At the lowest level it's just a giant collection of "atoms of space", whose relationships are continually being updated according to a computational rule. And inevitably much of that process is computationally irreducible, in the sense that there's no general way to "figure out what's going to happen" except, in effect, by just running each step.
- But given that, how come the universe doesn't just seem to us arbitrarily complex and unpredictable? How come there's order and regularity that we can perceive in it? There's still plenty of computational irreducibility. But somehow there are also pockets of reducibility that we manage to leverage to form a simpler description of the world, that we can successfully and coherently make use of. And a fundamental discovery of our Physics Project is that the two great pillars of twentieth-century physics—general relativity and quantum mechanics—correspond precisely to two such pockets of reducibility.

Stephen Wolfram: Consciousness

- How should we think about this? An idea that will generalize is that as “observers” of the gas, we’re conflating lots of different microscopic configurations of molecules, and just paying attention to overall aggregate properties.
- In the language of statistical mechanics, it’s effectively a story of “coarse graining”. But within our computational approach, there’s now a clear, computational way to characterize this. At the level of individual molecules there’s an irreducible computation happening. And to “understand what’s going on” the observer is doing a computation.
- But the crucial point is that if there’s a certain boundedness to that computation then this has immediate consequences for the effective behavior the observer will perceive. And in the case of something like a gas, it turns out to directly imply the Second Law of Thermodynamics.
- Now we can see it as a consequence of the interplay between underlying computational irreducibility and the computational boundedness of observers. If the observer kept track of all the computationally irreducible motions of individual molecules, they wouldn’t see Second Law behavior. The Second Law depends on a pocket of computational reducibility that in effect emerges only when there’s a constraint on the observer that amounts to the requirement that the observer has a “coherent view” of what’s going on.

Stephen Wolfram: Consciousness

- There's an immediate analog—that actually ends up being an example of the same fundamental computational phenomenon. Consider a gas, like air. Ultimately the gas consists of lots of molecules bouncing around in a complicated way that's full of computational irreducibility.
- But it's a central fact of statistical mechanics that if we look at the gas on a large scale, we can get a useful description of what it does just in terms of properties like temperature and pressure. And in effect this reflects a pocket of computational reducibility, that allows us to operate without engaging with all the computational irreducibility underneath.

