Notes on NeoPlexus – Program and Consortium

Scientific basis:

**Dynamic Quantum Potentials and Topological Resonance in Atoms, Brains and Computers**

Addressing long-standing issues in quantum physics and biology with implications for what can be achieved in computing devices

Engineering focus:

**GCM (Generalized Computing Machine), a trans-Turing architecture incorporating TIR (Topological Information Resonance)**

Differing from qubit-based quantum computing and based upon models of quantum processes in macroscopic systems including molecular biology

Observations and Critical Reinterpretations pertaining to entanglement and superposition relations in elementary physics, macromolecular dynamics of condensed states and biological systems, and addressing the tasks of engineering a generalized computing machine embodying topological representations of information

M. Dudziak version 0.99, 12 Dec. 2017
Provided here are a few notes, excerpts, abstracts, including (mostly) the preface and introduction and some excerpts from a document still in preparation. This is given here in the interests of creating the framework and platform for dialog, discussion, and collaboration. There is more on all of this, certain in the technical areas, but the objective is to initiate constructive, critical, dialectic discussion among a few people.

These are only notes, in many cases brief headers from other materials. “All the rest and more” is certainly available upon request.

Repeat: this is not a preprint of a “paper” - it is a compilation of notes, chunks, and headers from papers and from work-in-progress. One main goal is to convey the idea that Your Work is Very Important in what can be Built because of a different way of looking at the whole picture of things (like going to the art gallery and looking at some paintings from different perspectives and distances)

A word about the maths and equations, which are substantive, substantial, significant (important). Well, here in this document are virtually none at all - absent by deliberate intent. There are four main reasons:

1. the original impetus has been to introduce some concepts as ideas, speculative and concrete, as connections between concepts, and as philosophical concepts as much as they are scientific notions or engineering suggestions.
2. The mathematics is not yet to the point where the author is ready to claim that it is complete and correct, on enough significant points, to be put forth into something now, especially as “preliminary and introductory” as is this document
3. Composing something like this introduction is faster in Word than in TeX and the maths are in handwritten notes, TeX, and other program formats and need to be organized and formatted
4. What really needs to be said here first, is best through words and visualizations. Jumping into the maths is for demonstrating a formal supportive basis, approaching theorem/proof, but at least demonstration of consistency with generally accepted physics and chemistry. As for visualizations, for here, graphics design is slow and tools (skills) are less than desirable. Most of all, there is a desire to initiate (instigate) dialog and creative arguments and designs, so for the most part this document is a verbal construct.
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

Contents Guideline

Some empathic assistance is offered to the reader. Different headings may be interesting points to start, rather than at the beginning. There is an intentional general flow moving from the simple and elementary to the more complex, and ultimately, to engineering challenges (“how to build and how to use”). However, for different readers, it may be more profitable to start at points that seem to match with one’s area of work, experience and interest.

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Preface – Objectives and the Format of this Document

Goal
The goal in this monograph is to present an outline – only in a high-level introduction - of a new direction of thinking and active research about several closely related and fundamental concepts in physics, biology and computer science. This new direction changes interpretations about certain basic quantum processes in physics at the Planck-scale, in particle and nuclear physics, and in the macroscopic scale of condensed physics, chemistry and biology, particularly in molecular and cellular biology. There are and will be implications for computer and information science and for the life sciences including medicine.

This is a very comprehensive rethinking of some theories that have been well-developed over decades, supported by experimental evidence, but not yet fitting together into mainstream models of quantum mechanics, relativity and gravity, or cellular functions including memory and learning in neurophysiology. For some readers, the arguments here will appear to be radical or certainly contrary to many long-time accepted, even dogmatic, interpretations. For others, what is presented here will be seen as pointers to validation and rationales for deeper exploration and concerted, focused new investigation including within the engineering domain.

A New Theoretical Model with an Engineering Objective
The research is aimed at creating a fundamentally new and more complete theoretical model of quantum processes including superposition states and entanglement phenomena, with direct explanatory and utilitarian impact upon macroscopic phenomena, not the least of which being the fundamental wave-particle duality of quantum mechanics and the relationships between these phenomena and gravity and the fundamental electromagnetic, weak and strong forces between particles. Some of the direct extensions and implications concern how learning and memory is implemented in the brain and how quantum mechanics can be employed in building new types of computers that work upon principles other than the classical Turing machine model of instructions and data represented in bits, bytes and other sequences (including qubit-based quantum computer designs). Overall the new theoretical framework may be described by the term “topological information resonance” (TIR) - this will be explicated in this document.

All of this rethinking and re-interpretation is also aimed at the practical engineering goal for building a physical machine which embodies the TIR model. That machine implements the theoretical principals in a manner that can be demonstrated and sustainably used in “real-world” applications, solving problems in extremely complex, non-linear and “non-algorithmic” systems that are not well-addressed through current computational engineering. Indeed, a major part of the motivation for such a new type of computer architecture is to create a physical device capable of performing tasks in the modeling and control (cybernetics) of systems whose state-spaces behave with such complexity, nonlinearity, uncertainty and non-computability (in the “Turing” sense) that conventional parameter-set models are formally and practically inadequate. Such problems exist in many fields and situations and the cybernetic approaches, including the use of synthetic (artificial) intelligence and machine learning, have pointed in the directions of trans-Turing mechanisms for computing and decision.

There are details – mathematics, theoretical framework, experiments, and a body of work extending over a few decades by a fairly large group of researchers, many of whom have heretofore been completely or mostly independent of one another. There is experimental evidence for what is asserted, claimed and argued here, and there are answers to many of the known counterarguments. There are major open questions that can only be answered by a concerted effort involving teamwork and collaboration among some of these established researchers. A project structure for proceeding and doing so has been established and is in the initial processes of being implemented as a formal program (“NeoPlexus Consortium”) [a].
**Introduction**

This is written in order to help enable construction of a scaffold. The edifice for which this scaffold exists and which it serves, will be a framework for understanding some theoretical topics in a different light and for engineering something that is based upon the different theory that results. A scaffold exists to assist in the construction of some edifice such as a multi-story building, something too high and complex to build without some external structure during the construction phase. That is the approach being taken here toward erecting a new theoretical edifice, and with it a new kind of machine to be designed on the foundational theory.

As much as there are areas of uncertainty and big gaps in understanding, a few facts stand out clearly and these can be considered as posts for where we can reliably begin to set the base of our scaffold and gradually for laying the foundation stones of the entire edifice. Among the most generic (or general) are a few that are particularly reliable. Quantum mechanics is very accurate and reliable in many areas of applied physics including electrical engineering of structures – machines – operating at the near-atomic scale and certainly, very efficiently, at submicron and nanometer scales. Biology works, quite well for “natural engineering” of adaptive sensori-motor systems that we describe as having the capacity for learning and performing intelligently. These are two foundations about which we can say that stable architectures can be built for performing repeatedly and reliable certain step-actions (e.g., computing as we know it) and also for performing actions that generate new information not known previously. Humans and other creatures not only learn and adapt but imagine and invent.

Herein is a very “top-down” approach to a multiple set of problems which are individually and together at the heart of many long-standing issues in physics, mathematics, biology, and computer science and engineering. At the same time, this document is beginning at the “bottom” and moving “up” in some respects of physical scale and complexity, moving from quantum physical events to biology, neuroscience and computer engineering. Among the problems that are being introduced and addressed – because, it is asserted, they all matter and must be considered together, somehow - are the very fundamental questions of quantum mechanics concerning entanglement and non-locality, and the interpretations that have posed barriers for the past century regarding quantum physics, gravity and general relativity. But also included in this “big set” are the questions about quantum processes in macroscopic systems, particularly in biological organisms and the implications therefrom for neurobiology and cognitive science, as well as in synthetically engineered systems that can be used to perform computational tasks – thus, also, in this landscape of questions, assertions and suggestions, are the matters of quantum computing and non-algorithmic computation.

All of these issues are asserted here to be inseparably bound and requiring that they be addressed theoretically and experimentally in a cohesive and unified approach. The reasons for this assertion should become clear in the course of reading this document. There are interpretations about quantum behavior at multiple scales in Nature that have significant implications for biology and for computing, and among them are the notions of how information can be represented and processed in a machine other than through an arithmeto-logical protocol as is done in all Turing-type computers including those that employ qubit designs for bit representation.

What follows here are points of departure and not completed sections of any paper – not a full argument, nor a disclosure of complete experiments, much less a proof. These are given here in order to provide a set of dots that may be cognitively – and imaginatively - connected by the readers. Will some readers see an elephant, a cat, an old face or a young face, a man or a landscape? Much of the reaction-space that is possible at this point, and many of the thoughts that will come to readers’ minds, will be determined by something that is one of the assertions made herein, on the basis of a refreshing reinterpretation of quantum events in microscopic, mesoscopic and macroscopic structures.

One of the bold assertions concerns biological memory and learning and what can be possible in a machine whose engineering is more like the configuration networks of proteins and membranes in eukaryotic (nucleated) cells (not only neurons, and indeed also in some ways within bacteria and viruses) and where “computation” is more about surface and shape matching and fitting of Hamiltonians in a way that will be termed “topological resonance” and less about bits and bytes (including “qubits”) in any kind of semiconductor, topological insulator, or protein-based construction. One assertion that will evolve
through the erection of the scaffold and the foundations in this work will point to how biological memory and recall involves highly nonlinear processes which reconstruct everything “fresh and anew” but with a complex background of dynamic inputs which are in some way “like” a superposition of states, albeit much more complex than those of photons, ions, or Bose-Einstein condensates in current artificial structures, an assertion that there are in fact no static memories in our brains but rather there are protocols for assembling experiences into objects – protocols that clearly work very efficiently and reliably.

** The meaning of these three photos will hopefully become apparent during the course of reading the first few pages. (Hint: having to do with scaffolding as an important ingredient of constructing initially difficult but ultimately simple (and beautiful, and stable) edifices.)
### Roadmap

**Beginning with Some Distinctions – Where We Begin, Where We Go**

Before bringing up theoretical physics or implications of quantum potential in biology and neural processing, let's first consider one target in the engineering world. This is to create a method (technology, machine) that can work effectively to solve certain problems that are considered by these terms (among others): complex, extreme, NP-hard, non-algorithmic, non-computable. We want something that will be a tool that can be analogous to what we have become accustomed to in the world of numerical calculations and “computing as we know it.”

<table>
<thead>
<tr>
<th>Today’s computers – a more than 75 yr. tradition</th>
<th>Something new and completely different!</th>
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<tbody>
<tr>
<td>Turing-class machines – instructions in sequences, like on a virtual “tape” (as was done with some early computing machines)</td>
<td>Topological, geometrical, “Gestalt” oriented, system-oriented, and working with a different way of representing information other than as sequences of bits (thus, “trans-Turing” and also “Generalized” computing machines)</td>
</tr>
<tr>
<td>Inspired by the process of numerical calculation and basic deductive logic (roots in mass sorting and comparisons of short coded sequences (cryptanalysis, Enigma decoding) and in accounting (tabulations and general ledgers))</td>
<td>Inspired by biology from the scale of viruses on up to artists, inventors and musicians – focused upon field-like, surface/volume comparisons and pattern identification that does not consist only in translating everything first into coded numeric sequences</td>
</tr>
<tr>
<td>Designed to do arithmetic first and foremost and to make binary choices based upon simple comparisons of binary values</td>
<td>Not its main focus – this machine is not for multiplying “234 by 456” – for that, use a CPU with an ALU/FPU, and thus, this New machine is “heterogeneous” but in a more “intimate” (internalized) way than with current multi-processor devices</td>
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<tr>
<td>Binary-based, bits and bytes to represent things – and very importantly, what goes into bit-structure b will remain unchanged, stable, in content and structure, until and only until some action (from outside, thus, from “the program” (of “instructions,” motivated by other “data”) will definitively cause (order) that representation to change</td>
<td>Not about bits and bytes, per se, but obviously using “small parts” (arranged in certain configurations – thus, encoding “information”) to build larger structures that will change - over time and according to both “inputs” and “outputs” from that structure – into different forms (shapes)</td>
</tr>
<tr>
<td>ALU, FPU, GPU specialized logics, but all basically doing the same thing – move, compare, add, sub, etc.</td>
<td>Something comparable but involving special classes of reactions, perhaps in a group-theoretic basis, to certain types of movement of value that is expressed through topological changes – but the individual discernible elements that change (e.g., some “knot” feature, some twist, some conformational change in a molecular array, is not a “byte” or “bit” to be “read” but it is a part of a larger manifold structure.</td>
</tr>
<tr>
<td>Conventional “quantum computers” (qubits and arrays thereof) are the same fundamental type, and focused upon algorithms (e.g., Shor, Grover) to factor, sort, and do numerical calculations</td>
<td>Is a bit-based (byte-based) machine needed to do this? Can such an architecture even be used to do such non-Turing tasks? Everything points to molecular-scale operations that can be controlled in conformational changes by signals that originate from the binary-based world.</td>
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<td>Designed to take some model m designed for some system S which has a defined set of functions and their parameters, and use defined arithmetic and logic operations to get some result and return that to someone (user, another system, etc.)</td>
<td>Designed to work with 1 or more or even a huge number of competitive/cooperative models m, and to be capable of modifying functions and parameter-set choices even using stochastic, randomized selection processes that fit changes in the system S that cannot be predicted-modeled in advance</td>
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<tr>
<td>Concretely, fundamentally Algorithm-based logic – algorithm-first, and little or no departure from it</td>
<td>Algorithmic in a general sense but allowing for departures and shifts into something outside the bounds of the closed system of the models defined beforehand</td>
</tr>
<tr>
<td>Conventional “artificial intelligence” (all of it, thus far, historically) is designed upon the principles and assumptions expressed in the rows in this column</td>
<td>Imaginative and inventive, compared to conventional models of intelligent behavior. “Adaptive synthetic intelligence” that is more like how biology works as seen in experience</td>
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<td>Barriers, failures, impasses occur in dealing with “XCS” systems, leading to singularities, catastrophes, and other ways where “model m” fails and cannot cope</td>
<td>Expressly intended to be more suitable and practical for XCS problems. (Admittedly, a mega-supercomputer with quantum-Turing machine supplements may be able to solve similar problems, but at what cost, size, constraints?)</td>
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Elementary Building Blocks

These are the topics being covered in a longer document that will be available upon request. As you can see from these “headers,” the thinking here is that several “fundamentals” need to be brought together in a cohesive way in order to achieve the kind of breakthrough that many are seeking.

