Nilpotence: the Key to a Theory of Everything

Peter Marcer[1] Peter Rowlands[2] and Bernard Diaz[3]
[1] 55 rue Jean Jaures, 83600, Frejus, Var, France
[2] Science Communication Unit, Department of Physics &
[3] Department of Computer Science
The University of Liverpool
Peach Street, Liverpool, UK, L69 7ZF
e-mail: aikidopeter@aol.com, p.rowlands@liv.ac.uk, b.m.diaz@liv.ac.uk

Abstract
Various implications of Rowlands and Diaz' (R&D') discovery of a universal nilpotent computational rewrite system, are described. Evidence is presented that this discovery not only provides a new semantic fundamental foundation for universal quantum computation, but is the keystone of a fundamental computational foundation for mathematics, quantum physics, the genetic code/molecular biology, neuroscience and cosmology.

1 Introduction

Rewrite systems are synonymous with computing/information processing. They concern the languages in which programs are rewritten as symbols for computing hardware to interpret. R&D show [1] that their nilpotent rewrite system is universal in the sense that it delivers the entire infinite alphabet of symbols in one step, when presented with zero°° as the initial subset alphabet. This system turns out to be of particular significance, since, as R&D again show [1] its subset alphabets emerge in a minimal way and not only have a mathematical interpretation as algebra, but concern Rowlands and Cullerne's (R&C) nilpotent Dirac algebra [2]. This corresponds to a generalization of Dirac's well known quantum mechanical equation, so as include not just mass and electric charge, but those of the strong and weak charges and implicitly includes the property of spin as well. R&D's paper [1] then goes on to conjecture that such a universal rewrite system, has a minimum of two rewrite rules or productions:-
i) a creation operation, delivering a new symbol at each invocation, where this new symbol may be a single character of the alphabet, a subset alphabet, or the entire alphabet, and

ii) a conserve/proofreading operation, which examines all currently existing symbols to ensure that the bringing into existence of a new symbol or subset alphabet, etc, produces no anomalies.

°° Footnote, "zero" is used to simplify the presentation given here. In a more technical extended presentation the need to start with anything at all can be dispensed with.

2 Analysis over the Surreals

Such a conjecture is independently confirmed by analysis over the surreal numbers [3] in relation to universal models of theories in the language of sets, where John Conway (the originator of what Knuth calls the surreal numbers [4]) has shown that the simplest lexicographical universal model N of a theory concerns the alphabet of the two symbols L and R where the usual convention of L signifying left and R right, which he uses to generate all the numbers great and small, is abolished. This model defines the way of turning the class of all ordinal numbers into a complete mathematical field such that each ordinal extends the set of all previous ordinals in the simplest possible way, by regarding sums, products, inverses, algebraic extensions and transcendental extensions (by means of mathematical groups and rings to fields) as successively more complicated concepts. However these extensions may equally be seen lexico-graphically[3] as defining the form of alphabetic extensions as is appropriate to a computational rewrite system; or they may be viewed as extensions of Turing's definition of computation by means of his universal Turing machine over the integers, where the integers are not now seen as integers but viewed as a countable set of symbols [5].

Surreal analysis [3] also shows that these extensions, which necessitate the introduction of $\sqrt{-1}$ for the symbol usually denoted as i , are also maximal in the sense that they encompass all the properties of the arithmetic continua R and its Euclidean, Hyperbolic and Elliptic geometric counterparts, and in particular, such universal models have a unique birthorder field automorphism (birthordering). Furthermore Conway's model of the surreal number field N_o [4], where L does signify left, and R right (encompassing all the numbers great and small including the transfinite and the infinitesimals) is also nilpotent in the sense that it is generated from the empty set; that its first number is defined to be such that the symbol zero has the value 0; and notably this implies that the value one ½ and those of the half integers play a special role [4].

The R&D rewrite model thus demonstrates that the theory specific to Conway's simplest universal model with two basic alphabetic symbols must be quantum mechanics, as represented by the nilpotent generalization of Dirac's famous equation, which R&D show:-

(i) breaks its nilpotent symmetry (or emptiness) by associating the respective charges with vector, scalar and pseudo-scalar operators, such that

(ii) the quantizations (including spin) of the families of elementary particles so realized are the familiar ones known and established by experimental particle physics and can be regarded as the sources/sinks of the 3+1 space-time quantum field in both its Lorentz and Einstein General Relativistic invariant forms [2].

R&D's work thus provides a counterexample to the widely held established view that Einstein's General Relativity (expressed now in the form of a multivariate 4 vector group representation) is incompatible with quantum mechanics (expressed as the generalized Dirac nilpotent representation). It indicates that space and time are smooth at the smallest scale, and not fuzzy and foaming as current ideas of quantum gravity appear to require, see Science 301 29th August 2003, 1169-70, spacetime 'Einstein 1, Quantum Gravity 0'.

