

**NESTED LEVELS OF ORGANIZED SYSTEMS:  
A NEW MODEL OF MULTIPLE NESTED INTERACTING ENTROPIES THAT RESULT IN  
THE PRODUCTION OF COMPLEXITY**

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**ABSTRACT**

A single holistic theory for how the universe is organized, and how its diversity of scales and systems coordinate and *perform* together, may yet be obtainable. But not within the current paradigms. We are stopped by some foundational misunderstandings within mathematics that forced the impasse we are currently at - especially the discontinuity between relativity and quantum mechanics - especially the discontinuity between physics/chemistry and biology/sociology/economics. A solution is presented, illuminating and defining mathematical relations previously ignored/unidentified. A third model that *interfaces* Prigogine's statistical emergence of complexity and Mandelbot's fractal (non-statistical) emergence of complexity.

**THE CHALLENGE SCENARIO**

Mathematics has become a spectacularly complex system, as you are all aware of it and practice it. But it is a language. And as much as we hope it is thorough, informative, useful and applicable where we want it to be and need it to be, experience has proven, especially with philosophical analysis and logic models such as Godel's theorems (Rose, 1995), we recognize that languages are narrow frames of reference about existence and behavior spaces and relationships – not as thorough as we might presume.

When you are embedded in a language you've known and depended on all your life you assume it was handed to you fully tested by generations before and around you, adequate to all your needs for understanding and engaging your world, and, you accept it as foundationally complete and accurate. But, just as a speaker of Swahili or Japanese or French or Chinese or English, or any other languages know, not all knowledge or data or comprehensions translate perfectly, or contain equal perceptions. Sometimes deeper discoveries are made – based on external encounters - that result in changes and improvements to an established 'home language'. Back in the 1930's, building on Einstein's and Reichenbach's (rose, 1995) then expanded ideas of relativity relations describing the universe having multiple frames of reference of comparable validity, the chemist/linguist Benjamin Whorf, observed and stated for us,

“each language is not merely a reproducing instrument for voicing ideas but ... is itself the shaper of ideas, the program and guide for the individual's mental activity, for his analysis of impressions, for his synthesis of his mental stock in trade.

“This fact is very significant for modern science, for it means that no individual is free to describe nature with absolute impartiality but is constrained to certain modes of interpretation even while he thinks himself most free. The person most nearly free in such respects would be familiar with very many widely different ... systems. ... We are thus introduced to a new principle of "relativity", which holds that all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated.” (Whorf, 1956).

Whorf's last remark is of critical importance to the proposition of a General Theory of Systems, and, to the mathematical effort to coordinate and make sense of all dynamics in the universe. In his prefacing words, Whorf alerts us that we may be so habituated to a given accepted language that we don't recognize deficits or omissions - which may be preventing satisfactorily extensive knowledge awareness. His

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closing remark about ‘calibration’ challenges us to be alert to coordinating all aspects not just *among* languages, but also *within* an established language, recognizing that any missed relational definitions are a red flag of deficiency and needed improvement. Universal information correlation – including internal rationales allowing “for” correlations – is likely the most important fundamental principle of existence; in our or any universe, in any presentation of “existence” - universal ‘self relevance’ & universal ‘else relevance’. This is critical. Right now, current mathematics just does not have such operators and functions (transforms, reforming translating re-symbolizing operators) – necessary internal definition codings – wherein we can correlate and cross calibrate and co-explain field equations with statistical equations. It also has unresolved discontinuities – such as ‘division by zero’; plural not-coherently associated definitions of exponents and dimensions, and, dissimilar incoherent definitions of negative versus negation.

We continue to use the expansive and finely developed edifice of mathematics, as if all the parts validly correspond to real observations and phenomena, but, those cited internal relations (and some others) are left absent certain coherent associations - internally. And no one is addressing those inconsistencies. This author proposes that the only path to resolving any of the current obvious external problems will be through identifying, repairing and connecting missing *internal* information associations.

Humanity’s continuing improvement and enlargement of mathematics has been an accepted grail, from Greek geometry to Roman numerals (which lacked the concept and associated symbol of ‘zero’), to Arabic/Hindu numerals *with* zero (as placeholder *and* number), to Leibnitz/Newtonian Calculus, to Cantor’s transfinite, to Boole’s alternate algebra, to Clausius and Boltzmann entropy, to Dirac’s quantum notations, to Feynman’s quantum chromodynamics, to Shannon’s information theory, to Gell-Mann’s quarks, to Mandelbrot’s fractal equations, to Zadeh’s Fuzzy logic, to Prigogine’s ‘dissipative systems’ - and innumerable mathematical inventors and inventions renowned but not named here. All have been additions, embellishments and advancements on the foundations that came before them.

Even so, we are still at a loss. Our house of mathematics has added even more properties and relations: convoluted statistics variations, Abelian/non-Abelian optional frames of reference, the square root of minus-one, (re)normalization tricks that explore relations where chosen parameters are stripped of their dimensionality, string theories and Mbranes, and, in the realms of biology, sociology and economics – the notion of compensatory “derivatives” equations, and, in ultra-fine measurements near the Planck realm that reference global macroscale events.

With all those concept innovations we are still left with unclear and competing notions of entropy (disorder) – originally identified as a property of machines, thermodynamics and chemistry - and , with a basket full of different definitions for ‘information’ (including some associated with ‘entropy’) ; we have no way to coordinate relativity and quantum mechanics. Instead, conventional mathematics leaves us calculating the production of infinities we have no way of interpreting or continuing with; we end up with fraction relations producing ‘division by zero’ – an incomprehensible and undefined operation; and we have many unproven essential hypotheses and conjectures, as exemplified by the Millennium Prize Problems set by the Clay Mathematics Institute (Clay Mathematics Institute, n.d.).

One of the undiscussed unresolved questions that complexity theorists don’t even acknowledge is: How is it that Mandelbrot discovered and defined “emergence” using fractal, non-statistical mathematics, where as Prigogine discovered and defined “emergence” using statistical mathematics? How could two (supposedly unrelated) mathematical mechanisms arrive at the same destination and discovery? It would not be unreasonable to have a population of mathematicians dedicate their professional careers to exploring the underlying relationship between fractal equations and statistical probability equations ; how are they related? ; is there an important equality transform waiting to be described and specified, bridging the strange disjunction between two ‘different’ mathematics methodologies that show peer achievements of math logic in that they both produce new levels of describable organization?

Too, in physics, we are able to mathematically and nominally model and *describe* behaviors and action patterns - such as gravity and electromagnetism, but we have no notion of their real instantiating causal sources - except that we intuit that there ought to be tangible – or at least ‘rational’ - processes.

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### THE CHALLENGE CRITERIA

We observe the universe from the smallest size measures to the largest size measures (in 2018, estimated as spanning  $10^{62}$  orders of magnitude) as a self-consistent coordinated and coherently behaving dynamic on all those variant scales of existence. If that is the correct status of existence as we experience it, then a unified field theory or theory of everything - in the way physicists, cosmologists and mathematicians aspire to it - requires that the architecture and grammar of mathematics also be general enough *and* self related as well – besides relevance to the processes, forms and energies and relations it is supposed to model, map and correspond to, as also consistent, coordinated and coherent.

A **General Theory of Phenomena** – which focuses on relationships and on qualities – has to be that holistically integrated, functional and coherent. A General Theory of Phenomena cannot be pertinent just of the phenomena (systems; extants; dynamics) it is devised to inform about, but must be self-relevant and coherent in all its conceptual communication aspects as well.

The importance of a **General Theory of Systems** is the boldest goal that sentience can aim for. Else-understanding intimate with self-gnostic sentient awareness. Not in the sense of ‘knowing *all possible* information, states and possibilities’, but achieving a grasp of *all principles of relations, behaviors, correlations and dynamics of sustained and evolvable existence*. And that requires the clearest profound understanding of sentience’s architecture and abilities and internal coherences, itself.