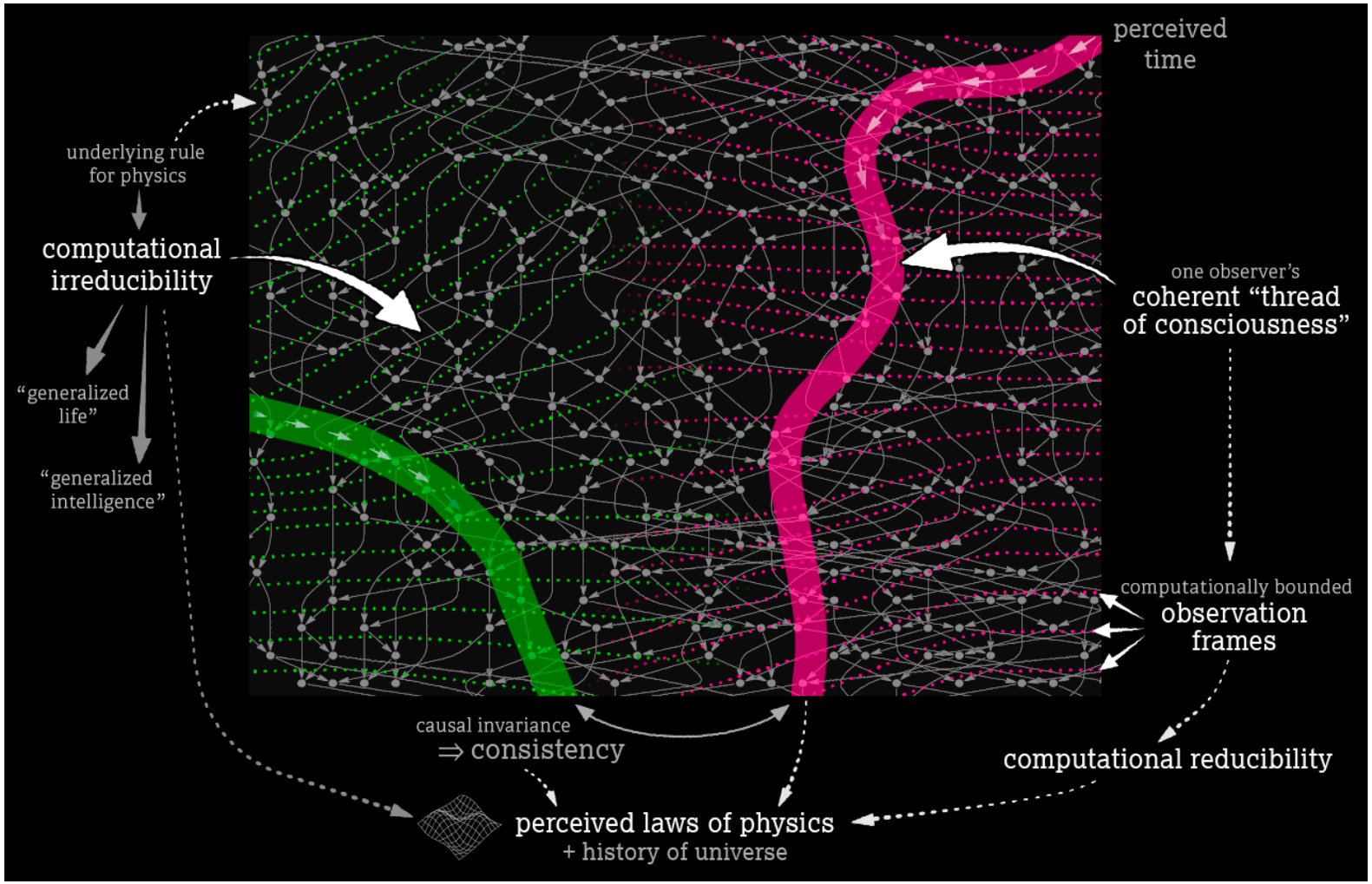
Stephen Wolfram: Consciousness

- So what about physical space? The traditional view had been that space was something that could to a large extent just be described as a coherent mathematical object. But in our models of physics, space is actually made of an immense number of discrete elements whose pattern of interconnections evolves in a complex and computationally irreducible way.
- But it's much like with the gas molecules. If an observer is going to form a coherent view of what's going on, and if they have bounded computational capabilities, then this puts definite constraints on what behavior they will perceive. And it turns out that those constraints yield exactly relativity.
- In other words, for the "atoms of space", relativity is the result of the interplay between underlying computational irreducibility and the requirement that the observer has a coherent view of what's going on.

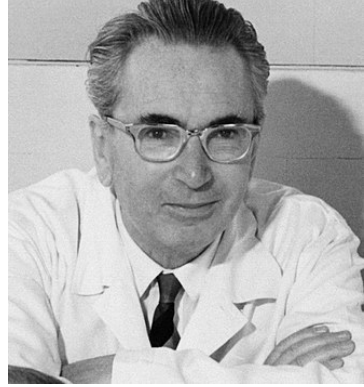
Stephen Wolfram: Consciousness

- What's special about the way we humans experience the world? At some level, the very fact that we even have a notion of "experiencing" it at all is special. The world is doing what it does, we're able to meaningfully "form coherent thoughts" about the universe. And just as we can form coherent thoughts about the universe, so also we can form coherent thoughts about that small part of the universe that corresponds to our brains—or to the computations that represent the operation of our minds.
- But they seem to point to a fundamental feature of consciousness. Consciousness is not about the general computation that brains—or, for that matter, many other things—can do. It's about the particular feature of our brains that causes us to have a coherent thread of experience.
- Consciousness—like intelligence—is something of which we only have a clear sense in the single case of humans. But just as we've seen that the notion of intelligence can be generalized to the notion of arbitrary sophisticated computation, so now it seems that the notion of consciousness can be generalized to the notion of forming a coherent thread of representation for computations.