That is to say, in an empty Universe, this nilpotent symmetry breaking process constitutes the genesis that brings 3+1 spacetime and its complementary elementary particles into existence for the very first time, such that they are first born in a 'virgin birth' from nothing ie their empty set. This (empty) Universe is therefore an (empty) White W(hole). And just as importantly this is the initial step in the 'birthordering' or birth order process, which can thus be hypothesized to describe this Universe's evolution as defined by the Quantum Carnot Engine [11] see below.

Equally Dirac's famous formalization of quantum mechanics by means of bra and ket vectors [6], representing once again the two fundamental operators of its description, must also be such a nilpotent rewrite system for describing quantum mechanical computation. It, by implication, therefore describes not just quantum mechanical dynamics, but includes quantum mechanical measurement and therefore a thermodynamic decoherent evolution or birthordering, in which the creation of 3+1 space-time and elementary particle matter is the fundamental first step. Additionally therefore R&D's rewrite system indicates that the bra vector acts fundamentally as a quantum creation operator, and the ket, as a quantum annihilation operator, whereby this restores nilpotency so as to constitute an operation of proofreading. Thus, since the roles of the bra and ket operators may reversed, the Dirac notation also includes what is called a Bargmann-Fock model for bosons and the harmonic analysis of the three dimensional Heisenberg nilpotent Lie group[7].

Equally, the Conway universal model where the symbol L now is given the value 1, and symbol R, the value 0, implies that this particular universal model concerns a Heaviside operator, equivalent to the corresponding singular Green's function (Schwarz distribution) which permits the same description of the physical wave phenomenon by means of an integral formula. And in the three spatial dimensions implicit in R&D's nilpotent rewrite system, this Heaviside operator is therefore Dirac's equally famous "delta function" as it is known in quantum wave mechanics. These conclusions are also in agreement therefore with Feynman's conceptual use of Huygens' principle of secondary sources to derive his equally famous path integral formulation of quantum mechanics [8],

since as Jessel shows such Heaviside operators are fundamental to the formalization of Huygens' Principle [9].

Thus it seems that the concept of nilpotence (or the empty set as the description of the initial mathematical state of a system as used by Conway in relation to universal models) is foundational to physics, for, from the above arguments, the initial nature of the dark energy from which 3+1 space-time and elementary particle matter emerge, can now be inferred.

That is to say dark energy must constitute quantum coherence since at this postulated origin of the Universe, there is, implicitly from R&C's nilpotent Dirac equation, both the 3D spatial, and the temporal quantum coherence sufficient for holography ie for full quantum holographic wavefront reconstruction in some hologram plane. This conclusion follows from the well known quantum mechanical fact that although the phase of any quantum wave function is arbitrary up to a constant phase factor, the phase difference between two wave functions is however of physical significance, as the geometric/Berry phase discovered by Berry shows [10]. That is to say, these conditions satisfy the requirement of quantum holographic image encoding/decoding procedures, which need the mixing of a coherent reference signal beam (as occurs for example in Mach-Zehnder interferometry) to incrementally record (in the case of encoding) the phase of the object signal beam in the hologram plane so as to form a hologram: a condition that occurs spontaneously in the above circumstances at the point of phase conjugation. And this would therefore result in phase conjugate adaptive resonance, so as to provide a Big Bang Resonance and subsequent Adaptive Evolution/birthordering. Such quantum coherence therefore not only assures the basic material composition of the Universe upon symmetry breaking as described by R&C in terms of 3+1 space time and elementary particle matter as it seen today, and as far as is known as has always been in the case in the past, but requires a truly quantum mechanical system/Universe. Furthermore the spatial and temporal quantum coherence necessary for this full wavefront reconstruction, says that this Universe can be considered as constituting a quantum hologram; a conclusion in excellent accord with the recent findings in regard to string/membrane theory. String theory is however only a quantized classical description, which encompasses the four fundamental properties of mass and charge and their corresponding force fields. It does not provide the basis, as does quantum coherence as dark energy, for a true quantum thermodynamic description of the Universe as the above description, which is quantum holographic, does; however, the authors believe nilpotent theory encompasses a 10-D string theory without strings. Such a thermodynamic description is that of the Quantum Carnot Engine [11], which will evolve in ways that a classical thermodynamic description of the universe cannot. In particular, therefore, R&C work shows that any classical model of the Universe would be empty ie have neither 3+1 space time and elementary particle matter, unless these are independently & separately assumed to exist prior the

Big Bang. And such a classical universe would therefore remain empty so as to be totally without interest. That is to say, the nilpotent Universe is the only possible description that can explain the origin of the Universe that we observe today. Further evidence in support of this hypothesis is now cited. In particular it seems clear from the above arguments:-

(i) that mathematics must now be considered to be a single inseparable body of knowledge, as first proposed by Langlands, so that theoretical physics will indeed the same thing as mathematics thus explaining what is often referred to as "the unreasonable effectiveness of mathematics in relation to physics". A hypothesis first advanced by Chapline [12] and

(ii) that the nilpotent version of quantum mechanics is the basis for a semantic theory of holographic pattern recognition, which can be conceptualized as in John Wheeler's now famous diagram, as a single eye looking at the body of itself.