If the language of mathematics harbors any disjunctions or missed associations, how can we expect it to accurately represent the consistency of the universe we search to identify, the qualities of existence? My point is, mathematics itself is a required subject of analysis – it should not be presumed to be perfect, sufficiently defined, or internally designed as it stands (as some already complete perfect mapping language/depiction schema). Yet we currently proceed as if it is, with some correlations to physical phenomena that don’t mesh well in our current concepts of the universe, with disjunctions presumed to be a result of not understanding the external phenomena accurately enough. We don’t question the tool used for the descriptions as being a concurrent problem. But we should.

A schemata that spans all performance processes needs to be applicable to not just to physics and inanimate systems, but to biology, sociology, and economics as well and all manner of entailments (causal connections, both typical and novel) and complicated coordinations, as Robert Rosen (Rosen, 1985) suggested. The scope and architecture of the language of mathematics needs to be more general and more flexible than it currently is. And it needs to be *internally* completely integrated and correlated. We simply don’t have that yet. We are missing concepts that associate statistics with dimensions. Translations and transforms between certain terms are missing and incomplete. And that is a hole in essential reasoning and logic. Set theories and causality associations as they currently stand, are not sufficient to the larger greater task.

Another blatant disjunction is found in naïve axioms of information and communication. We recognize and measure a speed of information transmission in physical spacetime. We add that in as a factor in certain equations. But in mathematical space, no such velocity exists. In matrix relations, even ones of infinite extent, if we make a change in a metric value, that ‘change’ is instantaneously propagated throughout the matrix. There is no ‘speed of information or relation’ distribution. Now, it might not be reasonable to designate or consider such a distribution property; but then again, it might be a worthy philosophical issue. Especially when certain physics equations point to information distribution unconstrained by any speed limit of communication. Besides presumptively defining instantaneous simultaneous information connection in a 13 billion light year universe, shouldn’t there be a rationale justifying it?

If Thomas Kuhn (Kuhn, 1962) was correct, then an increasing set of anomalies will press us to look for alternative associations, relations and possibilities of explanation in our concepts of existence. Not just modeling the existential phenomena, but in the representation~conversation~conceptual systems that

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we use, applying to the phenomena. Anomalies of physics models are not the only ones. Anomalies intrinsic in the mathematics also exist – ones that are not easy to recognize or appreciate, because the historic axiomatic rationales have been taught to us as habit and ingrained as accepted relations. No one is prompted to re-examine and re-dissect the principles, only to learn them as grail information.

We are supposedly in a new millennia of superior conceptual appreciations, but, we are not using those appreciations to re-evaluate mathematics, or data, or information or the symbolic systems we communicate with. If we learn and employ information relations that exist as ‘communication’, why don’t we consider those relations back-applied to mathematics? We have the concepts of ‘induction’ and ‘deduction’ bedrocking number theory and logic sequencing, but why don’t we analyze mathematics as a dynamic internally “communicating” system as well? What potential ‘relations’ and properties exist between different terms and symbols, operators and functions, and how do they relate to (not just “map”) phenomena spaces? We need deeper explicit understandings for existential dimensions correlating with conceptual dimensions. “Induction and deduction principles are not enough.

Leibnitz~Newtonian Calculus does a fascinating thing, when analyzed carefully. It maps physical simultaneous relations that have dimensional associations, not just numeric ones. Calculus operations produce information transforms between different exponential states. And those exponential changes, arrived at after examining partitioning demarcations, are dimensional transforms. Partitioning is a conceptual method that mimics physical information data processing found in real signal identification and measurement arrangements. A data processing mechanism is limited to some smallest bit-size of data that it can ‘recognize’. Partitioning accomplishes the exact same relation process, except we allow the partition (width) size to go smaller and smaller (to zero), as we let the number of partitions grow to infinity; integrating the information domain and producing a change in exponent value (dimensions). We don’t even waste time with the Planck limit - which physical measuring throws in our way. Calculus was the –original- “perfect conceptual information theory” analysis (before the notions of information and data and bits and bit-size and signals, were identified). Shannon’s later to be designed “statistical information theory” – employing new standards and concepts – is actually a second-state ‘information theory’. Particularly since it is built on calculus (the prior signal processing mathematics), to make a different alternative definition of signals and data. And illuminates different ‘dimensional relations’.

### **MORE ‘ANOMALIES’ WORTH CONSIDERATION.**

From observations, several incongruent behaviors are known in various sciences and systems. One is Markovnikov vs. anti-Markovnikov (Markovnikov Chemistry, Online) mechanisms adding atoms to certain molecules. In one mechanism, atoms join molecules where an energy barrier is lower and easier to access, in the alternate mechanism the lower energy site is de-selected, against the general energy rule typically observed.

Another broad puzzle is the problem of complexity formation, which robustly occurs in opposition to Clausian thermodynamic entropy, a pervasive science rule of energy behaviors, conventionally taken to be un-opposable.

How is it that the universe regularly produces amazing, intricate order - not just simple clumping or crystalline regularity - against the fundamental rule that entropy and disorder must always increase?

How is it that the universe elegantly and pervasively holds atomic nuclear plasmas together with simple handfuls of electrons alone, when science designed mechanisms have to bring to bear massively larger factors of energy to accomplish the same thing, and, for only short Planck-length moments of time, versus natural longed lived stable states of “contained plasmas”? What is balanced in the dimensional relations of atoms that we are not duplicating? Is it possible that balancing energy is not the only thing involved in atomic electrons’ containment of nuclear plasmas? Maybe something in the dimensional structures of the fields and particles is balanced as well. Something we haven’t considered yet, because math language isn’t highlighting it yet.

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Regarding complexity, yes, Mandelbrot discovered that self-iterating equations will generate forms of complexity that match many *patterns* of complexity found in the natural world. But the equations are alternate generators of net-observed patterns, not replicants of the natural generators.

Fractal equations can only replicate the boundary geometry and imagery of surfaces, mountains, coastlines, liquids, plant forms, fur, and skin textures – the fractal equations do not describe the generative physical internal core relations of the physical systems - internal electromagnetic fields and stressors or couplers, or the quanta of interacting masses, or ‘the metabolic relations’ *inside* living tissue. Fractal equations are surface relations, not the inner core mechanisms or actual architectural dynamics of systems. Fractal equations mimic net-dimensional external observable patterns, and not the inner generating architecture. We might say that fractals deal with *presentational dimensions*, while leaving *process mechanisms* and other *natural dimensions* unspecified. Fractal mathematics is a non-statistical model, that seems to result in against-general-entropy ‘emergence of new self stable complex organizations’ in exponential domains of reference, because of a relationship between ‘inputs’ and ‘outputs’ as two nodes of reflecting reiterating calculation communication.

Prigogine’s ‘dissipative systems’ too are a step towards describing how in some cases random energy will patternize and induce seeming complex order from non-complex energy radiators, but, Prigogine’s equations do not have obvious applications to the complicated realms we really want to explain. Plus, they are statistical.

Those two approaches – separate methodologies - are an unrationalized conundrum for science and humanity. The two incompatible mathematics produce the same result .. complexity that forms in opposition to the prior found ‘law’ of energy behaviors over time and through space that for 300 years has been assumed to be un-opposable .. the strict rule of tendency towards entropy (disorder) increase; confusion; de-synchronization of parts, pieces, relations.

Therefore, something in the two mathematical models is related. But that shared relation property hasn’t been enunciated yet, as it needs to be. We need to re-examine and identify what must exist within the architecture of mathematics that is the critical shared information interaction relation between the two different approaches and descriptions. If they produce the same result, they have to contain a shared unitary operation relation – even when it currently appears they serendipitously produced the same results using different calculation mechanisms. In the hundreds of years and tomes on tomes of analysis of mathematics, we seem to have missed understanding some inherent relations and processes in our mathematics. Something as important and deeply fundamental as the thousands of years humanity did very well with geometry and numbering without the use of the digit and concept of ‘zero’.

Physics treats it as a misunderstanding of the relationship between quantum mechanics and general relativity field theory.