Stephen Wolfram: Consciousness

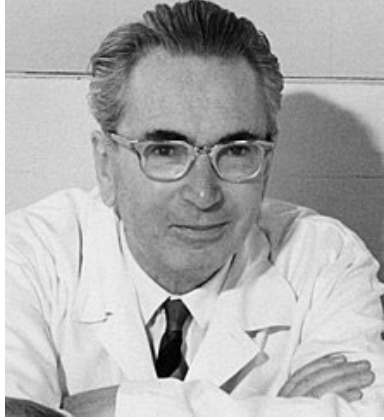


Meaning in Life: Viktor Frankl



- Viktor Emil Frankl (26 March 1905 – 2 September 1997) was an Austrian psychiatrist and Holocaust survivor, who founded logotherapy, a school of psychotherapy that describes a search for a life's meaning as the central human motivational force.
- In 1942, just nine months after his marriage, Frankl and his family were sent to the Theresienstadt concentration camp. His father died there of starvation and pneumonia. In 1944, Frankl and the surviving members of his family were transported to Auschwitz, where his mother and brother were murdered in the gas chambers. His wife Tilly died later of typhus in Bergen-Belsen. Frankl spent three years in four concentration camps.
- In 1948, Frankl earned a PhD in philosophy from the University of Vienna. His dissertation, *The Unconscious God*, examines the relationship between psychology and religion, and advocates for the use of the Socratic dialogue (self-discovery discourse) for clients to get in touch with their spiritual unconscious.
- Logotherapy is part of existential and humanistic psychology theories.
- Frankl is viewed as peer of Freud, Jung and Adler by many professionals

Realizing Meaning in Life: Viktor Frankel



- Frankl identified three main ways of realizing meaning in life: by making a difference in the world, by having particular experiences, or by adopting particular attitudes.
- The primary techniques offered by logotherapy and existential analysis are:
  - Paradoxical intention: clients learn to overcome obsessions or anxieties by self-distancing and humorous exaggeration.
  - Dereflection: drawing the client's attention away from their symptoms, as hyper-reflection can lead to inaction.
  - Socratic dialogue and attitude modification: asking questions designed to help a client find and pursue self-defined meaning in life.
- His acknowledgement of meaning as a central motivational force and factor in mental health is his lasting contribution to the field of psychology. It provided the foundational principles for the emerging field of positive psychology. Frankl's work has also been endorsed in the Chabad philosophy of Hasidic Judaism.

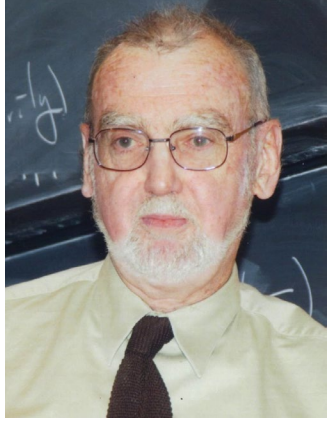
MetaMathematics

- **Metamathematics** is the study of mathematics itself using mathematical methods. This study produces metatheories, which are mathematical theories about other mathematical theories.
- Emphasis on metamathematics (and perhaps the creation of the term itself) owes itself to David Hilbert's attempt to secure the foundations of mathematics in the early part of the 20th century.
- Metamathematics provides "a rigorous mathematical technique for investigating a great variety of foundation problems for mathematics and logic" (Kleene 1952, p. 59). An important feature of metamathematics is its emphasis on differentiating between reasoning from inside a system and from outside a system. An informal illustration of this is categorizing the proposition "2+2=4" as belonging to mathematics while categorizing the proposition "'2+2=4' is valid" as belonging to metamathematics.
- **This statement is false** is outside conventional logic: if it is false, then it is true; if it is true, then it is false

Eugene Wigner: 1963 Nobel Prize in Physics

- Wigner argued in 1952 that biology and cognition could be the origin of physical concepts, as we humans perceive them, and that the happy coincidence that mathematics and physics were so well matched, seemed to be "unreasonable" and hard to explain
- Wigner developed a thought experiment (later called Wigner's Friend paradox) to illustrate his belief that consciousness is foundational to the quantum mechanical measurement process. He thereby followed an ontological approach that sets human's consciousness at the center: "All that quantum mechanics purports to provide are probability connections between subsequent impressions (also called 'apperceptions') of the consciousness".
- Measurements are understood as the interactions which create the impressions in our consciousness (and as a result modify the wave function of the "measured" physical system), an idea which has been called the "consciousness causes collapse" interpretation