What follows here are not formal sections, much less chapters, but “key points” about how there is a Different Way to Interpret several features of our natural world, from the Planck-scale to the astronomical and in-between, and several aspects of our possible world(s) that we can physically engineer and build. The first set of key points concerns elementary processes in Nature; i.e., events that can be described as energy functions at scales considered to be sub-microscopic, at the level of particles. However, some of these elementary processes are reflected at much higher scales of size in extension (space) and duration (time).

**Gravity is unity (and is the other side of entanglement and quite connected to quantum superposition)**

We begin with something very simple and basic but which will no doubt seem shocking to some readers.

This starting-point is important because if our understanding about what is going on in “quantum entanglement” is wrong in the first place, then everything can be prone to errors when it comes to reasoning and conclusions about quantum events and relations in composite and macroscalar systems.

Gravity $\rightarrow$ quantum entanglement and quantum entanglement $\rightarrow$ gravity. You get one with the other and they are two ways of describing the same energetic process in nature, although because of the different scales at which we observe things, it appears to be different.

Something more than “ER” = “EPR” or “QR=GM” [Susskind, 2016-2017]
[cf. also Erik Verlinde and others, mostly 2010+]
[cf. Bohm and Hiley, and Bell, especially Hiley post-2000 and Hiley 2014, and several of Finkelstein papers on quantum dynamics and computation, including early “Space-Time Code” papers]

The claim here is that a misunderstanding of superposition states, and of what is the process of entanglement, derives from a misformulation about spacetime (space and time and spacetime as a unity), and about the nature of “particle-ness” but that also includes “wave-ness”. From this misunderstanding derives the misinterpretations about DeBroglie-Bohm and quantum potential and pilot waves (some of which is addressed in later remarks in this set of Notes).

The suggestion here is that the action between objects that is described as gravitational attraction is fundamentally connected with something that is an indivisibility and unity between the (only apparently) separate and distinct objects. This distinction is due to the ways in which we measure things and classify them as being at different coordinates in an (x,y,z,t) framework we term “spacetime,” the process by which spacetime becomes defined. … [much more on this in other papers]

There is something in common between the process of photons being entangled, as pairs, and then entanglement at more complex scales as composites of particles, including Bose-Einstein Condensate phenomena, and perhaps also Cooper phenomena responsible for superconductivity, and topological insulators with quantum knots. Different groups in physics with different priorities in what they are trying to explain and to accomplish (e.g., in some experiment or machine design) tend to view certain phenomena differently.

Consider:
- superposition-states within a singular entity (e.g., photon) in terms of quantum wave functions that reduce in a “collapse” event related to a distinct addition of “something else” (the action of observation, measurement, and thus, disturbance of the system), and
- entanglement in terms of two or more defined particles (some as micro/mesoscopic observables – electrons, ions, molecular assemblies) which share some particular property (e.g., spin) in a way that gets termed “non-local.” Why the term, “non-locality?” Because the process of change (e.g., spin) in a particle that cannot have a particle-like force-based exchange of information is still
associated with thinking in terms of different (x,y,z,t) locations of these two given particles – and this is by virtue of how measurements have been made to observe those two (or more) particles, which finds them at different space-coordinates at a given time of observation. … [again, much more on this in other papers]

**Complexity at different scales**
Transformation of scale (can) change the appearances (phenomena) of certain dynamics but not necessarily the logic (rule, mathematics, even the physical laws). This is connected with the ideas about quantum entanglement being mechanically different but functionally a common type of process at different scales/orders in Nature. But in all of this there is consistency with the physics as observed, as measured.

… Perhaps the dynamics of entangled systems in condensed matter much be viewed differently from the simpler scales. This points to why many people have trouble with Orch-OR (“Orchestrated Objective Reduction – Penrose & Hameroff, et al) for instance – because they are criticizing things at different scales of Nature on the basis of a classical notion about quantum behaviors and also not seeing the change in those quantum dynamics at different scales/orders … [much more on this in other papers]

**System complexity and model-ability**
(Controllability of a system through some given (constructed) model)

[Conjectures?]
It cannot be proven that for any system S, there is any given model m or a class of models M whose members (one or more models from \{m_0, m_1, m_2, … m_i\} ) will “accurately handle” all the critical points (singularities, catastrophes) that can emerge in the dynamics of S. (“Accurately handle” = “not fail” in a manner that satisfies certain criteria of what is the meaning (use) of “success” and “failure,” etc.)

Can it also be shown that any model will fail for system S in a particular “configuration” of the state-space of S? Can the existence of singularities be proven, enumerated and identified, in a way that narrows down definitively the selection of what model m_i to use at a given time for system S?

This appears to be related to Gödel’s two versions of the Incompleteness Theorem. It also seems to fit with findings by Arnold, Kolmogorov, with respect to different types of catastrophe and turbulence. [The author is working on some theorem development in this respect but it is a challenging effort.]

Another way of saying this: As a system S increases in dimensionality in its state-space, and the number of parameters N that influence (and control) functions in S increases, there is some limit to where any finite model m, which contains a finite set of parameters p(m_i) smaller in number than N, can be reliable for modeling and controlling S. (Again, there are the problems from the qualitative words of “reliability,” “success,” “failure,” etc.)

Can it be proven that N is a finite or, if so, a definite number, at any instance in time for system S?

If N can be shown to be a “larger cardinal” than any number p(m_i) - which defines the number of parameters active, or possible, within a given model m_i - then can it be proven or at least shown strongly that m_i will fail, certainly will fail under specific conditions (which could be pertinent to values of some parameters within m_i) is “better” or “worse” than some other models that are members of set M

In all of this we are dealing essentially with boundary conditions and limits. What are the bounding-spaces for a given model m_i? What are the “safety zones” and can they be defined before system S is “given over” to a particular model m_i that is running on, for instance, an autonomous computer?

If we are dealing with the state-spaces of some systems and looking for the boundaries of effectiveness and utility for certain models that are all members of a model set M, are we not acting in a way that is
conceptually, mentally, comparable to working with topological entities that fit well or fit poorly into some space? Are we not doing some form of geometry but it is obviously different from “ordinary” spatial geometry. We are using the concepts of a “geometry” (topology) for trying to describe, manage and control objects and processes that have nothing explicitly to do with 3-space or 4-spacetime.

...[much more on this in other papers]

**Gravity is not a force but a measure of “unity-entanglement”**

Gravity is not a force like EM or Electro-weak. This sounds very radical but isn’t really so. Nothing is changed about anything concerning “gravity” from Galileo to Cavendish to Einstein to LIGO! Of course there are gravitational waves. This is happening in spacetime, but it is not the same as an exchange between two objects (e.g., particles) even though, especially at the macroscopic scale, it can appear to be such (e.g., a baseball dropping from a building to the earth).

It is what “makes” superposition and wave-function collapse – or rather, we interpret events to be such superpositions – entanglements – in terms of point-particles from something that is fundamentally a process not limited or definable as being in specific separate points of space-time.

Thus far, none of the “new” ideas about gravity, quantum superposition and entanglement, or fundamental particle physics including “most” of what is in the “Standard Model” - none of this goes against a single bit of experimental evidence. It’s more about the underlying interpretations, and also, a set of very basic and historically (famously) omitted questions, all of which pertain to real fundamentals. What is and why is (charge, both EM and QC), and spin, and the tendency to be in some point (with or without mass), and many other such questions that many people seem to want to not ask even as they ask others to embark on leaps into far more than four dimensions (9, 10, 11, 26...).

What if “gravitons” are finally detected by any type of experiment, LIGO or otherwise? Such virtual particles would not be of the same “type” as photons or gluons. They may be more “epiphenomenon” than anything which can be classed as having a specific dimensionality including a spatial dimensionality (e.g., location and radius) or a lifespan measured in duration (temporal extension). We need to rethink “fermion” and “boson” and more fundamentally, what we mean by objects and what it is that is “there” which is being acted-upon by some force (or for which there is a “force carrier”) – what if in fact there is “nothing” (no-thing) in any “there” place or time?

**How does any of the above relate to a “new and Generalized Computing Machine?”**

How does the above, and such a GCM, relate and possibly matter deeply for models such as DeBroglie-Bohm, Implicate Order and Pilot Wave, and Orch-OR? How does all this matter for answering the questions about how not only pattern recognition but consciousness as a self-reflexive process occur within the “very XCS” (perhaps one of the most XCS) machines in Nature – the human brain?

Well, the claim here is that it all does, very much so, and strongly that (1) quantum processes in biology are the foundation for building a GCM which can withstand noise and decoherence from external and internal sources, and (2) quantum processes in biology and in any GCM involve a reinterpretation and application of quantum potential and pilot wave models in physics, which will (3) better explain phenomena observed in cellular processes and used to formulate Orch-OR and comparable models of quantum behavior in biology.

Furthermore, it is argued that the GCM, as it is conceived and being architected, actually matters immensely to our future ability to understand and formulate theory and applications for these aforementioned subjects. So, things go rather “full circle” in a good way, even though this makes things more complicated and complex.

(Some of those applications, by the way, can be of very strong instrumental value to readers of this or any document, since we are talking about applications in medicine and especially neuroscience including aspects of therapy for debilitative diseases such as dementia, and cancer, and cardiovascular monitoring.)
and control. This will come up in a later section about building a GCM based upon TIR (Topological Information Resonance) and the utility of examining how the human brain and central nervous system work in self-organized self-repair in response to trauma. Again, this is a “full-circle” situation where some seemingly diverse and unrelated things do matter for each other, and where the value is bidirectional. The human brain in “repair mode” can be instructive for building a new machine that operates on similar principles, and which in turn can be used to aid in medical tasks for new therapies for disabled and diseased brains.)

… [again, much more on this in other materials – bear in mind this is an “introduction” and “outline”]

Quantum Potentials and Pilot Waves
The DeBroglie-Bohm model of quantum physics and everything regarding the quantum potential and pilot wave models, has been poorly understood for decades, and part of the reason for such (which helps to explain the rejections within some mainstream physics communities over the past half-century and more) rests with a misunderstanding of what is going on with the energy process (aka, “work” – joules, and “action” – joule-seconds) that is taking place in the space and duration of photon emissions from sources and their measurement (which gives rise to a phenomenon classed as wave-like or as particle-like).

This is where the notion of cause comes into the picture and mistakes happen straightaway. There is not an assertion of some entity (“hidden” variables or not) that “cause” anything to happen in the behavior of a photon. There is no separate object, a “photon,” that is moving between emitter and screen at velocity c, but a process that is dimensionless in terms of space and time which is taking place in that “system” which comprises emitter and screen and everything connected thereto. It is only where there is an interference action with that system – an observation, a measurement – that the system change and this can be described as a change in its state-space that reflects a range of parameters governing what can be the observation at some point (s, t) where s defines a 3d location and t an instant of time.

The quantum potential is not a thing separate from the whole-system environment of the so-called particles and the environment in which they operate and act in ways that then are measured, observed, as being more wave-like or more particle-like. In reference to the classical two-slit experiments, it is not that the QP is something external to either the slits and the projector apparatus, nor to the photons themselves.

Each system environment generates a new QP if that system environment changes (e.g., new physical structure).

There is a QP in the macroscopic space (e.g., fluid dynamics system) and this includes in the biological framework of the cell and the brain. But it is not “implemented” in the way that it is at the simple scale of photons passing through a barrier!

Quantum potential is not something only at the scale of photons, but it moves “up the scale” of complexity and size, only it is applying to the logically equivalent entities at those higher scales, not photons.

… [more on this, “under construction”]

Quantum Potentials of different forms (and information at different scales)
Conjecture based upon both computer models and actual bio-lab experiments done (mid-1990’s, using atomic force microscopy, with in vitro neurons and glial cells):

The dynamics of coherent quantum-modulated communications in structures such as actin and myosin filament networks, and in cytoskeletal tubulin structures, may be comparable to the dynamics observed with bouncing droplets on a fluid surface (e.g., Couder, Bush et al), and only after some period of time, and choosing the right frequencies of observation and also the right scale of what is being observed in the molecular structures, there may appear to be something that has a consistency with, for instance, nonlinear Schrödinger functions.
There is a way “out” of things just being chaotic and noisy. That pathway may lead to observation that shows an evolving structure of information processing which controls (we may even say, “selects”) the ways that certain signals will be processed – this may lead to the biological (cellular) equivalent of what with “simple” photons becomes “measurable as a particle” or “measurable as a wave.” Only in this case we will be talking about signals that perform topological operations on large arrays of molecules (usually proteins, but sometimes other types including nucleic acids), acting “very very fast” in comparison to how, by the classical rules, things are supposed to happen.

Could this help to explain Fröhlich coherence phenomena, for instance? [Davydov, Brizhik, Ho, Hameroff et al]

... [more on this, in some papers, in unpublished work, and “under construction”]

Order embedded in chaotic behaviors in molecular vibrations and large molecular conformations
This is another way of approaching the same things mentioned earlier. Consider the observed behavior of muscle tissue, and the manner (not yet explained by conventional (“classical”) molecular biology) by which there is coherence in not only so many molecules within a cell and not only among contiguous, adjoining, or “nearby” cells, but at distances within an organism’s body such that we appear to be dealing with “yet another case of non-locality, or no satisfying explanation otherwise.”

Non-locality, yes, in a way, but this is not about superluminal signaling or some hidden nth dimension of space, nor some other “other” entity that needs to be introduced into physics or biology. Hmmm? It gets back to the idea that gravity is a manifestation of a unity and connectedness that is operating between entities that have some common origins and connectivity which does not disappear just because the observed entities are separated and moving apart in spacetime, and this unity factor (property, function) is manifesting differently at scales of particles, molecules, and much larger entities, so it does not appear to be the same kind of “entanglement” at the level of actin and myosin networks, or muscle tissue, or a whole organism - or a herd, flock, swarm, crowd of some species operating together on a particular “wavelength” (in the vernacular) – or a singular “pilot wave” in more technical terms. ... [much more on this, “under construction”]

How Quantum Potential can work at macroscopic scales in biology, in a brain, in a GCM computer
We may learn more about what is going on at the Planck scale or in general by examining the hydrodynamics investigated by Couder et al and also Bush et al. This work is strangely ignored, it seems, within some condensed matter circles and within many contemporary quantum-computer projects. It is important to keep in mind that a pilot-wave process at the millimeter scale is not “the same” mechanics as at the Planck-scale or nanometer-scale, and some confusion about this may be the cause of some division in thinking between different groups of researchers. It may be a mistake to look for material causes but instead to examine how statistical ensembles and with certain types of dynamics, including turbulence, necessarily act in the same manner as small collections of particles, even photons-only. The key may be in the ensembles at many scales all following certain principles of self-organization and self-control. “Control” may seem like an odd concept to introduce but as we move forward and “up” the ladder of scales, hopefully this will become more understandable and acceptable. Control is something that operates within a closed or semi-closed system, it is not only about something from an external agent. And control within a system, self-organized, appears to be a process that involves stochastics and random clustering activities which gradually lead into some type of stabilization.