The embarrassing reality is that the problem doesn’t rest in those two models being incompatible. The problem rests deeper – importantly deeper since it is something that only general systems analysts can tackle and deal with. We have to shine a bright light on the not-yet-coherent, not-yet-integrated philosophical aspects of mathematics: statistics and non-statistics. They co-exist in the current architecture of mathematics but we have missed depicting their more extensive correspondences and relations and connections.

So the challenge of succeeding in making general systems modeling the absolute criteria frame of reference of human thinking, resides in a totally fresh analysis of our primary tool of analysis, not just the phenomena we currently project the analytical tool towards. Both together. We are missing something in the nature of the models our incomplete mathematics has brought us to currently have. And, we are expecting to find a complete general theory of systems - including their panoramic shared properties among all of them - while using a description tool we haven’t finish understanding and building and improving.

Plus, there is a concurrent phenomena that has not yet been addressed in depictions of “emergence” in any of the literature. The novelty of producing order from processes that are designated as effectively entropic has missed specifying –all- the characteristics of self-reinforced new behavior domains. The qualia that has gone un-described and unevaluated is the identity criteria of place and dynamic presence.

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That is, any new domain establishes a behavior and energy nexus having its own substantial inertia and entropic centers .. which in relation to the originating domains, offers resistance and back-action, a communication (interaction) presence.

The primary spatio-temporal property of the phrase: “all systems exist in context of companion spatio-temporal domains .. sub-loci and supra-loci”, makes prominent the notion that systems and dimensions may at times be conveniently evaluated as being tightly closed bounded (in order to understand certain dynamics and behaviors and rules of relations – laws of nature, so to speak), *but*, the larger reality is that every real system exists in “contextual dimensional relation” to adjacent *levels* and *tiers* of organization – interior and exterior – to whatever organization may be under consideration.

So the concern in divining a general theory of systems has to be concurrently two-fold. The designation of shared behavior properties resident ‘within’ nominally identified boundaries – and - shared dynamic properties ‘between’ tiered dimensionally nested embedded inter-engaged, interrelated intercommunicative domains (tiers, levels). Not just the productive processes that produced order and complexity, but also any newly established concurrent relations and bi-directional dynamic communicating effects *between* tiers of complexity. Entwined systems function not only as producer and produced systems or states, but also as coupled interactive systems; R. Rosen “entailments”.

The tiers are identifiable as distinct ordered entity domains, but also as third-relation ‘coupled’ domains - new identities, new ‘systems’; whether the coupled states are robust and long lived – or – transient and short lived (such as sequential molecular forms in the Krebs Citric Acid Cycle).

Order establishes identities and selfness, dynamic coherence and consistency – which this author labeled “integrity” (Rose 1972, 1992, 2000), [UIU, 1972] for concept identification purposes in his model of a General Theory of Systems.

**Patterns – patterns of behaviors – interrelation patterns irrespective of energies, material structure, or time spans involved in performances. These are the essentials of the shared qualia of all systems and systems of systems in the universe.**

Yes, we understand that thermodynamic energy is a driver for performance and action. Everywhere we look we see amassed energy doing things. We even predict an exhausted universe as energy dissipates and thermodynamic entropy goes to ‘maximum’. But what drives living systems into existence *against* that dictum? An anti-entropy ‘force’ per Prigogine and Mandelbrot? Or, is it possible there is a different common action source for inorganic and organic systems that they perform under? If our goal is a *universal* synchronized model, there should be. For in fact, that is exactly what we observe and experience. Non-living and living systems totally and completely engaging together. Maybe we have enough information and observations to **re-assemble the processes in a fresh and improved model.**

Right now the only model we have says there are four forces and a semi-defined process called entropy, a time oriented measure of energy exchange and *distribution states* that motivates process behaviors, which, to the best of our understanding, erodes complexity and drains systems of the empowerment to do things.

So the question is, with all the extraordinary advanced insightful mathematics at our command, and the descriptive companion languages of arrayed humanity, what is missing in our attempts to linguistically match what we observe the universe doing and being? What is missing, such that we can recognize in plain words the things I’ve mentioned, but fail to bring them together in mathematics, the language we hold most dear?

I have some recommendations.

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### THE PROFFERED GENERAL THEORY OF SYSTEMS

As incredible and as heretical as this might sound to you, I propose that our current mathematics is a Ptolemeic cobbling of accurate observations, true fundamental relational principles, appropriate definitions, viable operators, and correct perceptual insights – but put together in certain subtly insufficient ways.

For example, the Greek geometer~astonomer Ptolemy was no fool, though that is how we portray him compared to Copernicus. His epicycles model of an Earth centered universe eventually proved not correct, but for 2000 years was satisfactory for surviving seasons and agriculture-based economies. Neither were Ptolemy's contemporaries, or peers in mathematics, geometry and world observers fools either. Euclid, Archimedes, Apollonius, Aristotle et al were no idiots. But they didn't stand to challenge the geocentric cosmology. Why would they? It worked. Epicycles and all. The seasons were measured accurately, the paths of the wandering stars (planets) were accounted for, planting and harvesting were predictably ordered, tools were made, buildings were measured and cities built, cultures invented and economically synchronized, the arts and literature raised the quality of human life. And no one needed "zero" in arithmetic calculations. What was to question?

In 1995 two high school students Dan Litchfield and Dave Goldenheim were given an assignment to find a geometric method of dividing a random line segment into n-equal parts. What they discovered was a non-trivial method of partitioning (Bogomolny, n.d.) unknown to Euclid et al. Are the ancient Greek geometers any less esteemed for the oversight, discovered by novice teenagers 2500 years later? No, of course not. They had other methods for partitioning that worked easily and true. Why seek something different when what you have satisfies your needs?

In both these cases, the first part of Whorf's hypothesis holds true. The system a people or culture or scientific community uses may have anomalies or unanswered questions, but the last thing one thinks to do is start over from scratch by throwing away what works, even when a persistent anomaly remains using habituated methodologies.

In today's phenomenally vast and intricate house of mathematics, that's really the last thing anyone would think of doing. But we are at an impasse and there really is no other choice. Thankfully, not much change seems to be needed to reset ourselves on a better path. But it promises to be just as fundamental a change as going from an earth centered to a sun centered cosmology. Interestingly, we only need hold ourselves and our mathematics to a higher consistency in applying existing concepts and relational notions and definitions.

Where we see commonalities - coordinate them better. Where we see relational uniformities - generalize them more extensively. Where we define a notion - be consistent in all applications. Where we recognize shared domains, manifolds and ranges - even if the scales of diverse phenomena don't immediately seem to match - then modify the basis and scope of the descriptive system to encompass them all. For example: sound, light, heat, radio waves, ocean waves, cosmic pulses, and circadian rhythms are all different phenomena. No, not really - they are just different sampled phenomena along the single electromagnetic spectrum. In mathematics, we need to do the same sort of thing: generalize the fundamentals and remain consistent in relationship applications. For example: a definition currently exists - "a whole positive number exponent is defined as the 'dimension' of its basis parameter", e.g.  $x^2$  is two dimensions of x. But, when we move away from the definitional restriction of 'whole positive number', it starts to get messy and computationally embarrassing – e.g.  $x^0$ ,  $x^{-4}$ ,  $x^{2/3}$ , or  $x^{ei}$ . Especially  $x^0$ .

We grudgingly acknowledge fractal (fractional) dimensions because by common-sense we live in a 3-dimension realm with time being that strange '4<sup>th</sup> dimension'. We don't experience and we find it difficult to mentally relate to, 'partial physical dimensions'. How would one diagram an infinite number of companion 'in-between dimensions' to show them in a graphing of (x,y,z) coordinate space? And even though quantum mechanics is structured as phase-space (3 space vectors pair bound with three momentum (time) vectors), every string theorist and M-branes and hyperdimensional cosmologist and

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quantum gravity theorist starkly proclaim 10 or 11 or  $n$ -teen ‘space dimensions’ and one and only one time dimension - probably for not having a clue how to keep track of 10 or 11 or  $n$  clock-bases at the ‘same time’ (!). So we ignore the challenges. We make a menagerie of new definitions to avoid disparities. We ignore special conditions instead of understanding and coordinating them.

