A Necessary Comprehensive Reformulation of Foundational Physics as a Prerequisite for Developing Sound and Practical Next-Generation Theories, Computers and Starships

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Abstract

The dual challenges of non-locality and entanglement have made themselves present in multifarious forms for over a century in physics, biology, and other life sciences including psychology. But in general these are related to issues that recur across the sciences in both scale of size and scale of complexity in structure and behavior, and in one common dialectic that demands a resolution, also called "unification." The fundamental challenge has been one of integration for being able to preserve invariance, and with that, consistency, integrity and coherence, in theory as well as practice (application) among the most microcosmic and most macrocosmic. The suggestions, much less any assertions, of meaningful relationships between processes separable by limits of light velocity and deemed to be non-local, or deemed to be negligible due to high levels of external noise and decoherence (by classical interpretations of thermodynamics or otherwise), have generally been met with disdain and disregard in mainstream scientific circles. The argument is now put forth that physics, biology, information science, and the engineering of information through computing machines have together led to a critical and singular convergence of our conceptual frameworks used in these fields and others. This is a convergence of meaning and interpretation about the fundamental components used in describing and representing systems, processes, states, dimensions, and causes, spanning from the notions of substance, space and time. Foremost among such are superposition, entanglement, identity, unity, and also such basics as position, direction, certainty and control. The ultimate goal of this paper is to inspire change in thinking that leads to change in doing, designing and building. The ultimate claim here can be summarized as follows: A radically new computing machine based upon topological components representing the information process may be what is required, as a model and as a functioning machine, in order to demonstrate effectively the underlying theory about how Nature operates as a topological information process that employs form and structure to optimize the construction of information. And such a theory that encompasses action potentials operating within the interactions of particles, nuclei, atoms, molecules, cells, and organisms, is certainly required in order to establish the architecture for a computer that will operate according to similar principles.

Introduction

A. Excerpts taken from the Introduction to the volume, “Principia Physis” [1]

The dual challenges of non-locality and entanglement have made themselves present in multifarious forms for over a century in physics, biology, and other life sciences including psychology. From one perspective these problems may appear to be “only” concerning quantum physics at the Planck-scale or near thereto. But in general these are related to issues that recur across the sciences in both scale of size and scale of complexity in structure and behavior, and in one common dialectic that demands a resolution, also called “unification.” The fundamental challenge has been one of integration for being able to preserve invariance, and with that, consistency, integrity and coherence, in theory as well as practice (application), among the most microcosmic (waves and particles, both massless and massed) and the most macrocosmic (the universe as exactly that, a unity, a whole).

For the most part these problems and the underlying questions have been compartmentalized into separate problem sets and investigations, most of which have circulated only within conceptually-close theoretical circles. Nonetheless, the empirical nature of science has made its presence felt strongly in recent years, with promise of creating a wave of “sea-change” in even the most orthodox of such circles. Advances in sensitivity of experimental apparatus, particularly over the past decade, have reinforced the evidence of observables that, according to conventional and generally-accepted quantum mechanics, chemistry, and neurobiology, should simply not occur. Such observables include a diversity in type and spatiotemporal scale: quantum-level actions including coherence of entangled states among large ensembles of particles, solitonic energy transfer within biochemical processes such as protein folding and nucleic acid twisting, several aspects of enzyme-related catalysis, morphogenic changes in viral surface proteins during cell membrane intrusion processes, and also, at the relatively huge scale of cells and multi-cellular structures, dynamical pattern formation and large-scale bioelectromagnetic resonance within biological neural networks in brains.

The suggestions, much less any assertions, of meaningful relationships between processes separable by limits of light velocity and deemed to be non-local, or deemed to be negligible due to high levels of external noise and decoherence (by classical interpretations of thermodynamics or otherwise), have generally been met with disdain and disregard in mainstream scientific circles of discourse during the same approximately one hundred years. The history of the deBroglie-Bohm-Hiley model of quantum mechanics, with language of pilot waves, quantum potentials, and something akin or at least comparable to control of large energetic systems by the form and structure of otherwise insignificant low energies, is not only a paramount example but, it is here claimed, an integral part of understanding how to build a way out of the labyrinth in which contemporary physics, chemistry, biology, and other sciences find themselves today.

During this same period of the previous hundred years, there have been several seemingly unrelated developments that, it will be argued, connect in important ways for solving questions about multiple fundamentals in science. Firstly, at the the micro/nano scale, resolving certain dilemmas and paradoxes about non-locality, entanglement and the emergence of gravity and particle structure. Secondly, at the much larger scales of extension and duration, solving conundrums about the emergence of biological form and structure, and the processing of information in complex structures within both biological and synthetic machines such as computers. This century of development has provided important foundations for answering these questions, which seemingly have not been brought together yet in a manner that is clear for each type of problem. Among these foundations achieved have been establishment, with proofs, of limits and bounds with regard to completeness and consistency (Goedel). Almost simultaneously there have been established, with proof by performance as well as in theory, machines for calculating linear series of precisely-defined operations (Turing).

There are two other important sets of discovery and theory that are pillars for a new edifice which does not tear down the old but reshape its topology, so to speak, into a simpler and more elegant – and useful – form. Firstly, there have been experimental detections of quantum entangled state coherence and transmission within biological organisms, consistent with well-established molecular biology and cell biology, and offering answers to how certain very basic processes work within photosynthesis and biomagnetic navigation. Secondly, there have been promising developments in the construction of semi-stable arrays of multiple quantum-entangled atomic-scale objects that can be employed for the massively parallel computations (albeit Turing-principle calculation algorithms) known collectively as quantum computing.