The QP as a process which explains (careful about using any word like “govern”) the relationship between particle and wave categorizations is inextricably linked with the “environment” in which the physics is happening (e.g., experiment). What do things become like in a very, very different physical environment, like one that is inside a “noisy” environment that has more slits, more mirrors, more “stuff” altogether? What about when that environment is exponentially more “dynamic” like in a living cell? In a clustered network of knitted, knotted proteins making up a reactive, motile structure termed the cytoskeleton, and composed of millions of tubulin structures that are each acting in a manner like what on the simpler scale is the classic two-slit experiment?
Some kind of QP exists in this macroscalar environment, and it is very different from the Planck-scale QP. And how is it affecting things at this larger scale? The suggestion is that it is happening on topological phenomena, on groups and clusters, and that this may be closer to Bose-Einstein and Cooper phenomena, and relevant for explaining how “topological insulators” work (including the recent (2017) discoveries of being able to create quantum knots” therein).

**Noise and Decoherence are important, essential, for “superposed” parallel computation**
What is perceived as noise and decoherence at the lower scale – and which “noise,” by the way, is so antipathetic and deplorable for many physicists and also a problem for those working on “quantum computers” who want to get rid of it at all possible costs – is actually an important part of what enables, creates, sustains Structure at a somewhat higher scale.

Thus, all the “noise” that is deplored by some critics of Orch-OR and similar models of quantum processes in biological machines (brains, neurons) may be the critically important way that there is in fact coherent superposition extending over large (multi-cm$^2$ and multi-cm$^3$) regions of the brain and over large (multi-ms and even multi-second) time intervals. Yes, this is all “against the grain” – the notion that noise and uncertainty of specific features can be important, even essential, in how a type of entanglement occurs, allowing not only “fast” parallel operations but parallel evaluations of complex models to occur. [b]

[Thought experiment of sorts]
Within a state-space q of a given system, there may be one or many clusters (groupings of parameters and functions governing their relations) that define regions of q where different parameters are optimal for the system's performance goals. These regions may not be discernible and they may change over time, during at least the initial evolution of the overall system in which q exists. They may be compared to bubbles, which form and join together and then separate, or else to a collection of roughly-shaped polyhedra which change in type as they mix and merge together, changing their geometry, until at some point defined boundaries emerge.

It may be beneficial for any control machine (computer) to evaluate a large number of possible variations of these clusters; i.e., to simulate their evolution forward in time, in order to identify where boundaries form, how the clusters individuate from one another, and which are more optimally representative for use in control of the system they represent. But their bounds may not be known or knowable in advance. Thus it is not like the case with many forms of AI-based control where there are relatively pre-set or established possibilities (a fixed number or fixed “geometry” of the state-space clusters to be considered) that must be evaluated and for a selection to be made on the basis of some criteria.

Consider that the boundaries between the clusters “filling” q-space are fuzzy, uncertain, and perhaps best describable as noise. This is analogous to some type of statistical uncertainty but it is not now about simply position and momentum. All of the clusters may be “entangled” in the sense that there is no way to separate them within the state-space q. From a conventional algorithmic perspective, this is a disadvantage, but from what may be termed a topological perspective, noisiness, poor definition, overlap, and uncertainty of “mutual information” bounds during the parallel evaluation process may be beneficial, indeed desirable. How could this be so? It can be faster and more definite to narrow-down similarities and differences, and to create groupings among these state-space clusters, by reason of how they fit together in a “landscape” (topography) composed of themselves, and by reason of similar geometrical features shared by different clusters.

Looking at a landscape from an aerial perspective it is easier and faster to recognize and separate “rough terrain” like hills, ravines, mountains, valleys, from other types like plains, terraced fields, lakes, deserts. This is only an analogy but it points to what can be done if we have a machine that can “read” and “write” somehow with surfaces and volumes and not needing to first digitize everything and run only differential equations...

It is further suggested that herein (noise, uncertainty, and the deliberate use of “fuzziness” and “confusion”) is what enables cognitive (associative, adaptive, assimilative) operations including one form that fascinates virtually everyone – consciousness. That term, “consciousness,” seems to be something
brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

that many in “STEM” fields want to avoid. It is a good question why that is so. It may be that more subjective, phenomenological analysis of the world around us and how we perceive it, is what will help us to build a better “objective” machine that embodies synthetic intelligence.

… [more on this, “under construction”, including a lot of graphics and visualization examples]

Well, this is moving into a larger scale of things...

**brief intermission and a few words (pictures) from (one of) our sponsors**

No doubt the basic idea that the structure of spacetime and the nature of photons and subsequent particles that emerge and give it “shape,” embodying a self-organizing process - where Form and Structure are in essence the most efficient, lowest-energy and “straightest shortest world-line” for Action (work x time, joule-seconds), all of which may be considered to be a unified interaction of energies (or in one word, a “universe”) - is a challenge to some (including those trying to give expression to it in “short form” through a few introductory sentences.

The idea that several prominent and long-standing theories and models spanning from quantum physics to cellular biology and the cybernetics of living systems, including among the most complex and arguably most sophisticated cybernetic systems, the human brain, are all essential for understanding and making sense of each other (and thereby giving rise to a unified theory that is more encompassing than just to rewrite the Standard Model and satisfy arguments about how quantum mechanics and general relativity coexist in one of those universes (namely ours) where they obvious do coexist just fine) – this may be really a challenge. Most of the ideas expressed in this collection of notes are not so new or original – they are based upon what has been developed by others over the past century. Individually, they have been mostly resisted and even rejected by mainstream physics and biology. Particularly so for quantum potential and pilot wave models, and for the Orch-OR associations of gravity and quantum superposition-collapse in the context of a “machine” (biology). But taken together, as is attempted here, and also assembled together into a logic for building an actual Machine, these begin to exhibit more and more coherence and consistency, both qualities that are regarded as important in measurements of truth-value and in making better theories.

How we see and how we put sensory experiences including what comes through our visual processing network as well as from other “media” processing functions of our central nervous system, into associations that have labels known as words, may seem afar afield from the quest to build a different and presumably better computing machine that can solve problems other than by shift-left, shift-right, add, sub, and a collection of other bit-oriented actions. Can we actually learn something fresh and valuable about how quantum mechanics operate at the Planck and particle and atomic scales, by examining how the brain works in building an “idea” from images coming in through the eyes, and moreover, having such processes trigger the internal “mental” image (which may have all sorts of attributes such as words and actual visual experiences) of something or someone not seen for years, or something that has never been seen, heard or touched before, or something that clearly does not exist in our physical world as we know of its structures, boundaries and limits?

Can all of such thinking actually help us to build a better Machine that can be used to model and control those uncertain, noisy, unpredictable and non-computable (in the Turing sense) systems we call XCS – extreme because they can and do go into uncontrollable, irrecoverable “extremes,” and complex because they are something different from being merely complicated? The answer put forth here is Yes.

The following four images are intended to help in conveying some of the “unspeakable” reasoning for a lot of what is introduced here, and for that positive answer of Yes. These four images are not uncommonly known, at least the types. They each convey Something about the challenges of designing a machine that can do things other computing machines cannot, as well as the answers for how to go about doing that engineering.
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)
**Intermediary Building Blocks**

The second set of key points concerns elementary processes that are at the scale of molecules and assemblies of molecules including those referred to as “cells.”

**Biological (or any) cells as topological clusters and measurement processes**

A cell as a topological cluster, a cellular-automata network, a local neighborhood region, and most importantly, as a boundary condition set, which may be represented by different models $m$, which comprise the model set $M$ for a larger system $S$, each model $m_i$ having $n$ parameters which are in relation sets with one another (1:1 and 1:group).

The cell is constantly measuring its boundaries, its borders, and redefining itself in terms of what is “outside” it – this includes processing of information that determines – on the basis of its internal system and its model set $M$, what actions to do next. These include the full range of metabolic activities, and the mechanism by which most cells do this (i.e., natural biological cells existing in Earth’s ecosystem) is through selection of particular proteins to be assembled, and this leads to activation and deactivation signals that cause particular codes for amino acid building blocks to be activated, leading to the lineup of RNA in the right order for those amino acids to match up and line up accordingly.

The cell thus demonstrates a very interesting natural phenomenon that is what is being targeted and aimed for design and construction as a synthetic device, the Generalized Computing Machine (GCM). It is argued (suggested, claimed) that the cell works on topological computation principles, involving mapping and comparing and “pantograph” type physical associative processes, involving surfaces and volumes of molecular structures that change in their conformations, and that the outputs of these topological computations, which are not digital, definitely not binary, are then transformed – “translated” – into a biological type of digital “language” which is what is employed to identify and select certain sequences, – series – of codes. Those codes are not represented in the digital binary-based language used in contemporary (Turing-class) computers, but they are a form of digital language, only with four codon values (ACTG, or ACUG) (which from recent experiments we know to be modifiable through the addition of different codons. [c]

**Orch-OR (Orchestrated Objective Reduction)**

Biology introduces a unique “open-closed” system situation. This is where the system as a whole is “orchestrating” the processes that occur within the cell, for instance, but this process is driven by a type of “QP” or “pilot wave” (physical, just not a simple “wave” of course) that is in a higher, more complex scale (system) affecting what is in the lower scale (e.g., cell, organ).

The quantum dynamics are at the level of nuclear and intermolecular structures as Penrose and Hameroff argue especially in their Review of 2014 and in the response to criticisms of that review.

Assertion: what is presented as theory and backed up by experiment in the Orch-OR model is criticized on the basis of some mistakes in thinking about what the quantum processes are, informationally speaking, at the tubulin level. To talk about qubits or any type of binary or similar coding protocol is to miss the point about the topological, field-like processing of information, bidirectionally, within the cell, in its interactions with its neighbors (boundaries, borders).

Orch-OR is consistent with the physics and with what we will call TIR – topological information resonance. It is not something for a Turing-class “quantum computer” and that is a mistake if it is being looked at in that way, from either “side” of the argument.

**Does a process like Orch-OR depend upon a larger encompassing geometry**

[Speculation and conjecture that can be modeled and tested]

In general there is a resistance, at least in certain circles of science and engineering, as well as in medicine, to not consider what it means for the whole (system, entity) to have a direct influence upon the behavior of its parts. This seems to stem from difficulties in having a representation of what that “wholeness” is and how it can be described and measured. Perhaps the problem of quantum action in biological systems offers an opportunity to reduce some of these difficulties, if we consider what it can mean for there to be a “quantum potential” or something of a “pilot wave” structure that is present in living...
systems and consistently in all components down to the cellular level.

Could a process like Orch-OR occur in anything other than an ensemble-structure precisely like the tubulin-based cytoskeleton structure of cells – or something with similar properties as a massive collection of objects capable of conformational change? Could such organized quantum processes occur in anything other than cell-like structures that are part of a mass of others (comprising what gets termed as an “organ”)? The division of a system into a large number of “sets of sets” wherein there can be extremely large numbers of connections and memberships among the elements, may be the way that a process like Orch-OR or anything similar can occur and be stable over time – either in a “natural” (evolved over millions and billions of years) or synthetic (man-made) system architecture.

… [more on this, in other papers and “under construction”]

A connection between molecular and cellular biology with cybernetics and control systems

There are techniques from within modern control theory that offer insight into what may be operational in biology, and this may help in understanding how molecular surfaces such as intracellular and cytoskeletal filaments (as opposed to more apparent “coding” structures such as nucleic acids) operate as informational, computational functions. Consider randomized algorithms and methods of modeling and control like SPSA (simultaneous perturbation and stochastic approximation), as pioneered and developed by Granichin et al (see References). This body of work originates in control theory and applications directed at systems with high state-space dimensionality and variability, uncertainty and noise. The applications development has extended into diverse fields such as aerodynamic turbulence, wireless network load-balancing, multi-agent control of cooperative robots and traffic, and pattern recognition in text. One important development has been in the use of “local voting protocols” [Granichin et al, Seattle, 2017 and other references]. This method involves randomized selection of individual or small clusters of sensors or other devices, all distributed within some larger system (e.g., pressure sensors on the wings and fuselage of an aircraft), as part of a strategy for optimizing the control process of responding in a timely fashion to non-deterministic, non-predictable events (e.g., extremes in air pressure differentials across the surface of an aircraft).

This is similar to cellular automata networks which “measure” the values of state-space variables both inside (members) and outside (boundaries) of their local networks and then changes can be made or signals sent, based upon some functions and rules assigned to those networks. As certain patterns emerge and stabilize, then the control system can adjust its protocol for selection, measurement, evaluation and change. But also, it retains its underlying flexibility for being able to respond to radical, nonlinear departures from the expected; i.e., when the current working model suddenly no longer works well and something else must be invoked – another built-in (instinctive, or learned) model, or else going back to the “pure” SPSA approach, almost a “restart from scratch.”

Biological systems appear to use something similar and this is at every scale - cellular, cluster (of cells), region (tissue), organ, system, organism. There is an ability to respond to outliers, anomalies, asymmetries, singularities. Without it, organisms (cell, organ, system) fail and die. This extends into longer-term interactions between the biological organism and its environment, where decisions are made through neurological processes and the whole process begins to be labeled as adaptive or intelligent behavior. At every scale including at the more easily observable scale of human cognitively-directed behavior, there is clear evidence of some type of randomized, stochastic measurement, approximation, and evaluation of uncertain sets of parameters, leading to actions which then have feedback into the prior set of processes (e.g., correct/incorrect, good-enough/insufficient, OK-to-continue/need-to-revise).

Consider if one were to design a machine for performing local-voting measurements of small clusters and networks of sensors or sensor-actuators, of any sort, and the available building-blocks were molecules that could be easily, rapidly, and with low-energy cost, assembled together. Something like Lego or K-Nex (a popular children’s construction toy) gives an illustration (particularly K-Nex). [c] Then one would do well to make something that can easily be extended through all parts of the system, it can be easily disassembled and rearranged (and repaired), and its dynamics, indicating some correlation with information-value about the overall system in which this machine is built, can be easily measured. That measurement would ideally not have the “cost” of being another machine or machines that need to somehow be aligned spatially or temporally with the main machine that is representing the information.
How to do everything simply, efficiently, and optimally in the presence of relatively huge amounts of noise? How to actually employ that noise in a useful manner instead?