Even Einstein dropped the ball on this one. Yes, we have his Relativity geometry that added Time to Euclidean and hyperbolic space. But if every whole number exponent is tantamount to a dimension designation, then doesn’t  $E=mc^2$  tell us that time is *two*-dimensional (where  $c$  is a time~velocity parameter)? And doesn’t his description of a gravitational field being tantamount to a continuous acceleration zone also re-express this idea? For what is acceleration, but ‘ $t \times t$ ’? Again, the cross product of *two* orthogonal time dimensions. Simply put, the differential gradient called gravity *is* the resulting field stresses or densities of *two* intersecting/engaging temporal vectors that generate a variable density domain. As I will discuss later, applying the gas laws notion that a reduction in density is tantamount to a decreased entropy state, I proffer the notion that all differential polar geometries are the origins of *gradients* and that all gradients are the fundamental expression of entropy ‘tendencies’ - action inducement zones. The “fundamental” forces are differential (entropy gradiented) fields *first* - being special scales and shapes - but they are gradients first, *before* they are their own individual type ‘forces’ and functions.

Imagine a pachinko machine or a sand hourglass. The behaviors are always presumptively evaluated at the earth’s surface – inside what we now recognize as a gravity field - oriented to let the balls fall through the pachinko pegs, or sand grains fall through the timer-glass bottleneck. When every part of either apparatus is appropriately related, classic statistical gaussian curves are resultantly generated.

Instead, imagine either device in outer space, far from a gravity field; or, laid flat or sideways in the gravity field. Nothing happens. No statistical accumulation of balls or sand is produced. The action driver – which **must be co-present** in order to end up with a net, over time, product of statistical values – is removed. But conventional math excludes that requisite action parameter. No calculation or relation-set produces statistics in the absence of a ‘gradient parameter’, action driver.

If we are designing a General Theory of Systems, then it is obvious that the paradigm must include the mandatory general systems behavior concept: “No action potential gradient, no activity”. With the challenge for general systems analysis being: where can we identify the presence of ‘action potential gradients’ in all systems considered? What ‘forms’ embody the qualia of ‘action potential’? We typically limit it to ‘stored energy’, or positional potential. But “action potential” – if it is to be pervasively present - must now be a qualia defined to be resident in all organization architectures, even when there is no obvious storage phenomena. That is, it has to be resident inside the fundamental ‘structures’ of existence – in spacetime itself, as a primal location. And what is the architecture of spacetime – it is dimensions. So in the first primal presence – relationships among ‘dimensions’ must possess ‘action potential’ – where differential densities of loci embody action potential – before mass, before energy – as we are accustomed to associating with actions and activity.

Absent a gradient field, or set of relations - such as a teacher handing out a test for students to answer and then generate a statistical spread of gaussian right/wrong values - all the fine statistical math means nothing - standard deviations or all related computations as well. In conventional mathematic architecture, we don’t consider the *crucial generative component* or get to exploring the critically present and important dimensional and information rich architecture that’s really co-present in all motive phenomena situations – and systems.



**Fig. 1.** Not just Sigma~function, but Gradient (Sigma~function)

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Another variant never considered in statistical analysis is the presumption of ‘internal synchrony of factors’. In a pachinko device, instead of small ball bearings, with fixed pegs to bounce off of, use frail pegs and high mass balls, and suddenly the ‘standard curve’ becomes a ‘standard straight line’, always landing in the same spot for each ball dropped. No ‘gaussian curve’ gets generated, only a single point-ending 1D line, one value result.

### ADJACENT ENTROPIES - COMPETING ENTROPIES

A General Theory of Systems, in this analyst’s perspective, necessarily starts with the mandatory expansive proposition that important relational properties must exist at the instantiation of the universe. Even the potential for activity, with the question, can “action potential” be a resident qualia of and in the universe prior to energy and masses coming into being? Well, the only entities that seem to be existentially possible, before energy and masses, are primal spacetime, which are, according to conventional models, architected “dimensions”... whether modeled as Euclidian~Cartesian, Radial, or Reimann (square~linear, circular, or variably curved).

This is a challenging proposition of logic to make. Can ‘activity’ .. which by our meager experiences seem to require energy and matter ... can ‘activity’ and causal relations that enable ‘action’, be identified as an innate property of dimensional architecture, prior to the instantiation of energy and matter?

Physics models for decades have made the assumption that such is the case. Only it is mootly framed in the mathematical concept of ‘symmetry breaking’. But what is ‘breaking’, in such mathematics? Numbers? Numerical statistical probabilities composed of ‘assumptions’? Can intangible unformed conceptual mystery induce and re-form as tangible structural existence? The ultimate solution to the question of ‘what is creation?’ can most likely never be answered by sentient logic. But we can at least identify the qualities and properties of ‘existence’ by changing what we define the pervasive domain of existence being made of. In fact we have to, because only such a well formed notion of what existence is composed of supports a General Theory of Systems – a General Theory of Behaviors – a Paradigm of Coherent Omni-pervasive Properties tying together all Forms and Functions.

That is, we recognize “dimensions”, not as artifacts of conceptual parameter counting, in some invented mathematics that presumptively ‘maps’ physical existence, but as fundamental substantive materiality. A backward extension of something we already ascribe to energy. We calculate relationships between energy and mass, accepting that real mechanisms are part of the architecture of the universe. We don’t know the mechanisms exactly yet, but we accept that energy can condensely re-organize into mass, and that mass can de-organize into energy.

It is not an unreasonable analogy then, to proffer that dimensions are a prior familial real form. Such dimensions having the property potential to condense and re-organize as what we label ‘energy’. This is not a farfetched model of what ‘existence’ is coherently “made of”. It maps directly with what we already know about the form states of H<sub>2</sub>O. As a free-coherent gas (dimensions), liquid (energy) and ice (mass). The model also gives us the interactive relations identified and modeled by Einsteinian relativity. Mass and energy interact with and affect dimensional spacetime; and spacetime interacts with and affects mass and energy. Interaction – communication, as it were – is a relational property of the three familial presentations.

The qualia which we must also prescribe and identify is how something presumptively inert (if even ‘intangible’ in the common sense) and without condensed ‘energy’ differentials, essentially embodies the property of “action induction”? In reviewing the original industrial revolution math models, that property was already identified by Clausius in 1865 as a property of the ‘ability to do work’. “Work” being that action in its most primitive understanding.

He associated it with heat, volume, and pressure, but did not state that entropy was a ‘thing’. And that is the most wonderful gift he gave us in his identification and depiction of the aspect of dynamics systems. It was a “relationship”. In the past 150+ years, science has rigidly identified entropy as a factor rigidly associated with thermodynamics, because of the physical systems in which it was first recognized.

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Fortunately, Claude Shannon came along in 1948 and found that a similar relation could be discussed in regard to communication systems and the distribution and ordering of symbols, in information theory. Thermodynamics is a not-requisite property of information, and needless to say this has drawn ire and debate for the past 70 years from thermodynamic purists.

So what is the shared parameter in thermodynamics and information theory? It is the differential states of organization and ... distribution. Localization differences and density measures occur in thermodynamic systems and in information processing systems – relative to space involved, time involved – even focus is only on conceptual ‘content’ or accessibility. If that is the case, can we identify differential densities in a model of dimensions, where it would be reasonable and correct to ascribe ‘entropy’ relations?

Let’s take a moment to evaluate related spatial relation-spaces to see if they inform us how to proceed. Electromagnetic field densities that surround bar magnets and gravity field densities around masses, show us some very important information. Remember, we are looking for relationships, not ‘things’ to measure. The differential ‘intensities’ of EM and gravity field strengths at different locations – across spatial distances – equate with field densities differences. These are not ‘differences in energy measures’ such as we are used to employing when we account for action activities. We are seeing gradient differences innate within the stillness of motionless field densities.

The differences in field densities~intensities are relationally isomorphic with pressure-volume-energy densities associated in thermodynamics with entropy. So what we are recognizing is that ‘entropy’ .. order, distribution, localization, complexity ... is a property not limited to thermodynamic – dynamic – systems. It is a “relationship” that exists in many different forms of existence. It can be energy, it can be data, it can be matter, it can be essential fields, and it potentially can be the architecture of dimensions.