Langlands Program



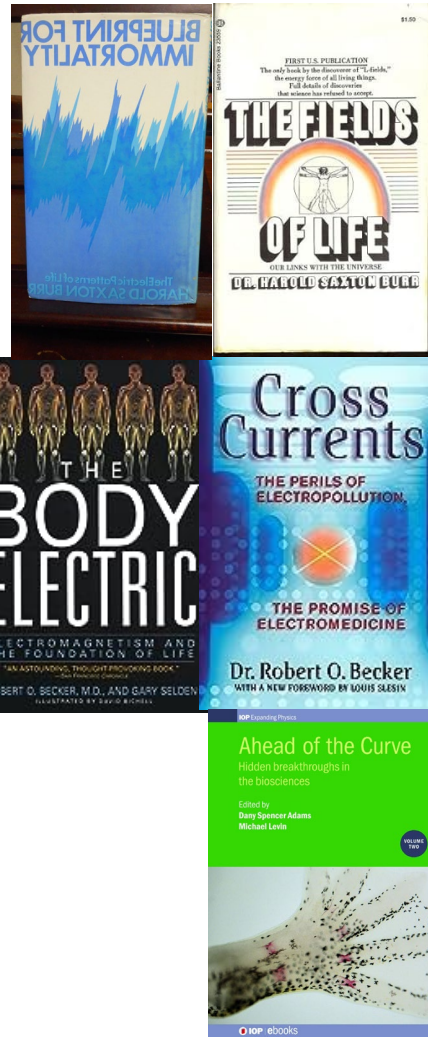
- In representation theory and algebraic number theory, the **Langlands program** is a web of far-reaching and consequential conjectures about connections between number theory and geometry.
- Proposed by Robert Langlands (1967, 1970), it seeks to relate Galois groups in algebraic number theory to automorphic forms and representation theory of algebraic groups over local fields and adeles.
- Widely seen as the single biggest project in modern mathematical research, the Langlands program has been described by Edward Frenkel as "a kind of grand unified theory of mathematics.

The Coming Technological Singularity

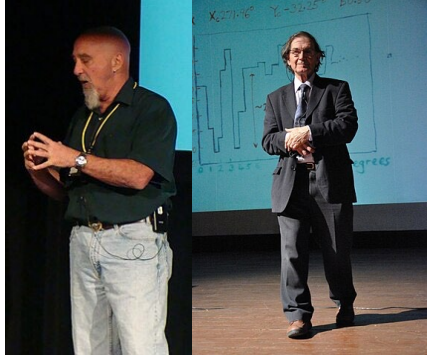
- Mankind is striving to create ever more powerful electronic or biological intelligences, based on
  - The development of artificial intelligence in computers
  - Large computer networks
  - Biology science may contribute to superhuman intelligence
- Once superintelligence is achieved, the human era is over
  - Humans solve problems thousands of times faster than evolution
  - Superintelligence would solve problems thousands of times faster than man
- This transition might occur very quickly (in the period of hours)

The Body Electric

- Each human body has roughly 50 trillion cells
- Each cell has an electric potential of roughly -20 millivolts as measured from the outside cell wall to the inside cell wall
- Every human body has an electric field associated with it
- Prominent Researchers
  - Yale University: Harold Burr (1935)
  - Syracuse University: Robert Becker (1985)
  - Tufts University: Michael Levin (2005-)



Orchestrated Objective Reduction: Microtubles and Quantum Mechanics



- **Orchestrated objective reduction** (**Orch OR**) is a theory which postulates that consciousness originates at the quantum level inside neurons, rather than the conventional view that it is a product of connections between neurons.
- The mechanism is held to be a quantum process called objective reduction that is orchestrated by cellular structures called microtubules. It is proposed that the theory may answer the hard problem of consciousness and provide a mechanism for free will.
- The hypothesis was first put forward in the early 1990s by Nobel laureate for physics, Roger Penrose, and anaesthesiologist and psychologist Stuart Hameroff. The hypothesis combines approaches from molecular biology, neuroscience, pharmacology, philosophy, quantum information theory, and quantum gravity