The suggestion here is to make such a machine that will be co-extensive with the whole system, physically, and where its structural changes hold the information content, for instance in its surface changes as it folds, bends, extends, contracts. A “random” measurement – an energetic reaction – of a conformational change occurring in one localized region can provide an indicator – a physical pointer in fact, through the molecular structure – of conformational changes in neighboring regions of the whole surface. Perturbations in the surface caused by “noise” introduced from without can be minimized, or the presence of that “noise” may be another carrier of information.

… [much more on this, in other papers and “under construction” – especially see selected References]

**Moving away from the entrapment of qubits and bits in general**

Information is not limited to digital representation, or rather, information (in-formation) is not equated with digital representation as a set of codes (which can have the use (meaning) of being either instructions (actions to be done by some machine or machines) or data (some object upon which actions are to be done by some machine or machines).

*Note: All the remaining material here consists of mainly “headline” items and shorter notes, because what is written already, previously on these topics is either too much to introduce here and now in this “introductory” outline, or else it is too rough, too many pits and holes and lumps, which need to be worked out. This is the big motivation for Dialog, Discussion, Meeting, Collaboration among the Right People who can pull all this together.*

*Rome was not built in a day. Nor the gothic cathedrals, the classic mosques, the huge temples. Nor was “Colossus” - the first real “computer” built by Alan Turing and his team at Bletchley Park during WW2 – designed or built by one person or only a few, and certainly not “overnight.”*

**Topological Information Resonance (TIR)**

Basic concepts:

- A mechanism that performs two kinds of I/O comparable to D/A (digital-analog) but here it could be termed, “D/T” – digital-to-topological. Information originating in some external system, represented in some digital form with n parameters in some functional relations to each other, is transformed into physical changes within the topology of a structure - bends, twists, rotations, knots.
- This mechanism processes information not by add, sub, shift, compare, etc. instructions but by how the structure changes its geometry in response to these continuous inputs and also the actions of making outputs from the “computing surface” through the inverse D/T – topological-to-digital transforms. There is not instruction set, no “data only,” and no “Turing tape.” The topology changes according to the rules of the chemistry and physics governing the material from which the mechanism is composed. Think about the different ways the following objects can have their surfaces (and volumes) "morphed" – wool blanket, sheet of cardboard, grid of flexible pipes and joints, mesh of screening, rope macramé wall hanging, array of carbon nanotubes, array of graphene.
- Certain topological conditions have “meaning” for the system in which this mechanism exists. These semantic relations are either learned (evolved, over time, the slow way) or else they must be trained into the system artificially.

How to build something like this? Perhaps a first set of steps is to examine the human brain and at how it does something seemingly “less cognitive” and also how it heals itself – by reorganizing its neural circuitry, in fact, in response to trauma. If a working model of a TIR-based machine (a TRP – Topological Resonance Processor) is needed (and it is), then it may be literally "inside our heads" right now, and we may learn a lot by examining what happens when things fail catastrophically.
Vision as example of Dynamic Geometric Assembly – a model for implementing a TIR-based machine

Information in a biological organism at the cellular level is all about some actions in response to some stimuli. This is also the case with anything involving neurons. Neurons do not hold "memories" of persons, places, things like a flash-stick holds images and files. Neurons perform reactions in response to certain stimuli from other neurons or other agents, and certain "constructs" that are the reactions to those stimuli result in more "constructs" in still other neurons. Some of them are expressible as words.

Vision offers an avenue for understanding that may be worth exploring because of so much research in the field, including in the medical and therapeutic disciplines, and because "vision" is something that is directly, personally, immediately experience-able (for most persons). Vision in the brain works not as image processing and file-object management in a computer, obviously. There is constant fresh assembly of stimuli, from rod and cone cells following pre-set neural pathways that trigger "connecting the dots" – and no mental image is made "as a whole" from one set of inputs through the eyes and visual cortex. It is not literally "connecting dots" but lines - verticals, horizontals, angulars – and this assembly leads to configurations, involving n neurons at a time, sharing similar activation states, and (suggested) similar internal configurations within their intracellular "topological computers."

There is a “resonance” and some type of “harmonics” - but it is not the simple physical resonance of two or more wave generators and their frequencies! Rather, it involves something of a topological similarity of state between multiple cells – involving geometrical rearrange-able components inside, and built out of proteins and connector molecules. "Resonance" just seems an effective word to use in describing what is going on, and in the case of vision, it involves multiple sets of neurons that get activated by partial assemblies of visual input stimuli, leading to parallel, competitive (in a way) and functionally-superposed (not actual quantum superposition, though) assembling of the partial data into a final "identification" of what it is that is "out there" in front of the eyes.

Exosomes and large-scale state-space topological-basis transmission of information in the CNS

This is an area of neuroscience that could have significant value for understanding a lot of the points sketched out earlier here, and especially for engineering a computing machine that uses TIR principles. Again, this may seem to be strange to bring into the discussion, because it may seem – at first glance – to be far afield of what is involved in building a “Generalized Computing Machine” or understanding fundamentals of quantum physics and quantum biology. Much of the work of interest here is based upon research by Chopp, Zhang, and others concerning exosome generation and transmission within the brain and throughout the central nervous system in response to trauma including stroke and brain trauma injuries. This became the basis of the VNT Project (Visual Neural Therapy). Here are a few excerpts to help explain the basics.

[From ref. 111, Chopp and Zhang, 2015]

“Recent discoveries of cellular generation of exosomes, small (~30–100nm) complex lipid membrane structures which encapsulate and transport proteins, RNAs, including microRNAs (miRNAs) have provided new insight in how cells within organisms communicate. These discoveries will likely have a major impact on the treatment of disease, with cancers and neurological diseases as evident targets. Exosomes provide a major medium of intercellular communications, and thereby there is potential by altering communications and instructions for protein production, we can employ exosomes to treat diseases. We now have an opportunity to treat neurological disease by modifying intercellular communication networks. Recent work demonstrating that the therapeutic benefit provided by stem cells for the treatments of stroke and traumatic brain injury depend on their generation and release of exosomes, provides a foundation for exosome-based therapy. Cell-free exosomes have also been recently employed to effectively treat stroke and brain trauma. The content of exosomes, particularly their miRNA cargo which can concurrently impact the post transcriptional regulation of many genes, can be regulated. We are at the cusp of capitalizing on this important means of intercellular communications for the treatment of diseases, such as cancers and neurological diseases, among many others.” [d]
The neuronal system embodies a self-modulating learning system that sustains, supports, and is based upon principles of plasticity and adaptive functionality (PAF) – the ability of the brain to reorganize certain regions to work on different functions in the instances where those functions have been disabled by injury or other degradation and degeneration. Further, the underlying mechanism to support such PAF involves coherent communication exchanges among many components of the whole (total) organism. Both of these statements pertain to what must be designed into a GCM and how some kind of TRP can be engineered. (But this does not imply that such a TRP must be a “wet” device involving neurons and exosomes.)

The brain reflects the many processes that are operating in parallel, and the brain issues signals, especially in the form of exosome releases, along with conventional neurotransmitter-based messaging, that can affect the plasticity and adaptive functionality of other regions of the brain and other system centers in the body. Furthering the hypothesis (speculative as it may sound to some) this coherence basis involves biological mechanisms of quantum entanglement at the macroscopic level of molecular networks and this is a kind of macroscopic analogy to the “Bose-Einstein Condensate” effect (coherent quantum entanglement resonance; CQER). But this may be precisely what is provided in an Orch-OR mechanism inside living cells, employing a cellular-scale type of quantum-potential/pilot-wave control mechanism (calling it for now “CQER”), in this case operating on molecules and how they will bind and conform, instead of operating on photons and how they will behave as being more wave-like or more particle-like. Further, that CQER control mechanism appears to be not unlike what is mathematically and computationally demonstrated in randomized algorithm-based cybernetics such as SPSA, local voting protocols (LPV) and topological clustering [ref to MD and Granichin papers].

Getting back to neurobiology and medicine for a moment, the key point here is the brain's innate plasticity and adaptive functionality (PAF). This is a natural feature of the CNS and in particular the brain. The ability to, in essence, rewire and reroute itself, functionally, in terms of processes. But the brain's PAF is very sensitive in order for this to work in the first place, and thus it is very easily affected by other factors including a wide variety of chemical effects which originate either from outside the whole system (body) or are generated within. In a way, this sensitivity can be described as sensitivity to noise, but some of that noise does get interpreted as information. The discrimination logic, of what to count or discount, is a major challenge in both neuromedicine and in any GCM engineering. A potentially useful model developed in the context of this “VNT” research (2015-2016 and in a “holding pattern” presently) is mentioned in note [e].

Re-emphasis of a non-bitwise representation of information taking place in TIR and in brains
The sentence from above is repeated for emphasis: Information is not limited to digital representation, or rather, information (in-formation) is not equated with digital representation as a set of codes (which can have the use (meaning) of being either instructions (actions to be done by some machine or machines) or data (some object upon which actions are to be done by some machine or machines).

The brain is not processing images, sounds, other sensory inputs as bits or bytes or strings. Nor is it using a Turing model of computation for assessing damage and sending commands in the form of exosome signal-objects to initiate “repair by rewiring.”

A topological mapping and representation may be how the brain as a massive network of connected surface elements – both inside cells and in their local-cluster networks and in larger and larger “sheets” of TIR-surfaces – does its computing. But of course, brains can do quite well at Turing-style computations. Humans can add, subtract, multiply, sort, and do all sorts of instruction-based, step-wise algorithmic actions. But these functions are something of a “special case” of what has been developed through the use of language and language-like symbols. It is as if the brain has a network of TRP computers, a massively parallel network, and over time, special functions developed that led to Turing-machine computations being done inside the brain. Henceforth, people built machines that emulated those functions, resulting in the computers of the last century and what are in use today. But to look toward the future, it may be necessary to break free of bits, bytes, strings and instruction sets and look again at how brains began learning and recognizing, “before” language and arithmetic.
**Transforming information into topological dynamics and structure**

This is one “heart of the problem” and it has been mentioned previously in these notes. But before there can be physical “circuits” there needs to be something like a Process Algebra that describes the operations that must take place and how to distinguish them from one another. Such an algebra must work with operations that result in changed shapes and orientations, such as operations performable on chains of polymers. This can begin in the abstract and then move toward selection of some materials that behave in ways that suit the algebraic operations. There must be a way to take some values coming in numeric form and convert them into group rotations (for instance) affecting 1 to n contiguous segments of some chain. One operation may result in x number of rotations or n-degree twists performed consecutively over y number of elements in a long chain. Consider for example as a “toy model” (pun intended) the rotation-combinations possible in a simple-geometry chain such as the Rubik Snake, a common puzzle toy (and a follow-on from the equally interesting Rubik Cube). With a chain comprising only 23 elements (“prisms” in the Rubik Snake), there are 6,770,518,220,623 (≈ 7×10^12) possible positions, eliminating prism collisions (physically impossible to execute) and mirror images. An association of different sequences of operations within one such chain can lead to many composite shapes that could in turn represent (as model m) different states of the external system (S) which is the source of information coming into the molecular “engine.”

But why are any particular shapes (of anything) considered to be information-bearing? It all has to do with the associations of those variant topologies with some external object – the meaning, the semantic connection. This does not happen automatically. It is somehow learned.

**How the topological structure can “compute” internally and create New information**

Consider that after n “cycles” of activity, involving inputs coming into the topological structure T that now holds representation of external data in its surface geometry, there should be some action which creates as its effect a new surface in T and this is new information pertinent to the external system being modeled (controlled). The idea here is that the object T can be modified according to certain rules which relate to the physics and chemistry of that structure (e.g., a protein-polymer conjugate array). These rules must be finite and sufficiently discernable from one another, and they must be part of the process algebra that
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

governs how these changes can occur, in response to what type of external signals applied to T. But this also means that there must be some type of correspondence between these operations and what can be expected to occur within that external system S which is the source of the information coming into T in the first place.

_Transforming topologies into information signals for other computing systems_.

Obviously there needs to be a way to reverse the information “transcription” so that what is encoded in topological features can be put into some digital representation, getting back to the world of numbers and strings. One of the challenges is how this structure can be “read” in a manner that reflects the changes made to its geometry. One possibility could be a variant of the basic principle behind atomic force and scanning tunneling and related surface-force measurement microscopy. Perhaps there is a place here for PRMC – piezo-resistive microcantilevers – of the sort developed for ultra-sensitive detection of specific molecular compounds [refs to Dudziak re: PRMC and NomadEyes and also with Thundat et al]. Measurements of a surface, translated into peaks and valley and other features, which can be performed in parallel, electro-optically, and then those features are given to a numerical processing engine that has all prior time-interval views and measurements of this surface with which to make comparisons.

Again, this all points to some finite set of operations that can be a language of topological dynamics that is associated by some type of mapping with the external system driving the whole computation. And that external system should be as unconnected to the physical properties of the TIR processing environment as any software program consisting of instructions with variables and constants is unconnected to the data coming in as input to that program.
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

**Complex Macroscopic Building Blocks**
The third set of key points concerns processes that are at the scale of organisms and composite organic structures (e.g., brains and central nervous systems) and sets of those organisms (population groups, ranging from 2 to n). But at this scale is where one can begin to think of synthetic devices that perform similar functions to those executed within cells and organized groups of cells.

**A Topological Resonance Computing Processor (TRCP)**
Computation that involves surfaces, shapes, and topological features like knots and where features do not change their topological nature in the course of surface (volumetric) dynamics.

This gets back to making a topological description of systems as composites of active state-space regions. These regions are definite by parameters and their relationships as defined within some models. The abstract surfaces and volumes can be manipulated as dynamic-bounded cellular automata networks (clusters). Each cluster is a region within the state-space of the system being modeled. A topological cluster connects some finite number of parameters within some ranges over their potential values, where by definition of the model there is some relationship between these parameters. In the TRP as a physical device, we need to do this clustering and have a way to measure their features – 3d features and relative locations to others. It becomes a kind of topographic mapping problem in a manner of speaking.

**Some thoughts about surfaces and spaces for a TRCP**
Any system that we want to control actively or passively (e.g., purely to simulate) can be represented as an m-dimensional surface (c-surface, control-surface) in an embedding n-dimensional space (e-space). These spaces can be divided, randomly or following a structured pattern, into cellular regions that have defined borders with one another. The borders of the regions are significant as indicators of approaching criticality points and catastrophe regions. There may be inexact, imprecise elements to this mapping transformation but it will be approximate and sufficient.