Instead of being a secondary product of masses and energies interacting, instead of being a phenomena of interaction states between the fundamental forces, it is identified as a relation characteristic of all existential phenomena, and therefore, in this paradigm, precedes the so-called “fundamental” forces (intimated as existing *before* any other property or qualia). Thermodynamic entropy is only one system where differential density relations can be identified, not the sole and only location where entropic relations can be identified.

A broad characterization of *patterned non-homogeneous relations* is being made here, proposing that ‘dimensional architecture’ is the first order set where the relations can be identified, which induce/produce all possible subsequent action forms and forces. The four ‘fundamental forces’ are variant products of that spatial relationship-set. Thermodynamic ‘entropy’ is an even later, third generation, product of those a priori general mathematical gradient regions/domains. To retain the relations Clausius identified and labeled ‘entropy’, to keep linguistically related, but distinguished the universal general property from thermodynamic entropy, I use the spelling “**entroepic**” and the differential regions and states “**troepic domains**”.

The amended and expanded paradigm places geometry and distribution relations *ahead* of energy and matter. Relational gradients arise as part of the first instantiation of the primal architecture of the universe - dimensions, *ahead* of the field forces that engender gradients at a later compaction of dimensions. All fields are entroepic domains. Therefore, when local fields and relational gradients interact, what are interacting are troepic/negentroepic potentials.

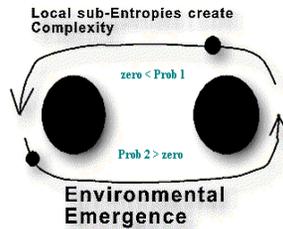
As such, all dynamic systems interact in such ways that negentroepic complexity is produced (most notably present between nested levels of organization). Entroepic increase of disorder in one level of orderings can produce negentroepic improved ordering in the next higher level of systems organization, particularly when bilateral communicative exchanges occur. Complexity production is the result of at least two information/energy/communication potentials interacting - each having event probabilities ‘greater than zero’.

“Dimensional domains” intrinsically self interact across their spatio-temporal domains. Internal “communication” is intrinsic with the architecture of existence.

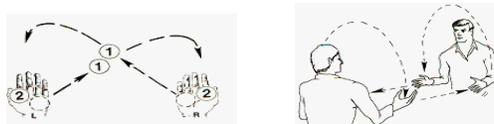
Rather than complexity being the product of complicated higher-math relationships, complexity’s primal robust form is simple engagement in companion dimensional spaces.

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Imagine two people roaming freely in a baseball field. You can assign an entropy value to their independent distribution in that space. One person is tossing a ball around to himself, using the rule that he cannot drop the ball or let it hit the ground. You can assign an entropy distribution space for the ball around the person. He calls the other person to come closer to a reasonable distance (beyond the ball distribution space you just measured), and they have a catch, again not letting the ball wholly get away from either of them. Notice what happens. The entropy distribution of the ball *increases* while the entropy distribution of the two people *decreases* - they became more localized and ordered - more 'complex'. The essential dynamic is now understood as: entropy/communication distribution in one tier of organization can induce complexity formation in the next adjacent tier of organization. This is essential electron sharing which builds complex molecules. This is the mechanism of a formed-complexity called 'game of chess', as long as the players engage in alternating chess-piece moves. This is the mechanism that forms the complexity structure called 'economy' .. mutually engaged redistribution of money to one agent with services or goods communicated/redistributed in return.



**Fig. 2a.** Entropic Complexity



**Fig. 2b,c.** Entropic Complexity

Fractal complexity is a special form of this defined process-set. The 'communicating' agents are the input and the output (which iterates as a new input). The "at-least two" 'greater than zero' probabilities are present in the Mandelbrot general equation format. The rule is satisfied in the equation's reflexive re-iteration process: input to output is one probability and output to new input is the second... both greater than zero. Disengage or take a critically required re-positioning redistribution probability to zero and the entangled complexity ceases.

Several key phenomena arise, as dynamic systems are now understood as local entropic groups encountering and engaging together - in simplistic pairs, or, in more complicated collections. Three diagrams (Figs 3,4,5) illustrate first, an approximation of the competing entropies, and second, an energy/stability schemata of complex organizations in general.

The adjacent competing entropies  $\{E_S, E_L\}$  have a *set of behavior synchronies* only just now being deciphered and equationed - which ranges of behaviors and local entropic/negentropic gradients states will eventually be described in a single combined equation. Referenced as  $E_S E_L$ :

1. Uncoupled  $E_S E_L$  || behave independently
2. Coupled:  $E_S E_L$  || Two entangled properties

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For the coupled case, the increased entropy of  $S$  imposes decreased entropy of  $L$ ; but both entropies now vary directly instead of inversely. We now have:

$$E_L : R / E_S$$

$\{E_S, E_L\}$  are entroepies fields in adjacent behavior spaces that are linkable through shared action or communication parameters and agents within  $R$ . Their entroepies vary in 3 related ways – independently, directly and inversely. The  $(:)$  symbol is a states equality operator that tells us that as sub-parameters within  $R$  associate or dissociate, float, couple and decouple, the adjacent entroepies will take one of those three relational states. Notably, the coupled states arrangement establishes a Gaussian bubble of stable conditionally bound behaviors – a new complex entity. This is set forth as a general systems rule for all levels of complexity and organization, and the creation of robust new organizations .. Integrityes.

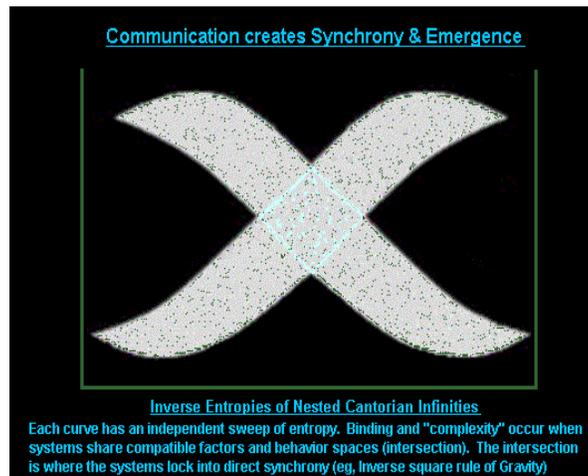


Fig. 3. Engaged adjacent entroepies

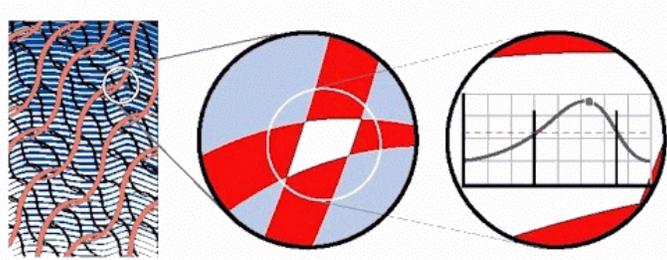
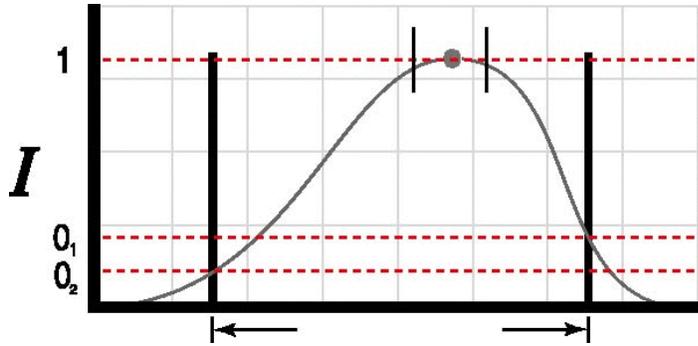
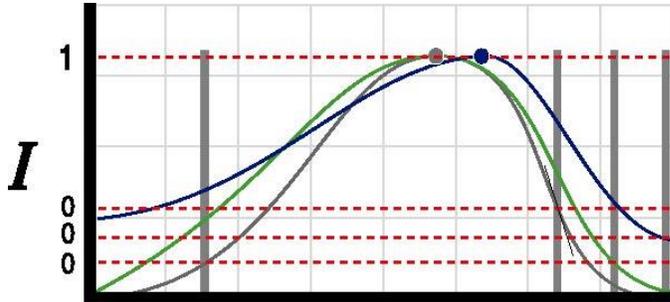


Fig. 4. Image on the right depicts a general schemata of performance health - integrity - applicable to all complex systems, detailed in the next figure.