The argument is now put forth that physics, biology, information science, and the engineering of information through computing machines have together led to a critical and singular convergence of our conceptual frameworks used in these fields and others. This is a convergence of meaning and interpretation about the fundamental components used in describing and representing systems, processes, states, dimensions, and causes, spanning from the notions of substance, space and time. Foremost among such are superposition, entanglement, identity, unity, and also such basics as position, direction, certainty and control. These are among the vertices in a complex polyhedron of meaning that has been assembled gradually over centuries and millennia and which now defines how phenomena are seen, correlated, interpreted. The goal of this paper is to refine, realign, and in some cases redefine, but not to break or discard that which holds water, works well, and serves its purpose in theory and practice.

The following points constitute the main arguments of this paper:

First, in order to establish a realistic and usable unification theory applicable to such two fundamental pillars of physical phenomena as quantum mechanics and general relativity, there must be a reassessment of what we mean by such concepts as locality, superposition, entanglement, and also such fundamentals as gravity and force. It is argued that there is a constant and consistent similarity between the structural relationships of phenomena at different scales of both size and complexity in Nature, and that this provides a better way to understand both why and how certain things are the way they appear, including to be in apparent contradiction.

Second, a re-evaluation of these fundamentals will lead to an improved understanding of natural systems in terms of models of representation which involve both description and control. It is argued that models to represent energy and its manifest form as action inherently involve aspects of control involving the environment in which any system operates. The cybernetic aspects of natural systems at wave-particle, atomic, molecular, cellular, and organic scales will provide a better avenue for descriptive theory and for applications based upon such models. Such cybernetic aspects may be described as “active information” and within physical systems this can be demonstrated as “action potentials.”

Third, a theoretical formulation that includes active information control and action potentials will provide a simpler and more consistent framework to understand relationships that span multiple scales of energetic behavior such as between quantum fields and molecular dynamics including biomolecular processes involved in cellular metabolism and, at the complex neural level, the processes of learning, memory and recognition. This framework will emphasize a topological representation of information and control that spans across different scales including that of biology.

Fourth, such understanding will provide the basis for developing a realistic architecture for a new and generalized form of computation, one that is trans-Turing in nature, not restricted to the arithmetic and logic operations of digital algorithm processing machines and not operating solely on representation of data in Boolean or similar bit/qubit formats. This new type of computation can be characterized by topological information resonance that operates, at a relatively macroscopic scale of molecular and nanoscale components, on the same principles of action potentials that modulate topological structures which represent information. This opens the path to a new type of computer that operates more like atoms in crystals, protein polymer chains, cellular microstructures such as cytoskeletons and nuclei, and brains.

The ultimate goal of this paper is to inspire change in thinking that leads to change in doing, designing and building. The ultimate claim here can be summarized as follows: A radically new computing machine based upon topological components representing the information process may be what is required, as a model and as a functioning machine, in order to demonstrate effectively the underlying theory about how Nature operates as a topological information process that employs form and structure to optimize the construction of information. And such a theory that encompasses action potentials operating within the interactions of particles, nuclei, atoms, molecules, cells, and organisms, is certainly required in order to establish the architecture for a computer that will operate according to similar principles.

B. The Plan of this Paper

[This is a shorter and concluding part of the Introduction and describes the main sections and their sub-sections. Part A above is from the book's introduction. Part B is unique to this paper. It will follow somewhat closely to what is in the set of collected notes composed in early December (2017) – "NeoPlexus-Program_intro-outline-and-notes_v0-99_draft_12dec17_dynamic-quantum-potentials-and-topolog-resonance-computing_mjdudziak".]

[Thus, something of this sort:]

Elementary Building Blocks

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

Complexity at different scales

System complexity and model-ability

Gravity is not a force but a measure of "unity-entanglement"

Quantum potentials and pilot waves

Quantum Potentials of different forms (and information at different scales)

Order embedded in chaotic behaviors in molecular vibrations and molecular conformations

How Quantum Potential can work at macroscopic scales in biology, brain, GCM computer

Noise and Decoherence are important, essential, for "superposed" parallel computation

Intermediary Building Blocks

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

Orch-OR (Orchestrated Objective Reduction)

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

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

Moving away from the entrapment of qubits and bits in general

Topological Information Resonance (TIR)

Vision as example of Dynamic Geometric Assembly – a model for implementing TIR

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

Re-emphasis of a non-bitwise representation of information taking place in TIR and in brains

Transforming information into topological dynamics and structure

How the topological structure can "compute" internally and create New information

Transforming topologies into information signals for other computing systems

Complex Macroscopic Building Blocks

A Topological Resonance Computing Processor (TRCP)

Some thoughts about surfaces and spaces for a TRCP

Fabrication and communications from the digital/analog world into the TRCP and vice versa

Generalized Computing Machine (GCM)

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

Heterogeneous processing that includes TRCP (TCP)

Super-Complex Macroscopic Building Blocks

Brains and Cognitive Processing as a type of Parallel TRCP Array

Fractal Catalytics – self-organizing functions in biology including the brain

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

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

Control of extreme(ly) complex systems (XCS)