So we have the following:
- **embedding-space** (e-space, E) : n dimensions which pertain to the parameters of significance within the space.
- **control-surface** (c-surface, C) : m dimensions which pertain to the parameters of significance within the surface.

In all cases $m < n$, $n \geq m+1$

Example: Consider an airplane wing as one example of a c-surface. It has a continuous surface (upper and lower) that is wrapped around its frame. (We omit for this exercise the region of the wing that is connected to the airplane fuselage.) This surface is mappable to a simple 2d surface. This in turn can be wrapped around a sphere. Measurements such as air pressure may be made for points on this wing surface at different intervals. These values may be represented as positive or negative values in a third dimension and the resulting geometry of the wing-as-sphere will be a rough, curved, fuzzy spherical surface that has peaks and pits, hills and valleys on its surface. Although there may be additional parameters (and thus dimensions) introduced into the c-surface representation, we will presently omit others beyond air pressure, within this example case.

The e-space is the physical environment, the 3d world in which the airplane operates. It may have a higher dimensionality based upon known parameters of significance that include air pressure, wind velocity, air temperature, humidity, and other measurable data.

Control of the wing will involve changes in the air pressures for all the measurable points on its surface. In terms of the general, abstract, topological model, we need to change the shape of the ball (sphere) and the fractal-like dimensionality of its surface, to some optimal values that will be desirable for how we want to manipulate the wing in flight.

We may know in advance an optimal configuration for the c-surface in its ball-like representation, or we may need to experiment with a variety of topological configurations. We do so by working with a model
that is simpler and easier to manipulate in two forms of computation: numerical calculations using a simpler geometry where the model approximates the c-surface, and also what can be called topological computation (conformational analog computation) that is non-numeric and involving a physical analog to the c-surface that can be manipulated in its geometry; it works on the basis of similarities of geometry between the computing model and the c-surface, and the execution of conformational changes within that model that reflect the mapping of similar changes in the c-surface. (It is also referred to as the “pantograph” model of computation, by explicit analogy to the drafting instrument known as the pantograph.)

Figure 2 – The classic pantograph

Can a “pantographic function” be built into the TRCP for transferring one set of information, from a model that is running in the control of some external system, into a different order of representation, where the model is “intact” but now it is a topological representation in a molecular array and not an array (for instance) of numbers?

Fabrication and communications from the digital/analog world into the TRCP and vice versa
As a general-purpose device, something to be used outside of “interesting laboratory demos,” the TRCP must meet the same kind of requirements as in the mainstream semiconductor manufacturing world.

An area to consider is MEMS because this is mature in design tools and also fabrication. The question is about what new things are going to go into a TRCP (such as some protein array structure) and how is that going to fit with the electronics manufacturing process.

This is where graphene circuits come into the picture. Perhaps the digital computing world is interfaced through a graphene layer to which the topologically active protein-polymer conjugate layer/layers is built. Graphene is promising for both conductivity and switching and in a manner that would appear to be suitable for the nanometer-scale layering and interfacing required for a TRCP.

A Generalized Computing Machine (GCM)
(From a recent paper) [Dudziak, CoDIT-1]
The Generalized Computing Machine (GCM) is a heterogeneous architecture that operates by performing both types of computation tasks – numerical and topological. These involve digital and non-digital processes. These may also be described as discrete and continuous. The digital computations are what are performed in a conventional “Turing Machine” (TM) type microprocessor. The non-digital processes are performed through a microfluidic MEMS device that employs molecular conformation actions involving the translation of digital information into electromechanical actions within a set (array, field) of molecular components [refs 12,13,14 from the CoDIT paper#1]. These molecular structures can change conformation and those changes can be measured and translated into digital signals that will serve as command and control values for processes governing the behavior of the c-surface system that is the
object for control. This type of device, is the subject of current design research and is modeled upon microfluidics employed for DNA and DNA amplification as part of the standard procedure of the well-known polymerase chain reaction (PCR) used in nucleic acid sequence matching [refs 15,16, same paper]. For simplicity the entire process can be described as “Topological Computation.”

For now there is this next figure (3), an illustration of the steps toward engineering a GCM (@ August, 2017), A starting point.

**More on the Topological (Resonance) Computing Processor (TRCP; TCP within the GCM)**

(From a recent paper) [Dudziak, CoDIT-1]

This may be considered as the analog to a digital program that embodies a discrete algorithm. However the TCP has both digital and non-digital components (as described earlier, above), insofar as it is implemented within a computer that must interact with other architectures (e.g., RISC machines).

An Embedding-space (e-space, E): n dimensions which pertain to the parameters of significance within the space.

A Control-surface (c-surface, C): m dimensions which pertain to the parameters of significance within the surface.

For a given problem (application) there is one e-space and there may be multiple c-surfaces operating within that e-space and also interacting with one another.

The first stage of TCP defines the control environment model:

[1.1] a set of models of the e-space E:
representation-model (r-model; all that can be represented, but not necessarily changed or transformed within E)

transformation-model (t-model; all that can be manipulated and changed within E)

[1,2] a set of models of the c-surface C – and C may consist of one or more c-surfaces  \( C_i := \{C_1, C_2, \ldots, C_x\} \)

- representation-model (r-model; all that can be represented, but not necessarily changed or transformed within \( C_i \))
- transformation-model (t-model; all that can be manipulated and changed within \( C_i \))

The t-models are subsets of their respective r-models.

For both sets of models, for both \( E \) and \( C \), there is a definition of the parameter sets within each type of model.

\( P[e] \) is the parameter set for the e-space and \( P[c_i] \) is the parameter set for each c-surface \( C_i \) within \( E \).

\( P[e] \) constitutes all the parameters of \( E \) that matter in the problem, and also, which may be targets for modification also. (Bear in mind that within any system "world environment" of an e-space and one or more c-surfaces, it may be that there can be significant changes to the e-space introduced by one or more c-surfaces. (Example: planes taking off and landing at an airport can easily affect the wind space (which is part of the e-space) creating turbulence that will in turn modify the e-space and affect other c-surfaces (other aircraft taking off and landing).)

The \( P[c] \) are the parameters that matter in the problem for the c-surface \( C_i \) and which are potentially modifiable, controllable. Normally each \( P[c_i] \) will be the same parameter types, the same dimensionality (e.g., all the the objects represented by the c-surfaces are the same things – UAVs, UGVs, airplanes, ships, social groups, financial networks, etc.)

The parameter set of a t-model is a subset of the parameter-set of an r-model, since there may be parameters within the r-model that are not computable or not modifiable.

So we have four types of parameter sets:

- \( P[e]^r \) = all knowable parameters of the e-space \( E \)
- \( P[e]^t \) = all transformable parameters of the e-space \( E \)
- \( P[c]^r \) = all knowable parameters of the c-surface \( C \) (and \( P[c]^r_i \) is for one c-surface \( C_i \))
- \( P[c]^t \) = all transformable parameters of the c-surface \( C \) (and \( P[c]^t_i \) is for one c-surface \( C_i \))

[2] The second stage of the TCP – mapping complex surfaces to simple spheres

Mapping the c-surface(s) to spherical surfaces is a numeric process. The \( C_i \) is mapped from its objective geometry (e.g., a component of an aircraft, automobile, or other device) onto a surface that can be approximated to the surface of a sphere. Next we look at the smooth surface and introduce the values for some parameter of interest within the set \( P[c]^i \). This results in a change to the surface of the sphere – a third dimension, the peaks and valleys. If there are additional parameters within \( P[c]^i \), then these can be introduced, and now the dimensionality of the surface is increased, but it is still always less than that of the e-space in which this sphere is embedded. This yields one or more c-surface spheres (or simply, "c-spheres") within an e-space.

These are simplifications of the c-surfaces. All of the relevant parameters in \( P[c]^i \), have been transformed from the geometry of the original c-surface to points in a surface wrapped around a sphere, and these points have additional dimensions of zero or some value relative to the flat surface of the c-sphere. Now any computations done with respect to the interactions between a given \( C_i \) and its \( E \) or between multiple \( C \) can be performed in the model of simpler-geometry, simple-topology c-spheres.

[3] The third stage of the TCP – modeling the behavior and interactions of spheres with the embedding space and with other spheres in that space

The next step is to compute how the parameters of the e-space and any other c-spheres that must be taken into account are affecting the features of a given c-sphere. We want to establish functional relations that move from some \( P[e]^r \) to some \( P[c]^t \).
This is the major task of the GCM. Modeling at the simple level of c-spheres within the e-space, and then translating the results into answers that can be interpreted and transformed into actions which effect new types of control of the objects represented by the c-spheres.

There are both digital-numerical computations and analog-topological computations that can be employed here.

In any case, a comprehensive system model is needed for the interactions of both the e-space and the c-surface (or c-surfaces). In this process we must develop within the model his requires identifying those parameters that can be altered, and in the process separating them from those that cannot be modified. This separation process will have been used in the process of creating the simplified environment of c-spheres and e-space – thus, we are at this point concerned with the following processes:

How $P[e]^r$ affect the behaviors of the c-spheres
How $P[c]^r$ affect behaviors of other c-spheres and e-space
How $P[c]^t$ can be altered for a given c-sphere
How $P[e]^t$ can be altered

**Heterogeneous processing that includes TRCP (TCP)**

The TCP is a major component and a different type of computation within the GCM but the GCM also includes other types of machines, in the same sense that many microprocessors since the early parallel processor, the transputer [], combine radically different ways of manipulating arithmetic and string data, all within one integrated engine.

**Numerical computations:** This is where cellular automata can be applied for modeling local neighborhood interactions. It is also where inverse methods can potentially be used, similar to their applications in signal processing and imaging. The goal is to determine how some parameters within $P[e]^r$ are affecting (interacting with) some features in the c-surface. However, this step may be optional. Perhaps we do not need to examine this aspect of causal relations, if we are only interested to find ways to alter the properties of the c-surface.

**Topological computations:** With a representation of one or more c-spheres, this representation includes the c-sphere geometry and its dynamics – how it can change shape under specific metrics – conditions that can indicate singularity points emerging in the state-space even though unpredicted by any of the established models (set M) that already may exist. This is an important point – setting up a method that can “notice” when anomalies are occurring that do not fit any pre-existing model m.

Now we need to translate that into the component of the GCM that can “resonate” geometrically, topologically, with that c-sphere, changing its conformation in a way that can be understood as a direct mapping. We can call this the TPU of the GCM – the Topological Processing Unit. This is the similarity-simplication or “pantograph” function that must be performed. (The TPU is the same as the TCP.)

Once we have “set” or “initiated” the state of the TPU, we are able to apply inputs to it in the form of physical energy signals that will cause the TPU to modify its physical shape and perhaps other properties that occur as a result of conformal shape-changing.

These signals are of two types or classes:

-- what we know from the actual objects represented by the c-spheres, or what we can compute digitally to be some “next projected states”

OR

-- what we want as some future-states of those objects, and we want to use the TPU to non-algorithmically compute how the objects should behave. Thus we will want to know how the simplified c-spheres should behave, and from those states, we can translate information to the actual objects as commands, modifications to whatever subsystems in those objects can do things like change trajectory, velocity, or other parameters which are essentially of the class $P[c]^t$.

What makes the GCM “generalized” is its ability to compute functions by using geometry, by topological shape-changing that mimics the non-discrete, non-digital “analog” behaviors of a theoretically unlimited variety and number of objects which each change some element of shape (position) – some element or
elements involving position relative to some embedding space in which the object exists and functions.

Thus, the TPU modifies its geometry in a manner that is determined to be consistent with the ways that the c-spheres can be modified, and this models the more complex behaviors of the objects that are reflected in the c-sphere parameter sets and their dynamics.

The new shapes of the TPU are what has been computed on the basis of then translated into modifications of the digital c-spheres. We translate from the TPU into making changes in those parameters for both the c-sphere(s) and the e-space, and these changes are in the parameters known as P[c]t and P[e]t respectively (since these are the modifiable parameters, about which we can effect alterations). The process of going from the TPU to the c-spheres and ultimately the actual objects of interest is a reversing of the original information path leading from those objects and their behaviors to the TPU inputs that trigger its conformational changes.

From the new states of E and Ci, we can now either control the future behavior of the Ci or we have a better understanding of what there is which we cannot or should not control or pay attention to. This information can now be incorporated into meta-level heuristics and rules that then influence (limit) the stochastic searching and approximation methods used on testing local clusters. This the system can be self-modifying, self-learning. The assumption throughout is that we have achieved these new states (changing the actual objects or having the knowledge of how they can, should or will change) by means that are computationally less time-consuming, and less resource-demanding, than to approach the problem using conventional Turing Machine (TM) computers.
Super-Complex Macroscopic Building Blocks
The fourth set of key points concerns larger and more complex systems that employ some kind of TCP (TPU) and which possibly could not function without such a type of computing internal to the system. First there needs to be a “stepping back” from having one’s eyes glued too tightly to thinking that any kind of GCM must be designed in “firm”-ware like the microcircuit logics of computing machines built in the past and present, which could be called a “static” design process. Perhaps the Machine needs to be able to require itself from time to time, as indeed is seen to be the case with biological brains, both during normal embryonic and infant development and in response to injury and disease.

Can very complex systems exist without something like TCP within their cybernetic architectures? Certainly many can and do quite well without Turing-type computation – again, biology is the demonstrator. But can certain levels of complexity exist, in Nature, or in any synthetic engineered system, without a basis for information processing that is works like what has been suggested and outlined above, leading to some kind of topological, surface/field representation and processing? Included here is the whole dimension of using randomness and stochastic selection, measurement and evaluation, which may be the most effective (only reliable) way that any system evolving over many generations (e.g., biological evolution) can accommodate real novelty, significantly new and qualitatively different features like body appendage shapes, methods of locomotion, spectral ranges for its different sense-organs, etc. If change over time is going to introduce random features into a system, its control mechanism must have some way of adapting to the randomness of both its environment and its internal structures. If the control system cannot adapt freely, then it will likely fail. Biology gives countless examples of this.

Brains and Cognitive Processing as a type of Parallel TCP Array
The same questions can be applied to the complexities of neural and specifically cognitive processing inside biological brains. Does reasoning require non-algorithmic processing? Does the thinking that creates “Turing machines” and their hardware and software, require neural processing that is dependent upon an “entanglement” and literal “con-fusion” of configurations of neural activities (dynamic, not static states) that are processed as surfaces and volumes and not as fixed data structures?