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5a.



5b.

**Figs. 5a&b.** These graphs are an idealization of the health, the functional dynamic **INTEGRITY**,  $I$ , of any given dynamic system. The limits correspond to energy/information a system carries, processes and requires - recognizing minimum requirements and maximum capacities and noting that systemic health sustains in the range **between** minimum and maximum energy~information processing amounts, rates and potentials.

### ADDING APOLLONIUS TO PYTHAGORAS: DIAGRAMMING THE FAMILY OF FUNDAMENTAL RELATIONS

To continue describing the new mathematics architecture, we have to challenge a deep misnomer - the idea of 'dimensionless numbers'. This is a mathematical schizophrenia rooted in the bias of physical experience. We are creatures rooted in material existence first and foremost, with a thousand generations long mental habit of understanding a 'dimension' as being some sort of requisite 'measure' be it distance or duration or set-content (enumerated parameters list). Well we understand what zero is - it's nothing. So logically if we come across some number - such as the fine structure constant - and there is no material connection with length, width or height, as a mathematical 'point' has no physicality associated with it, by default it is immaterial, 'pure' and unmeasurable ... dimensionless.

But to maintain this view mathematically is to force a continuum discontinuity. Rather, it is critical to let go of that definition artifact. In a universe that is wholly integrated - pun fully intended - every calculus integration and differentiation is in fact a visitation and exploration of information in accessible adjacent *dimensional* spaces in a math *continuum*.

In exactly the same way that we appreciate all energy in the universe is an example and expression of some location along the electromagnetic (gravitational/temporal) spectrum, we must recognize that everything in mathematics is dimensional - even negative and fractional dimensions, even transfinite dimensions and most importantly even *zeroth dimension*.

The new best-math architecture we are building - exponentially tiered Cantorian infinities - requires everything be consistently part of the pandemic plural-dimensional accessible matrix. The key is for zero to be a *dimension* place-holder in addition to being a calculation integer - exactly as we use it within standard math notation already. This completes the continua at every tier and adjacent exponential tier conjuncture.

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Including dimension-zero as a placeholder finally accomplishes for geometrics, complexity and organization what computation notation-zero did for numerical continuum.

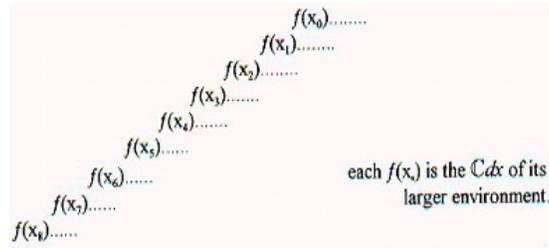
We are trying to break *Ptolemaic* habits here, trying to change, expand and improve our mental maps.  $\{ Ax^n ; Ax^0 \}$  The equation form  $Ax^n$  employs  $n$  as a dimension by required definition. In the construction  $Ax^0$ , "point" (exponent  $n$ ) is explicit identification of "zeroth dimension". All exponents are 'dimensional' notations; all dimensions have data 'content'. For example,

$$177x^4 + px^3 - 8.4x - 5 = 0$$

is a 5-dimensional equation, not 4D (even though the highest exponent is "4"). It should be written (or at least thought-noted)

$$177x^4 + px^3 + 0x^2 - 8.4x^1 - 5x^0 = 0$$

Currently equations are grammatically written and thought of as " $N$ " dimensions (highest written value exponent), yet function as " $N+ 1$ " dimensions - to umbrella and correctly consider a zeroth place held dimension domain. Dimension spaces can now be more accurately exponentially diagramed:



**Fig. 6.** Nested exponential Cantorian Infinities

where each ' $x_n$ ' represents a number line and each ' $n$ ' represents an adjacent companion number line, and all mathematical spaces are connected. We are no longer shackled to isolated, dominating, randomly identified and used 'number lines', where exponents are subsidiary function markers. We have pluralities of adjacent and dimensionally nested numerical 'systems' .. where number lines are not 'sets' but 'systems' .. with interdependent qualities and mathematical associations, and, are environmentally associated with other "number lines systems" - sub-exponential and supra-exponential; with new computational relations and transforms that demand fresh-eyed exploration.

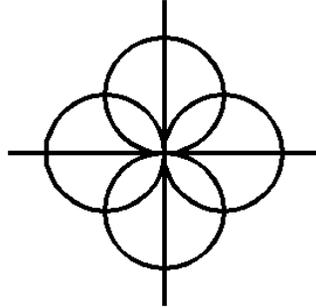
The transition to this new paradigm won't be easy. Its base form can be represented by this simple Figure 6 diagram, but in practice it will require the invention of new notations and operators to work, compute and navigate among the dimensional spaces. One of the problems is that current notation doesn't give us reference points to quickly identify which basis number line (in the nesting of several present different numberlines associated with the systems we are examining at any moment of equation design and dimensional space designation) – related to all the varied real physical phenomena and tiers of existential organization we observe, study and model. We are habituated to staying in one basis domain, but information and data looks different when we are exploring and keeping track of casually re-navigable environmentally co-present 'frames of reference'.

Curiously, 'information content' can also remain *invariant* and unchanged against transform operations. This is an added characteristic of numbers and values that we do not recognize or use in conventional mathematical manipulations. Currently for example, we assume that when numbers, values, dimensions are coded or reduced to zero, that all information is lost. That may not be the case. Think about writing something on a sheet of paper, which you 'normally' view in a flat two-dimensional

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presentation. Now look at the same page ‘edge on’ (which is tantamount to differentiating an equation). Suddenly the information is ‘gone’, when you’ve taken the information content ‘down a dimension’. Physically, you know how to ‘reconstruct and retrieve’ the original written image. Mathematically, the potential is there to retrieve what was dimensionally re-coded into compressed format. Also, the same information may ‘look different’, depending on the dimensional frame of reference it is mathematically observed from or in – but is still accessible and retrievable.

Standard calculus integration and differentiation changes the dimensionality of expressions. That is trivial. We understand that we do calculus operations in order to navigate among correlated dimensional spaces. But, do the same operations on certain trigonometric forms such as a simple sine function and something interesting occurs. You generate isomorphic ‘information content’ simply transformed by 90°.



**Fig. 7.** Calculus integration *duplicates information*, not just transforms it.

$$x = r \cos \theta, \quad y = r \sin \theta$$

In some intrinsic relationships not previously appreciated or evaluated, information is simultaneously variable *and* invariable; with the option for us that non-identical math expressions may otherwise have information qualia/content that is different in presentation but not essence; with the option that presentation information has different examinable qualities/quantities when accessed in different dimensional frames of reference. In continua domains there are quantum mechanical ways to instruct and deconstruct, to encode, decode and re-code - mathematical and contextual information. A fully dimensional singularity can ‘contain’ *all* the information of a 15 billion year old universe, if you unpack the content in just the right way.

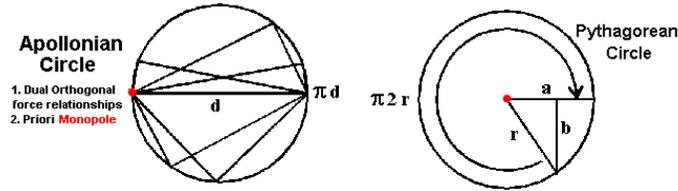
Simplistically, when navigating dimensional space, keeping track is only moderately difficult in adjacent exponential tiers. When you want to correlate exponential tiers that are extended and further away, a new math-GPSs will be needed.