There are recent developments that could point to how TCP is engineered in biological brains and this can be useful for thinking about how to design TCP as smaller components, independent of biology. Among them is fractal catalytic theory (FCT, aka the soliton-catalytic model) as advanced by Davia and Carpenter as a “theory of cognition grounded in metabolism.” This appears to tie in very well with autopoiesis system theory (Maturana and Varela) [115,116] and in fact the latter theoretical work is a basis for FCT 114]. A second development is that of neuronal group selection (NGS, as developed by Edelman, Fernando, Hayek and others [117,118].

Fractal Catalysis – self-organizing functions in biology including the brain
Within FCT, enzymatic catalysis is a “prototypical process” extending through all levels of scale in biological organisms and involved as much in the cognitive processes of the brain as in elementary catalysis at the molecular scale. In this approach, energy and structure “become synonymous in complex biological structures via a self-organizing, multiple-scale catalytic process (thus: bioenergetics = bioinformatics) – the proposed mechanism involving the catalytic action of soliton propagation in (biological) excitable media” [113]. Again, there is a suggested role in information processing at the molecular scale, in conformation-transforming (topology-morphing) processes (proteins) that involve non-dissipating waves (solitons) for the efficient transfer of energy [cf. Brizhik et al]. The fractal catalytic theory addresses problems associated with brain function that arise (as problems) from an assumed distinction between function and metabolism, by arguing that such a distinction does not exist; i.e., the function is the metabolic process and that is catalysis.

“a catalytic theory that grounds cognition in biology, building on the proposals of (a) Gibson and ecological psychologists concerning the role of invariance and (b) Shepard, Gestaltists and neuroscientists concerning the role of ‘resonating’ neural waves. Enzyme catalysis increases the speed of a molecular reaction, perhaps via a type of wave, a soliton, whose formation, persistence and form depend on the structural invariance of its environment. Generalizing to cognition (Davia, 2006), the waves of neural activity constitute a catalytic process, with the organism’s perception-action invariance playing the role of the environmental
structure. This ‘generalized catalysis’ is a process by which an entity mediates its environment and is the organism’s experience.” [114]

There are two suggestions here: First, that FCT can be better understood in terms of these catalytic processes being part of topological structure comparisons, matchings, and a physical resonance between networks or layers of neurons. Second, that something about how to physically implement some type of TCP (TPU) can be learned by examining how in the brain there are neural activities and relatively stable patterns of activity, maintained in a “noisy” environment, as proposed by the FCT.

**Neuronal group selection – morphogenesis and self-organizing leading to neural plasticity**

Additional insight into how some type of TIR is occurring as a “basic mechanism” within biology and in a “fractal” type of scalability, from the relatively simple domain of immune recognition and response all the way “up” the scale into the learning, memory and cognitive functions of the brain, may be found by looking at the work initiated by Edelman [117,118 ff]. The initial research was in immunology and demonstrated how populations of lymphocytes capable of binding to some foreign antigen are increased by differential clonal multiplication following antigen discovery. The organism is thus capable of creating complex adaptive systems as a result of local events with feedback. Extending directly from the immunology studies, Edelman proceeded to develop what is known in the vernacular as “Neural Darwinism” - a theory of “neuronal group selection” (NGS). Consisting of three major components, NGS proceeds in development from a “basic matrix” to a stable but plastic, adaptive structure:

1. **Anatomical connectivity in the brain develops via selective mechano-chemical events which in the mammalian brain occur epigenetically during embryonic development.** This creates a “template” of neuro-structural diversity anatomically, and postnatal behavioral experience feeds further epigenetic modifications in the strength of synaptic connections between neuronal groups. Reentrant signaling between neuronal groups allows for spatiotemporal continuity in response to real-world interactions. With neuronal heterogeneity (by Edelman called degeneracy), it is possible to test the many circuits (on the order of 30 billion neurons with an estimated one quadrillion connections between them in the human brain) with a diverse set of inputs, to see which neuronal groups respond “appropriately” statistically.

   Functional “distributed” (widespread) brain circuits thus emerge as a result. Cell adhesion molecules (CAMs) and substrate adhesion molecules (SAMs) on cell surfaces provide the mechanism that allows cells to dynamically control their intercellular binding properties. Such surface modulation allows cell collectives (clusters, local groupings) to effectively "signal" as the group aggregates. This in turn aids in the control of further morphogenesis. So morphology depends on CAM and SAM function, and CAM and SAM function also depend on developing morphology. Edelman theorized that cell proliferation, cell migration, cell death, neuron arbor distribution, and neurite branching are also governed by similar selective processes.

2. **The basic anatomical structure of the brain is more or less fixed, but there will be functionally equivalent albeit anatomically non-isomorphic neuronal groups that are capable of responding to certain sensory input.** Perhaps in very similar ways, or perhaps rather differently in terms of output results. The result is a “cooperative-competitive” (“coopertition”) environment where circuit groups which are proficient in their responses to certain types of inputs are "chosen" through the enhancement of the synaptic efficacies of the selected network – an optimization of the network of the whole brain. The more that there is a strong “proficiency” by a certain circuit group, the greater is the probability that the same network will respond to similar or identical signals at some future time. This reinforcement involves the strengthening of neuron-to-neuron synapses and brings us back to somewhat “classical” neural network theory. But herein can be seen the foundations for how the neural plasticity observed in neurorestorative medicines and therapies (e.g., Chopp, Zheng et al) and mentioned earlier (and see Notes [e] and [f] below) can actually work – why they occur, effected through the communication signaling of exosomes. This can also point to how a TCP (TPU) device can have some “plasticity” as indeed it must have. How to physically implement this in terms of circuits is part of the research ahead, of course.

3. **The third component of neuronal group selection theory attempts to explain the experience of spatiotemporal consistency.** Things are contiguous and adjoining, or separated, and this is critical
to any type of pattern recognition and learning. Edelman termed this process as “reentry” and devised a model of “reentrant signaling.” Sampling of the same stimulus event occurring at different points of spacetime are correlated in time by multiple (diverse, separated) neuronal groups. This creates a parallel, asynchronous, and asymmetric sampling for some given stimulus set and then there will be communication between these disjunctive groups with incurred latency.

Back to Orch-OR and non-qubit quantum processes enabling TRCP

Both FCT and NGS are deriving from neurophysiology and the study of “brains in action,” namely, observable systems interacting with external, and highly complex and nonlinear, environments. They do not address directly how things function at the molecular scale of intracellular or intercellular types of interaction (e.g., previous remarks here throughout have talked about TIR and quantum entanglement and coherence such as Orch-OR processes). Both FCT and NGS appear to be consistent with and supportive of one another, and with what can be taking place at those lower physical scales. In other words, some type of TIR can be the process taking place within cells and among cellular-automata clusters, effected through quantum entanglement in molecular arrays. The collective action over a large network of TCP functional units, with high degrees of connectivity possible and existing as such (as is the case in biological brains), enables the topological-based classification and discrimination that is at the heart of both identification and recognition (“re-cognition”) for all sorts of patterns and thus what are termed percepts, objects, concepts, ideas. At a larger scale, now with groupings of neurons, there will then emerge phenomena such as are observed within FCT and NGS.

Some additional direct quotations from Carpenter and Davia (2006) may be helpful in this last regard:

“Initially during catalysis, the enzyme binds with the reactants, forming an enzyme-substrate complex. Enzyme catalysis requires the precise application of energy along a reaction coordinate, and how this occurs is still a matter of research. Previously it was believed that the enzyme facilitated the reactants going to an intermediate configuration, the transition state, solely via a classical process that influenced the height of the energy barrier. However, this common textbook explanation is no longer accepted as sufficient or complete for catalysis at physiological temperatures. Recent research suggests that a vibrational mode of the enzyme-substrate complex facilitates the transition... It has been proposed that the vibratory mode involves solitons or soliton-like waves... The protein chains of the enzyme may support soliton waves that alter the conformation of the enzyme-substrate complex, affecting the width of the energy barrier. The conformational change lessens the distance between specific parts of the enzyme and thereby lessens the distance between the molecular reagents that are bound to it. This shortening increases the possibility of ‘quantum tunneling’ and increases the reaction rate. This occurs because quantum mechanics treats a particle as a probability-wave function. A particle cannot exist near a barrier without its wave function extending into the barrier. If the particle is near a barrier, and if the barrier is narrow enough, the wave function may extend through the barrier completely. Thus, there is a chance that the particle will disappear from one side of the barrier and appear on the other side, which is quantum tunneling. Classical and quantum solitons have similar properties, which may assist any transitions between quantum and classical processes. Pragmatically, this observation helps us to circumvent the debate about how widespread quantum processes are in neural and biological systems (Tegmark, 2000).” [114]

Control of extreme(ly) complex systems (XCS)

A GCM, with truly heterogeneous computing capacities, appears to be what is necessary for true “AI” which can be restated as Adaptive Synthetic Intelligence – not static but adaptive, and not so much “artificial” as being a synthesis of what Nature has already “designed and built.” The following abstracts from recent papers give some indications. The whole challenge of “XCS” in the world of society and economics is what provides the driving force for a GCM. It is not a “thought experiment” for the sake of intellectual satisfaction on anyone’s part, not some Faustian impetus to create an “artificial brain,” but a motivation to build tools that can be employed to handle problems that can be extreme threats to both individuals and society as a whole. (Cf. Figures 4 and 5 below for more on this.)
Multi-Scalar Multi-Agent Control for Optimization of Dynamic Networks Operating in Remote Environments

M. Dudziak, G. Kurtz *

Abstract—Multi-agent control systems have demonstrated effectiveness in a variety of physical applications including cooperative robot networks and multi-target tracking in high-noise network and group environments. We introduce the use of multi-scalar models that extend cellular automation regional neighborhood comparisons and local voting measures based upon stochastic approximation in order to provide more efficient and time-sensitive solutions to non-deterministic problems. The scaling factors may be spatial, temporal or in other semantic values. The exercising of both cooperative and competitive functions by the devices in such networks offers a method for optimizing system parameters to reduce search, sorting, ranking and anomaly evaluation tasks. Applications are illustrated for a group of robots assigned different tasks in remote operating environments with highly constrained communications and critical fail-safe conditions.

I. INTRODUCTION

Keywords: complex systems, uncertainty, stochastic algorithm, randomized algorithm, cooperative network, device independence, space robotics, command and control, multi-target, artificial intelligence, machine learning

Simply put, singularity events can be more sharply and irreversibly catastrophic. Certain singularities may be triggered by the inability of the control system in a relevant portion of the network of devices to detect anomalies and variances which could otherwise be met with a counterbalancing response that would compensate for the variance and enable the critical state to be avoided [9]. This inability may be the result of a deterministic sampling algorithm or a dependence upon certain heuristics; this has been one of the classic criticisms of neural network based pattern classifiers and recognizers [12].

The goal of reducing a complex state space is a challenge in any environment where there can be uncertainty or fuzziness with regard to that part of the state-space where anomalies and masking events may occur and further disturb or imbalance the relations between parameters which may be inherently noisy or difficult to measure under any circumstances. A "masking event" can be virtually any parameter p or set of values \{p, q, r, \ldots\} that causes a minimization of system resources (computational or otherwise) that in turn decreases the ability for some other 4p, where such variances may cause critical points to emerge within the same or other portions of the state-space [15].

Risks of system instability and criticality are further exacerbated by conditions that can be introduced from external agents and unpredictable configurations into which even a well-designed and well-tested system (e.g., aircraft, rail, satellite, wireless network) may be placed. External-origin disorders and failures increase in relation to not only complexity within a control system model and its physical and computational implementation, but also in response to other paths to vulnerability [1, 6].
Topological Clustering as a method of Control for Certain Critical-Point Sensitive Systems

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Abstract—New methods can provide more sensitive modeling and more reliable control, through use of dynamically-alterable local neighborhood clusters comprised of of the state-space parameters most disposed to be influential in non-linear systemic changes. Particular attention is directed to systems with extreme non-linearity and uncertainty in measurement and in control communications (e.g., micro-scalar, remote and inaccessible to real-time control). An architecture for modeling based upon topological similarity mapping principles is introduced as an alternative to classical Turing machine models including new “quantum computers.”

Keywords—cybernetics, control system, stability, multi-agent

I. Introduction

In a seminal paper of a decade ago, “Mathematical Models of Catastrophes: Control of Catastrophic Processes,” Arnold and co-authors [1] present what may be considered as the starting basis and platform for identification of a class of complex problems characterized by extremes, critical points, singularities and catastrophic functions. These may be named Extreme Complex Systems (XCS). Arguments can be made that such systems are more prevalent than perhaps previously seem to be more important and at the same time more trustworthy they do not depend on the details of the functioning system, whose mechanism and parameters may be insufficiently known.

The mathematical theory of singularities is this part of the contemporary infinitesimal analysis, without which a conscious management of complicated and poorly known nonlinear systems is practically impossible.” [1]

The systems we term XCS may be fundamentally different from many other systems that exhibit complicated behavior, even complexity, but without the unpredictability of change and diversity in how key parameters and parameter relations matter in the control of the system as a whole and its components. The extreme behaviors that matter here are those that can tip the whole system “on its head” and “onto the floor,” metaphorically speaking. These are not necessarily (or only) concerning scalar values in one or more state-space variables, but involving relationships between system parameters that may radically affect the utility of any prior-established model that is employed in a control system. If control must shift between models and key parameters and the borders of those model utility-spaces are poorly known, this can lead to loss of control, turbulence, instability, catastrophe.

[xx-Dudziak-CoDIT-2018-1]
Applications of TIR and GCM into Technologies and Markets

It should be understood that this is about directions in which others can carry forward what can be produced by the research program (described in sections below in this document) which will build the New Machine.

But there is a very important point here that must be underscored:
The nature of this research and its engineering output success depend upon having a set of applications to use as guideposts all through the whole R&D process, for the theoretical work and for the experimental tasks. Borrowing some concepts and practices from the proven-success world of software engineering, this may be called the “Use-Case” and Validation Requirements – having target applications that can be studied as part of the design process, and which will be used to provide verification and valuation that the system being designed and built will actually match and fit the cases of how it can be used.

There is also the AGILE Requirement. This is about project management and execution, and it is very important for successful research and engineering. The “Agile” methodology also derives initially from formal software engineering and team-oriented projects. It provides ways for people to work together more effectively on things that have sometimes “rough edges” and “undefineds” in the tasks.

Implications of TIR and GCM (TRP) for other problems (and opportunities!) in science, technology, engineering and mathematics (“STEM”)  

Several examples are mentioned here:

Cooperative Robotics
     ASTRIC – space-based robotic operations with asteroids and other space objects
     ECOS (including AgriBrains) – environmental sensing and monitoring, data fusion, and adaptive intelligent operations for control and optimization of various agricultural production tasks
     [These are described elsewhere – plenty of recent papers and presentations at different conferences – for instance, some can be found at http://mirnova.org ]

Biomedicine
     Cardiovascular monitoring and early-warning
     Epidemiology – pandemic distribution and tracking
     Drug design and advance-modeling of clinical trials
     Vision-based neurorestorative therapy (stroke, dementia, brain trauma)

Autonomous Vehicles and High-Density Traffic Management (not only for cars and trucks)
     Meta-level adaptive intelligence operating “above” conventional-AI running individual vehicles
     Adaptive synthetic intelligence that is massively multi-agent, cooperative, competitive, addressing traffic flow planning and optimization

Nuclear Fusion and Novel Radioisotope Production
     Already the subject of investigation based upon aspects of what we are seeing in the role of stochastic, randomized processes in natural behaviors of nucleons [], and in evidence of comparable behaviors involving the nuclear structures of heavy atoms within amino acids and proteins [], and with implications for how things can be effected in an artificial system for enhancing fusion of hydrogen into helium.

Predictive Analytics
     Population dispositions, trends, reactions to events and pronouncements (including legislation)
     Financial security and currency markets
     Social network media reactivity and trends
     Product marketability, acceptance, reaction

Education including internships, apprenticeship, entrepreneurship
     The whole process of building a GCM requires “trans-generational” thinking by those who are doing it, and there needs to be a place for all levels of incoming junior-level, student, apprentice people into the
activities. This cannot be done the “old way” – the research gets finished, formalized, and turned into courseware, and briefly, lightly introduced to students at earlier stages of their education only when some technology has matured to the point of producing large volumes of consumer products. The NeoPlexus Program will play a role in revolutionizing education through closer bonds and engagement between “students” and “active researchers.” This will cultivate innovation and practical invention and diffusion into society. There is already a good start on this connected with NeoPlexus and it is the Mirnova Academy.

The (Fine) Arts
The arts, collectively and individually, and all else that more often than not is omitted from “STEM” dialogs. But in some circles there is now building a stronger and stronger head of “S.T.E.A.M.” There are important aspects of imagination, invention (things getting tangible), innovation (things being modified and extended in new ways), and many aspects of Creative Expression in human activities, which have direct connection with TIR and what is being asserted is the macroscopic type of quantum potential and quantum superposition (entanglement) in the human brain and in group activities involving multiple persons. In fact, the creative process in the Arts offers deep insights into how STEM is done in real life. […] more in other papers and presentations: see some materials at http://mirnova.org)

Figure 4 below illustrates a range of Extreme Complex Systems that not only will benefit from but which arguably require a GCM computing solution. Moreover, these XCS will benefit from the process of thinking in terms of topological approaches to large and highly-dynamic state-space problems – the benefits do not depend only upon having the working, physical “GCM” in hand.
The Socioeconomics of NeoPlexus and the GCM

Science and technology never originated in a vacuum. Historically, the first science and mathematics developed from a combination of needs and wants, including very utilitarian and practical needs for survival. Food was a major driving force. As also everything else concerned with the basics of staying alive in an often hostile, inimical, and uncertain environment. As certain discoveries were made, these led to changes in every aspect of society and what it meant to be an individual and a community living on planet Earth. Over time certain actions (discoveries, inventions) may appear, from the vantage point of centuries and even millennia afterwards, to have been motivated and cultivated purely from intellectual or even “academic” interests. But invariably these were certainly very tightly coupled with desires and needs in social and economic spheres of life, including the desire for creating academic institutions to preserve and to cultivate “higher learning” of many varieties.

NeoPlexus is a Program to build something that can do a better job at solving problems which are for today’s and tomorrow’s human society, and specifically the world of 2017 and the coming decades, very similar in their intensity, universality, and criticality as the problems faced by the communities who decided to discover better ways to understand and to record and use knowledge about how the stars and planets moved in the skies, and how water could be moved and stored, and how knowledge about supplies of grain could be preserved. The problems of XCS in today’s world will not go away. Climate is dynamic and changing in ways that demand XCS-capable intelligent machines that “think differently” from calculators. Influenza and other viruses will occasionally mutate in ways that create epidemics and pandemics requiring a GCM-type machine to suggest new treatments. Asteroids will not always steer clear of Earth, as recent events (Chelyabinsk, 2013, and some near-misses since) have shown. NeoPlexus can produce the GCM and its topological adaptive intelligence, provided that the right perspectives are taken in examining some facts (and theories) that have been in our hands and before our eyes for decades and even, in the case of quantum mechanics and general relativity, the last century.

Table:

<table>
<thead>
<tr>
<th>General Problem Area</th>
<th>One major dynamic event-type</th>
<th>Critical (singularity) region (catastrophe function behavior)</th>
<th>Consequences of failure to solve the “critical-point”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change and global warming</td>
<td>Surface ice melting, especially in areas of large contiguous surfaces - Greenland and Antarctica.</td>
<td>“Spike” in water/air warming due to Latent Heat Fusion process as result of critically diminished ice AND also amplified methane releases</td>
<td>Society unable to cope and social structures collapse, leading to a global crises disrupting infrastructures including food supplies</td>
</tr>
<tr>
<td>Asteroid impact event</td>
<td>Asteroid or fragments of size 100m or larger</td>
<td>Impact in a location that severely affects human life</td>
<td>Major local or regional or global eco-disaster(s)</td>
</tr>
<tr>
<td>Increased variance of viral mutations with decreased separation of populations</td>
<td>Pandemic</td>
<td>Mutation achieves both optimal human-to-human transmission AND tolerance for lower respiratory tract</td>
<td>Pandemic with lethality levels exceeding 1918 flu pandemic scale</td>
</tr>
<tr>
<td>Global financial system fragility and susceptibility</td>
<td>Major crash in securities markets due to viral social media, cyberattacks or credit-default-swap scenarios</td>
<td>Catastrophic collapse (“Sept. 2008” on global scale and more intense effects)</td>
<td>Financial collapse affecting basic infrastructure industries and inevitable conflicts</td>
</tr>
</tbody>
</table>

Figure 5 – Several Extreme Complex Systems (XCS) that have extreme consequences
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

**Builders and Workspaces**
Those who can manipulate the “building blocks” highlighted above are People and Groups (organizations). Here are some introductory remarks about the Builders.

**Whose work of today (and from yesterday) can build the GCM?**
See the References below for a partial list. There are two categories of people for Today:

Direct principal-scientist participants within the NeoPlexus Consortium
This includes people who may consider themselves to be “retired” but who have in the mind of the author (of this document) very significant and valuable contributions to what can and will follow henceforth. The names are implied within the readership receiving this document, and one goal of distribution of this document is to bring people together in a Unified Team.

Constructive Advisors and Mentors
This group also includes persons who have received this document. Some persons may be supportive and want to be involved, but constrained by other obligations, commitments, choices. Their insights can and will be valuable on a personal level, intellectually and through influences.

**How to structure everything going forward**
This is set up and ready to implement in a committed way, organizationally and functionally. This is what is termed the NeoPlexus Consortium.

See this abstract, and then the paper (can be provided) [xx Dudziak-CoDIT-1]

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**NeoPlexus – developing a heterogeneous computer architecture suitable for extreme complex systems**

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**Abstract**—NeoPlexus is a newly established permanent program of international collaborative scientific research and application development. It is focused upon the design, construction and application of a new architecture and family of computing machines that are adept at solving problems of control involving extreme complex systems (XCS) for which conventional numerical computing methods and machines are fundamentally inadequate. The GCM involves a different foundation of computing from classical Turing Machines including qubit-based quantum computers and it incorporates geometrical and specifically topological dynamics. The target for implementation is to construct molecular-scale platform using protein-polymer conjugates and MEMS-type microfluidics.

increase in their state-space variability and as demands for adaptive, non-linearly responsive and computationally fast cybernetic techniques. These XCS may be characterized as non-deterministic, non-algorithmic and computationally NP-hard, regardless of instances where the control of such systems can be approximated for average or even majority cases.

The rationale for NeoPlexus is the need to provide accurate, reliable and practical modeling and solutions for many challenging tasks involving XCS among both natural and human-engineered systems. Some of these are constant and chronic challenges that are not new but such that the complexities, difficulties and the problems with current-technology approaches are now demanding more reliable and efficient solutions. Some of these problems are emergent and

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**Who can and should support the consortium and its program of work**
There is a list of course incomplete but it is a starting point. Because of the potentially “open” distribution of this document, we are summarizing points here and not listing the names of individuals and
organizations. But we have “done our homework” in terms of investigations and we have begun the dialogs with most of the significant players.

There are five main categories, and yes, there are concrete, sound reasons for including all of these types, including the last in the list, and very good reasons for the establishment of a formal Endowment Fund for the Consortium and its work. Again, as with “Builders” above, specific names are not included in this document, but they can be discussed in meetings that follow.

**Private-sector sponsors acting as investors and/or philanthropic benefactors**
Foundations and Individuals
Support through: Endowment Fund, direct sponsorship grants and awards

**Private-sector corporations**
Support through: Endowment Fund, direct sponsorship grants and awards, and specific contracts for R&D and consulting services

**Governmental agencies**
EU (EC), UK, US, CA, UAE, KO, JP, RU
Support through: specific grants and contracts for R&D and consulting services

**Universities**
EU, UK, US, CA, UAE, CN, KO, JP, RU
Support through: Endowment Fund, direct sponsorship grants and awards, and specific contracts for R&D and consulting services

**General public through social network-based crowdsourcing**
Support through: Endowment Fund and for specific project line-items (e.g., purchase of instruments, salary of interns and associates, attendance at conferences and seminars, and execution of special public events
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

Notes
[a] Cf. reference [xx], “NeoPlexus – developing a heterogeneous computer architecture suitable for extreme complex systems” (the CoDIT paper) [add remarks here]

[b] Ref. to Heisenberg uncertainty principle in QP and emphasis on its statistical nature and meaning thereof [add explanation of how this is often misunderstood, incl. in physics]

[c] short description and references to recent @ 11/2017 announcements about synthetic DNA experiments with two additional codons. [add remarks on how the codon structure fits with energy transfer optimization via solitons – e.g., Bogolubsky, Davydov, Brizhik

[d] Some refs and images about K-Nex. [add remarks about: can a machine (simulator, on conventional computer) be built to robotically assemble KNex into stable meaningful and discernible structures?]

[e] Chopp, Zhang et al
Also from [111 – Chopp, Zhang, 2015]
Keywords: Exosomes, microRNA, Neurorestorative therapy, Stroke, Traumatic brain injury

“We have emerged into an era of information technology which has revolutionized all forms of communication. We also stand on the threshold of another revolution in communication, in the biological and medical realms. Recently, a body of literature has revealed that microvesicles released by cells in all living systems from microorganisms to plants to humans encapsulate important biological cargo which is transported to adjacent cells and tissues and over long distances, and essentially provide a medium of information transfer in living systems. Here, we focus on a particular set of biologically potent microvesicles, exosomes.

Exosomes play vital roles in physiology and pathophysiology [1–3]. They are small lipid microvesicles (~30–100 nm) and active biological containers, which mediate intercellular communication by transferring proteins and genetic information and instructions between cells [1–3]. The membrane structure and cargo of these lipid containers reflect their birth cells and the physiological and environmental conditions of these cells. The discovery of exosomes with their varied and rich content will likely alter our understanding of the generation and progression of disease, particularly that of autoimmune disease, cancers, and neurodegenerative diseases, and as we will discuss, may provide novel ways to treat disease.

In this editorial, we will focus on how exosomes transmitting their nucleotide and protein cargo may be used for the treatment of neurological diseases. Our attention will primarily be on stroke, neural injury, and neurodegenerative diseases, such as multiple sclerosis (MS). For treatment of ischemic stroke, conventional neuroprotective therapy dictates that we race against the clock and rapidly attempt to lyse the offending vascular obstruction inhibiting cerebral perfusion by using FDA approved tissue plasminogen activator as a thrombolytic agent. For treatment of traumatic brain injury (TBI), there are no FDA approved therapeutic agents, but the therapeutic logic is to reduce secondary damage caused by progressive neurotoxic processes such free radicals and excitotoxicity, and attempt to maintain physiological function and homeostasis. Treatment of neurodegenerative disease, such as MS, has traditionally targeted means to reduce inflammation and to modulate the immune system, ostensibly to treat an autoimmune process. With new insight into the nature of intercellular communication mediated by exosomes, we may identify novel and varied options to treat diseases, particularly neurological diseases. We also propose that the goals of the treatment of neurological injury, stroke, and neurodegenerative disease should be refocused from the traditional neuroprotection, i.e., reducing tissue damage and death, to neurorestoration, where the primary outcome is improvement of neurological function, mediated by neurovascular remodeling and enhancement of central nervous system plasticity. The means to promote neurorestoration may reside in our ability to regulate via exosomes, intercellular communication of proteins and genetic and epigenetic instructions.”

[f] More on VNT

[f1] This model involves Riemannian space (or sub-Riemannian spaces) such that the normal state of all nodes is that they are in smooth connections between each other on some manifold, but that when there are disruptions (errors) then nodes will be pushed up or pushed down into positions that are essentially
knots or twists of the surface, and this can be understood as a kink or knot in the normal flow between the points of those nodes – a type of kinking or knotting. Now, interestingly, there is a lot of prior work in sub-Riemannian geometry with respect to vision processing in the brain. But this is a new, deep, raw field of research...

The brain is then viewed in a way as a space of processes – activities, dynamic relations between multiple subsets of nexus nodes – and the topology of this n-space is defined by those dimensional units which describe different energy levels over spacetime. But what are these energies? We are not talking about simple energy in the sense of particle physics, but energies that can perhaps only be described as complex relations between activities such as neural firings and releases of different transmitters and also things like exosomes – among complex subsets of neuronal nexus nodes.

This becomes more of an information-centric or computational model, wherein there are “optimization functions” that are governing how the brain operates in terms of its PAF. The brain then can be said to have a cybernetic function of self-control and self-regulation which is based upon optimization for different functions, and its plasticity and adaptive functionality (PAF) is an integral path for maintaining that optimization. The PAF is in turn mediated, delivered, through exosome-based signaling between different brain regions, and one of the key control mechanisms for that signaling is in coherent quantum-entanglement resonance effects (CQER) that exist between these diverse brain regions. When the CQER is disrupted, the PAF will be disrupted, and when the PAF is not working correctly, the overall optimization suffers and fails.