Now at least we have a foundation of an expanded and relationally correlatable mathematical architecture that can address relationships and ideas that we were unable to even speak about before.

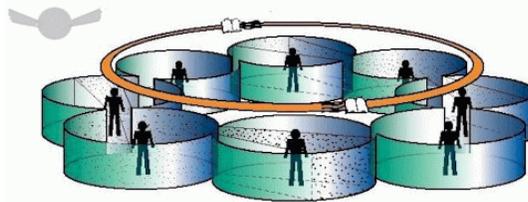
The prime essential is this: that the architecture of mathematics have no domains that are inaccessible to one another. Limits, walls, barriers of one sort or another may be locally definable, but in the overall, we must appreciate mathematics as a house of information. All-inclusiveness mandates accessibility - whether by transforms, substitutions, interpretations or alternate frames of reference, for describing expressions or equation groups/ relations. With limited space remaining here I will highlight topics discussed elsewhere (Rose, 1972, 1992).

Pythagorean trigonometry, key to our current math architecture, is so habituated that a critical geometrical relationship was missed. As cosmologists talk about symmetry breaking as the mechanism for dimensionally unpacking the universe it is assumed that circular, radial  $r=k$  and conventional trig relations are part of that process. On review however, it is noted that a zero<sup>th</sup> dimensional point, a one dimensional line, both contain the dimensional element point where the symmetry breaking might have initiated from. An  $r=k$  defined circle however does not. It is generated from a focal locus that is not a member of the representative structure ‘circle’.

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**Fig. 8.** Breaking symmetry must retain originating loci within the unpacked forms – e.g. the originating point *is a member of the generated circle-form circumference*, per Apollonius. The originating point is the end locus of 1D line; a circle is the collection of all right angle triangles leg intersections. A full correlated geometry of physics relations results.



**Fig. 9.** Accessible information transcends Godel limitations

**Figure 10** diagrams natural symmetry breaking - natural dimensional expansion. Additional findings explored and developed by the author elsewhere (Rose, 1972, 1992) including: symmetry breaking as the creative locus of ‘relational negative’; expanded probability theory that includes place-held probability counts; a conceptual challenge to Gödel’s Incompleteness Theorems (Figure 9); Stochastic Logic - that unifies Aristotle, Boole, Fuzzy Logic and quantum mechanical logic; an alternate rendition of waveforms that suggests certain information transmissions are possible that are impervious to noise; a possible geometry conservation principle that underscores fundamental particle pairs in spite of non-equal mass equivalence; a hypotheses that excessive determinism is counter-productive to the dynamic endurance of systems in open environments and function spaces.

### A SCHEMATIC DIAGRAM OF THE ENTIRE UNIVERSE

Finally, and hopefully of most profound use, is the extended modeling of the dynamics and relations that have been described here (Figure 10). Essentially, at the beginning of the universe, the originating forces each performed along the guidelines of Entropic Gradient Relations. Gravity - as the product of interacting time dimensions - acted out the essential role of spatially consolidating energy and particles. As a primal product of the geometry of the universe, gravity is not associated with a particle, it is pure field-construct. This is why gravity is measured everywhere, even freely and capriciously roaming beyond black holes. If gravity were a particle entity (as conventionally modeled) then it would never escape its companions - but it does, so it cannot be. The sister forces, using the same entropic principle, formed the essential particles. Recombining and engaging at different scales, all diversity built from there. But all of it, no matter the forms or complexity or convolutions or organizations and relational entailments, are the result of interacting entropic gradients with freedoms of function spaces interacting together (Figures 11 and 12).

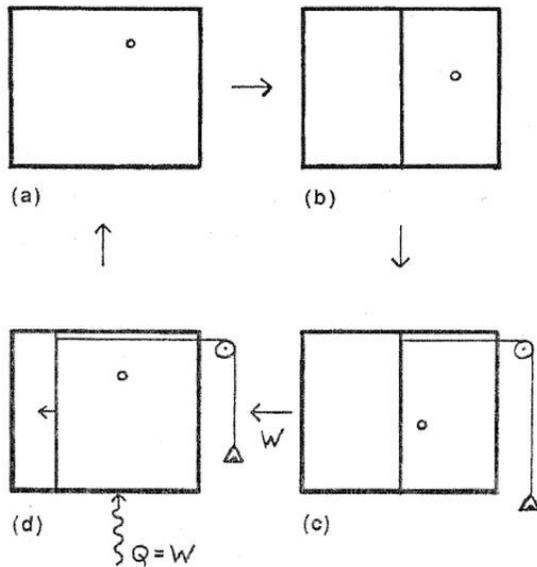
It is of important note, that this author in the early 2000’s analyzed the natural relationship between Claussian-Boltzman entropy and Shannon information entropy by deconstructing and comparing the Maxwell Demon connected chambers scenario by specifying one particle (aka “data bit”) being present-involved, versus a many-particled gas; each ‘chamber’ being effectively a frame of a Turing machine string. State changes from 1 to 0, and vice versa (present; not-present), are effectively identical to conventional entropy~negentropy states changes. As this current paper was being prepared the author also discovered that Leo Szilard (1929) did a pre “information theory” analysis using one-particle also,

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but Szilard was not aware of and did not discuss the association of entropy with information, either Turing's systems properties or Shannon's (1949) either. But, as Whorf admonished us, a holistic general systems thinker has to be aware of *all ranges and kinds of knowledge* and *properties of systems*. So the author makes note of these things simply to bring them to your attention, and expand your important knowledge base of comparative systems ... modelled and real.

### SZILARD – 1929 : 1 Particle Maxwell model

Szilard did *not*- recognize the Turing association. (Shannon, 1949).



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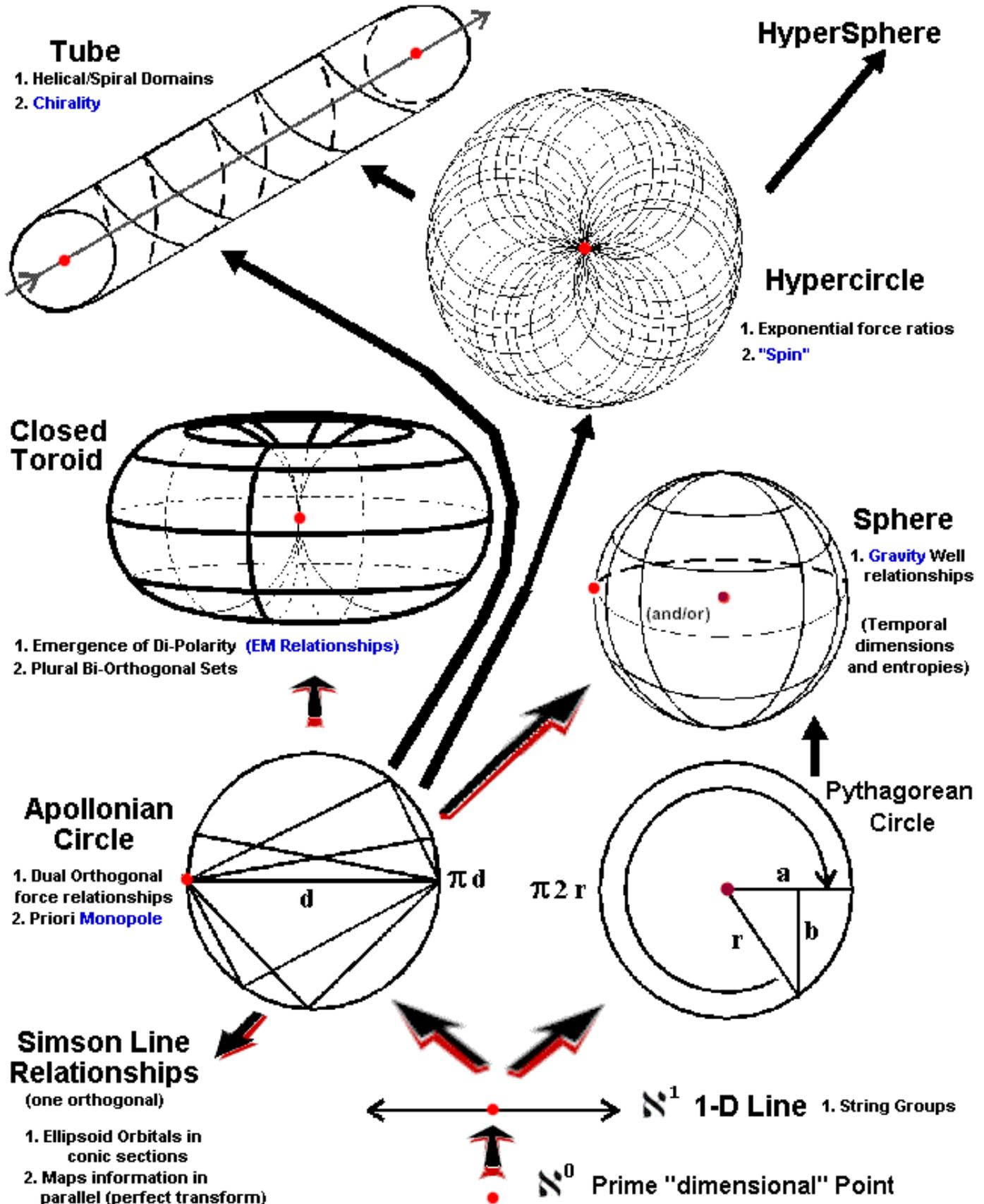