And getting back to the matter of disruptions, and effects that we term “dis-ease” - these are transformations in the energy exchanges, in these neuronal activities, that can be measured as changes in the dimensionalities of this “topos” space. Which brings us back to the twists, warps, hills, ripples, valleys, holes, etc. within the topological space of brain functions. These are the topological representation of what are changes in neuronal activities that veer away from the norm.

So we are saying that chronic impact and stimulation by various psychophysical toxins cause aberrations in the neuronal topology which in turn warp and distort other parts of that manifold which may be “seemingly unrelated” in a neurological functional perspective, much as a punch to a flexible sphere (like a soft beach ball) will cause distortions not only in the locality of the punch, the push “in”, but also in the whole remainder of the surface of that sphere (some of which will not be noticed to the observer, they are seemingly so faint, but they can, as with any playing around with a simple balloon can show and remind us, cause distortions that ultimately break the bonds between parts of that ball/balloon, often catastrophically).

Exosome response and transmission (dispersion, traffic) is clearly associated and linked with a variety of events ranging from tissue trauma to infection and inflammation to cancer. I would like to suggest that, very broadly, they (exosomes) are closely coupled with fundamental cellular and biotopological (cell clusters, regions, neighborhoods) cybernetics that is otherwise understood by its many “species” of variations – embryonic stem cell differentiation, adult cell differentiation, biochemically induced adult stem cell differentiation, a variety of epigenetic effects, and the nonlinear behavior, systematically disfavorable (often fatal) but locally (probably) quite in line with what specific cells are receiving and processing as signals, albeit with aberrant algorithms – namely, the phenomenon of defect cellular apoptosis (cancer).

One area that is of interest and need for deeper research – and which this VNT project can amply address and assist – is in the question of the regulation, control, and in short, the modulation (positively, negatively, beneficially for the organism, or pathologically) of exosome responses during, after, and even in some cases, temporally before the explicit, macroscopic outbreak of some condition in the body. (Here I am talking about pre-symptomatic, non-diagnosable states of a disorder, including an infectious disease, or a cancer development – obviously, certain traumatic events (TBI) do not have precursors (except in the sense of certain ancillary psychophysiological states that could possibly be viewed as “leading up to and paving the way” for some TBI events to take place – but this is another matter).
For example, consider the basic VNT clinical study proposal. We are talking about visual processes, involving eyes, optic nerves, visual cortex, and interfaces with cognitive/motor/verbal regions of the brain, potentially other areas as well. We are looking for "what happens in the visual cortex" that could trigger exosome activity in another brain center (for instance, involving language comprehension or speech, or motor coordination, or any number of cognitive functions). This appears to be different from, yet somehow related, to the control mechanisms by which exosome traffic is generated directly following a particular injury, a neural lesion, such as from a stroke or TBI, or a progressed degradation and degeneration in a brain region due to CDD (e.g., Alzheimer's).

We should be concerned with what processes – biochemical, known organic and inorganic compounds (e.g., heavy metals, organophosphates, many other compounds that are neurotoxins in their effects) – can affect, positively or negatively in functional outcomes, the release and transmission (diffusion) of particular exosomes through the brain, the CNS, the entire body. If we can understand this better, then we may be able to amplify, for therapeutic benefits, the speed and concentration of different exosomes which may be the body's own and even best "medicine" for different imbalances and diseases.

Moreover, we should be concerned with "biological noise" and effects on exosome behaviors. Here I mean something that is deep-down connected, my "sixth sense" tells me, with biosolitons as transmission protocols within many macromolecules and especially involving proteins, specific enzymes, nucleic acids. We have evidence for biosolitons operating in the longitudinal expressions (extension and contraction) for actin in muscle tissue, and for their disruption (the biosoliton wave-form efficiency and maintenance of the wave packet – the essence of a "soliton" in the first place) by different chemical agents and in particular by electromagnetic fields (including, btw, sustained microwave frequency radiation) [Froelich, Davydov, Ho, D. Davis, et al].
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

References (Bibliography)
[This list is obviously very (!) incomplete. Some things will be removed, and more added, and those listed here will be completed.]

NEW MATERIAL being added – this section will be reorganized when stable


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J. Bush (multiple)

Y. Couder (multiple)


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Eddington, A.(“Nature of …”)
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

Einstein, A. (incl. EPR)


[other work on QB from UC-Berkeley, UI-UC, Harvard, London]

D. Finkelstein
D. Finkelstein
D. Finkelstein (multiple)


J. Gough


Hiley, B.

Hiley, B.

Hiley, B. (multiple)

Kauffmann, L.

Kauffmann, S. (multiple)


Maturana, H. (major piece)


Penrose, R. (multiple)

Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)


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A. Skyrme, “Skyrmions”


Verlinde, E. (Entropic Gravity)
Williamson et al “On the nature of the phonton and electron…”


Zurek (Quantum Measurement…)

Vattay, G (multiple)


R. Wallace (others on surface-computing in membranes)


Young, A. (several)

Zeeman, C

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Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)


Bilson-Thompson, S.

Smolin, L.

Michael Chopp, PhD, Vice Chair, Neurology, Scientific Director of HFHS Neuroscience Institute
Zheng Gang Zhang, MD, PhD, Senior Scientist, Neurology & Neuroscience Institute
Paul Edwards, MD, Chair, Dept of Ophthalmology
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[111] Chopp, M., Zhang, Z.,

Emerging potential of exosomes and non-coding microRNAs for the treatment of neurological injury/diseases

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Expert Opin Emerg Drugs. Author manuscript; available in PMC 2016 Jul 1.
Published in final edited form as:
Published online 2015 Jul 1. doi: 10.1517/14728214.2015.1061993
PMCID: PMC4878696
NIHMSID: NIHMS786093
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The CORVUS II / SCARI (Self-organizing Curious Anticipatory Architectures for Robust Intelligence) project mounted by the Cognitive Models subgroup of Texas A&M University-Commerce (Principal Investigator Derek Harter, Ph.D.) existed to “build and understand models of cognition based on (the) theory of intelligence as a self-organizing catalytic process” via the implementation of a “curious infrastructure built on top of a distributed, heterogeneous grid computing environment”.


The Fractal Geometry of the Brain pp 169-186 | Cite as
The Fractal Geometry of the Human Brain: An Evolutionary Perspective
Michel Hofman
Part of the Springer Series in Computational Neuroscience book series (NEUROSCI)


Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance... (M. Dudziak)


Jeffrey E Lee and Erica Ollmann Saphire, Ebolavirus glycoprotein structure and mechanism of entry
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2829775/


Infection Mechanism of Genus Ebolavirus


Ebola Virus Proteins
http://pdb101.rcsb.org/motm/178
research by Lukas Tamm, PhD, the Harrison Distinguished Professor of Molecular Physiology and Biological Physics and director of UVA’s Center for Membrane Biology
Appendix - Visual Media

Here are several images. Some are text-intensive. Some convey prior thinking on some of the topics introduced and sketched-out above. Many of the drawings here with texts about some aspects of the scientific model and also about the process of working systematically on something like a GCM machine, are now a bit outmoded and full of mistakes (in the mind of the author who created them). Why are they here, then? Because there is something worth sharing to help convey the ideas introduced earlier, and also because there is some value as everyone knows in an image, a visual, and not just in series and sequences of words and symbols (including mathematical expressions).

It gets back to the image of the six blind men with the elephant and their problems in identifying this new creature that they had never experienced before.

[1]
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

8-d Spacetime Matrix
Similar to hypercrystalline Vacuum (QF), some elements of Implicate Order (OB, BI).
Pre-spacetime, pre-‘big-bang/inflation’ stage,
Probability densities of energy as field, not
particles or distinct manifest localizations
4-d spacetime extension and 4-d intension
(tension, torsion) dynamics
Visible 4-d spacetime is like ripple or bubble
effect within fast-moving streams, ripples

Standard Model as topological field-computation
Patterns/rules of a computational process that describes how the 8-d spacetime matrix bends, twists, and shapes itself into geometrical processes that result in a condensation-effect yielding the measurable behavior of particles – the Standard Model is a sort of program-description of the algorithms

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Black holes
Energy principally in finitized, particularized form as light/dark matter flows in and is “dispersed” back into the fundamental matrix, the “dark energy” volume of the whole universe.
Energy releases at horizons is consistent and to be expected
Controllable interaction with retention of local spacetime structure (e.g., space-time) is theoretically possible if other “hidden” 4 dimensions can be stabilized during process

Tensegritaions (solitonic network) dynamics
Particles (point-like processes; massless, light/dark matter) are constant dynamics of the Whole (surface, volume, 8-d “volume”) and involve interactions of solitonic exchanges of energy – as in the model of the ripples and ripples in a fast-moving stream

Light as “rip, tear, defect”
Photons in one sense do not move or translate position, and “pared” photons are continuous within hidden intension-density dimensions
Constant invariant-relativistic speed of light is connected with overall dark-energy (cosmological constant) and hidden “4” intensional dimensions

Re-emergence of energies as matter
Not something like “white holes” but more like the condensation processes that result in clouds, fog, rain, snow
Potentially harnessed for directed production of photons from the “matrix” by generation of conditions that will support the “topological condensation” within definable, localizable spacetime regions

Macroscopic and biological dynamics
Quantization, quantum entanglement and coherent quantum-entanglement resonance (QER) effects are derived from fundamental topological and relativistic dynamics at the 8-d spacetime level
Scale of quantum changes with complexity and consequent magnitude in spatial and temporal behaviors
Formation of macromolecules and organic systems is natural consequence of the same rules and functions that generate matter in particle, nuclear, atomic scales.
Life and intelligence are direct consequences of the fundamental algorithms by which the 8-d matrix becomes finitized and quantized

Fundamental Relationships: Quantum Relativity Dynamics Theory
Topological twists
Geometrical code functions for dynamic changes in the matrix, translate into distinctive energy densities. Quantization, and sustained dynamics that create relational behaviors between these localizations – thus “light and dark matter” - “dark energy” being that which remains in the primordial state

Quantization-condensate
Topological process of linking, knotting, twisting, to inherent and fundamental processes of particulation, condensation-like, quantization Universal process from scale of particles to macroscopic structures (including atomic, molecular, biological, cosmological)

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Body-Neuroscience
Cognitive-Motor Processes
Neural Coding
Experience-based communications
Adaptive plasticity-based response
Neurorehabilitation Medicine and Therapy

Physio-Medicine
Cardiovascular disorders
Neurodegenerative diseases
Auto-immune disorders
Experience-based communications
Adaptive plasticity-based response

Information Science
AI (SYINT) (Syntetic Intelligence)
Recognition and Learning
Prediction and Forecast
Virtual Reality Systems
Internet of Things (IoT)
Robotics

Space
“EXO” (exploration) STEM
ASTRO (Asteroid, comet, satellite) mining
Space Station – L5 orbits, Moon, Mars
Astrobiology, Planets
Exoplanetary (interstellar) Exploration and Colonization

Relationships between QR-QB-QC-QE theory and applications
Quantum Biology, Cellular Communications, Genetic Control, Disease, Injury, Disorder, Aging

A brief memo

M. J. Dudziak, PhD  IIS  27 June 2016

The processes by which a complex living organism (e.g., human) reacts to acute injury (including severe tissue trauma and damages from infection including inflammation) are not dissimilar to processes (functions) that pertain to other forms of severe biosystem stress including disorders and diseases such as cancer, cardiovascular disease, fatigue, and most broadly and open-ended of all, the processes of aging.

These processes – both negative (debilitating) and positive (healing) – involve chemical and electromagnetic interactions that influence, among other things, gene activation and the intercellular signaling that is mediated by molecules known as exosomes.

These processes involve multiple levels of molecular, intercellular, and regional tissue relationships and communications. Central and fundamental is a phenomenon that is loosely termed quantum entanglement (QE; also coherent quantum entanglement resonance, CQER), and the experimental evidence is now emerging to match the theoretical models. QE occurs within nucleic acids (e.g., DNA) and proteins, but at different scales. At one level, it involves coherence between segments of DNA that are responsible for variations in how DNA folds and shapes itself as a long "string," and this in turn has a role in the control of gene activation.

One of the phenomena of special interest is that which involves generation and transmission of intercellular signals through molecules known as exosomes. Such molecules execute important communications from one region of the body to another and there are extensive research findings which demonstrate the role of exosomes in the body's self-healing process.

We begin to believe and assert that there are ways to influence these processes using a variety of stimuli besides those which involve chemical agents (drugs), stem cell treatments, or invasive surgeries. Such stimuli may act as catalysts, accelerators, and enhancers for pharmaceutical, stem cell, and other medical treatments, and in some cases they may be sufficient or preferable as therapies without other procedures such as drugs and external agents, or surgical procedures.
Brief introduction & outline of NeoPlexus Program - dynamic quantum potentials & topological resonance… (M. Dudziak)

[QR-QE] Quantum Relativity and Energy
[QR-QM-QG] Quantum Relativity/Mechanics/Gravity
[CQER] Coexisting Quantum Entanglement Resonance
[QEG] Quantum Energy Generation

Relationships between QR-superscalar and micro/macrosopic domains including biological sphere

[QB-QBC] Quantum Biology and Computing

Physio-Medicine and Neuro-Cognition
Stem-cell differentiation, embryonic development, system integrity
Cognitive-Memory Processes:
Exosome-based communications
Adaptive plasticity-based response
Neurodegenerative disorders
Cardiovascular disorders
Oncology
Infectious diseases / Epidemiology
Auto-immune disorders
Inflammation and cytokine storm events
Stress-anxiety-depression and cognitive dysfunctions

Quantization and Entanglement at different scales of magnitude and complexity means different order of relation than conventional quantum physics
§ Pre-particle "vacuum probability density flux"
§ Particles as stable wave-front interaction-collisions of 8-d tension-density-solitons
§ Particle-scale (e.g., entangled photons, EPR, Aspect, contemporary quantum teleportation and qubit-array experiments)
§ Molecular-scale (multiple types e.g., A-T and C-G entangled electron clouds in nucleotides; more complex (biosolitonic exchange equilibria activity) in protein conformation and DNA helical dynamics)
§ More complex order within CQER dynamics in organic systems (e.g., brain and CNS)
§ More complex in PSED phenomena between individuals and collective arrays or organisms (populations)
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[7]