Fig 10. Completed Geometric Schemata

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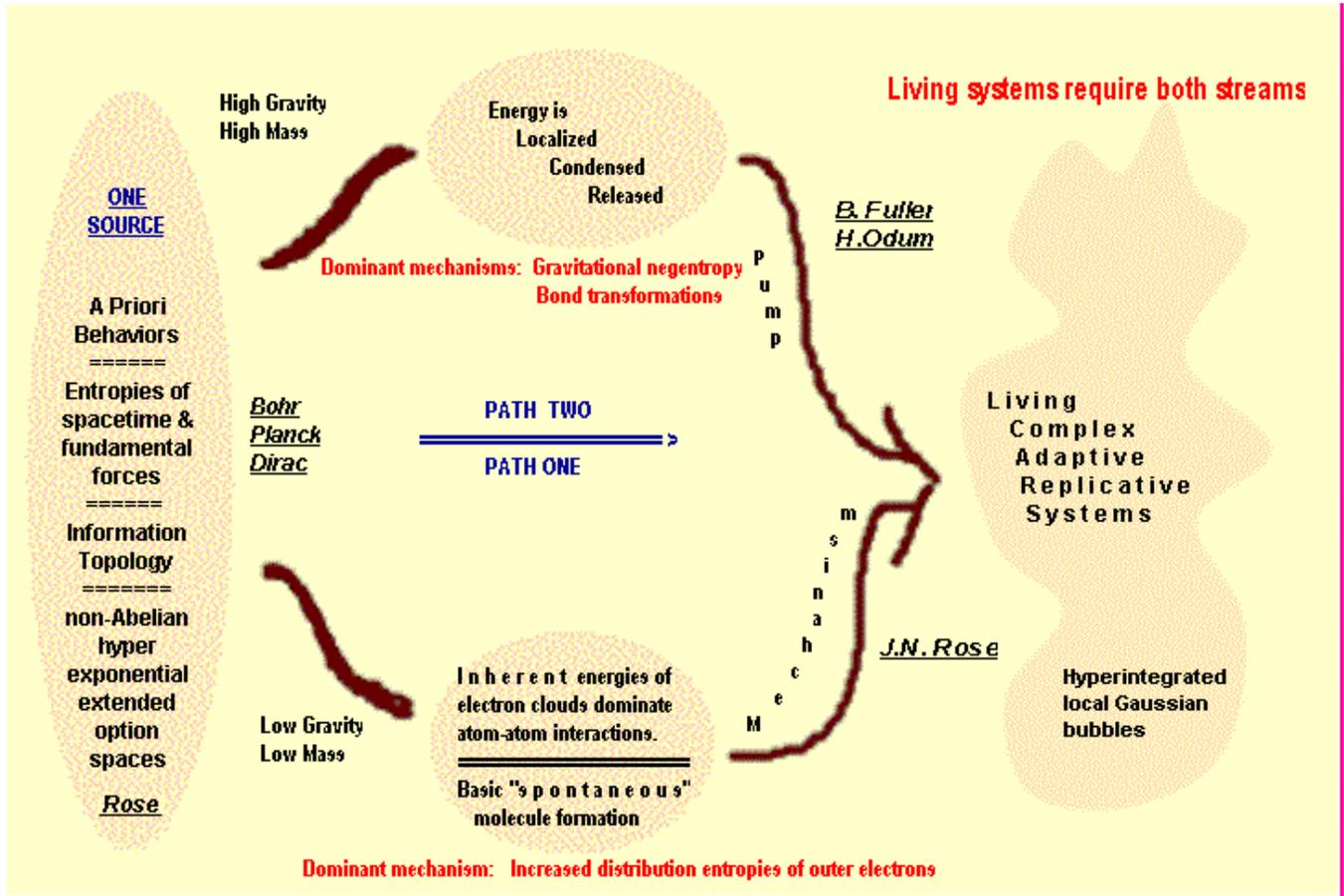


Fig. 11. Gravity Entropies & EM Entropies build complexity

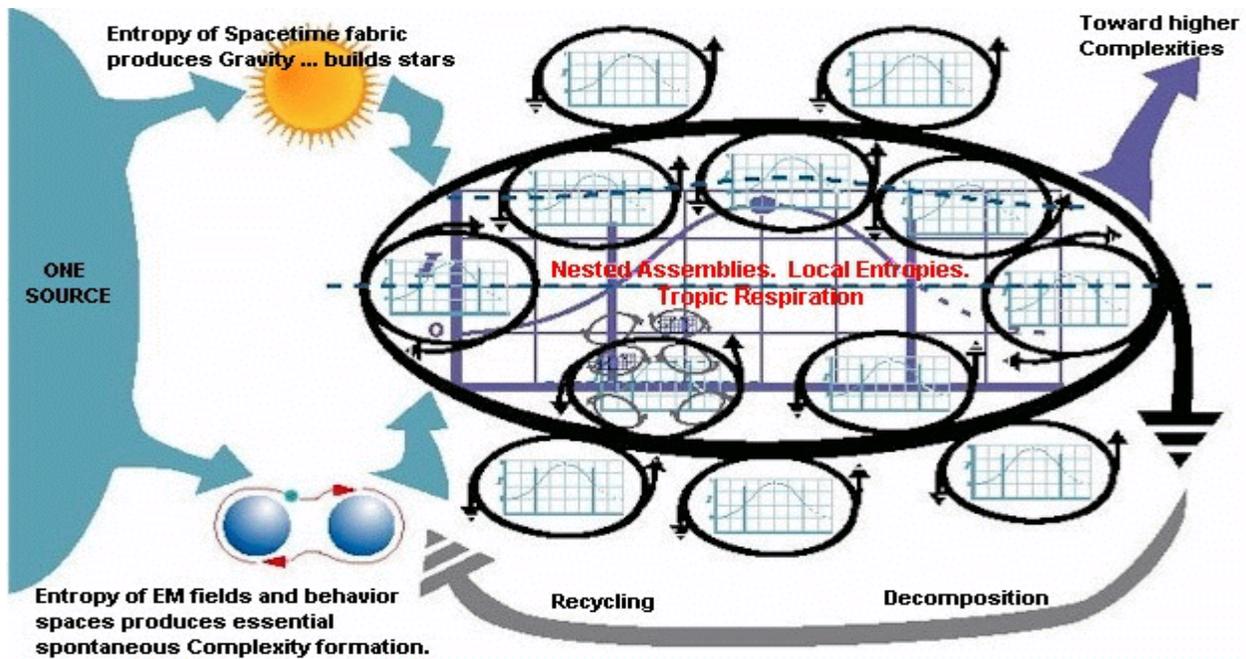


Fig. 12. The Universe: the Entropic Performances Model