Thus it can be hypothesized that the R&D rewrite system is the basis for two new foundational disciplines ie the computational foundations of physics & mathematics.

3 Wheeler's meaning circuit, physical law without law, the grand unification of elementary particle physics and cosmology.

For with this hindsight, it is in particular clear that the concept of the rewrite system is a means to mathematically formalize J.A. Wheeler's argument The Meaning Circuit [13], that while the laws of physics require description in terms of mathematical algorithms, these algorithmic forms will be useless (ie have no meaning) unless they can be executed using the laws of physics themselves. In particular Wheeler argues that this could provide a mechanism or bootstrap for deciding the actual form of physical law, without any foreknowledge of what that law might be. A concept he calls "physical law without law".

Hence R&D's nilpotent rewrite system which yields a description of the recognized laws of quantum mechanics in the form of the generalized nilpotent Dirac equation starting from the symmetry breaking of the "empty set", provides a mathematical solution formalizing Wheeler's concepts of both the Meaning Circuit and of "physical law without law". That is to say that by introducing the notion of nilpotence, and beginning solely with the symbol zero (ie without knowing beforehand anything of the nature of physical law or physics itself), R&D's rewrite methodology shows how to generate an actual mathematical description of physical law in recognizable quantum mechanical form. That is, Wheeler's conceptions correspond in this case to physical law in the form of the generalized nilpotent Dirac equation, which the R&D' rewrite methodology shows is in fact universal. Furthermore Rowlands nilpotent Dirac equation, which implicitly includes the boundary condition of zero or the empty set (implied by its nilpotence) should be (and in fact has so far been) able to predict

theoretically all the values of all the known and the possible physical constants and invariants, which currently can only be known empirically from experiment. That is to say this methodology can generate all the physical constants so that they can known without empirical determination, in accordance with Einstein's belief quoted in "Subtle is the Lord" A. Pais, Oxford University Press, 1982, page 34,:-

"In a sensible theory, there can be no numbers whose values are determinable only empirically. I can, of course, not prove that …. dimensionless constants in the laws of nature, which from a purely logical point of view can just as well have other values, should not exist. To me in my "Gottvertrauen" (faith in God) this seems evident, but there may well be few who have the same opinion."
Albert Einstein,

This would therefore provide a totally exhaustive means of testing this new model's correctness, as one would expect from its description as a "proof reading" mechanism. Furthermore the birthordering that R&D's rewrite system provides, is, because of its nilpotence, always entirely renormalizable so as produce an entirely finite representations of the quantum mechanical evolution, where such birthordering defines that evolution's proper time ordering in such a way that it cannot be globally reversed. Such an evolution is thus in conformity with the First, Second and Third Laws of Thermodynamics, showing that while quantum mechanics may be dynamically locally time reversible on all local scales, its global evolution is by contrast thermodynamically irreversible, and can never return to its initial (global) state. Such an evolution therefore must concern the continual thermodynamic reconfiguration in 3+1 space time of a finite quantity of elementary particle matter which appears simultaneously with that spacetime at the first moment of creation or " the Big Bang". Thus it follows from the formalization of Huygens' principle of secondary sources[9], that the Big Bang or Source of the Universe (corresponding to the white (w)hole from which 3+1 spacetime and elementary particle matter emerge), must in this case be equivalent to a set of secondary sources, which are in fact local sinks or Black holes at which both 3+1 space time and elementary particle matter disappear, so as to function as what in computer terminology is a 'garbage collector'.

Equally such a nilpotent rewrite system describing both arithmetic and geometric properties   must be describe what in computer systems is called universal computer construction ie

such nilpotent quantum computation will be both computer universal in the sense of arithmetic and constructor universal in the sense of geometry. That is it includes both universal digital computation as discovered by Turing in the form of the universal Turing Machine model[14], and universal computer construction or self replication as revealed by Von Neumann [15].

4 The icing on the cake.

And thus in agreement with Perus and Bishofs [16], in the basic general equation of Dirac's bra/ket notation ie $|\Psi\rangle = |\Psi\rangle\langle\Psi|\Psi\rangle$, the above arguments show that the rightmost $|\Psi\rangle$ may represent an holographic output, such that the left most $|\Psi\rangle$ denotes the holographic input and $|\Psi\rangle\langle\Psi|$ the action of the associative holographic memory. It is seen therefore

i) that in correspondence to their classical counterparts, quantum holographic procedures may be described with quantum wave functions, as is indeed the case in Schempp's quantum holography based on the 3 dimensional Heisenberg nilpotent Lie group, as previously explained and referenced [7] and (it follows)

ii) that 3 dimensional geometric space and generalized 3 dimensional spatial image processing are essentially ubiquitous to quantum mechanics, as is illustrated via by the application of Schempp's quantum holography [17] to the control of (nuclear) magnetic resonance imaging (MRI) systems in medical use worldwide. see http://wwwcivm.mc.duke.edu for example. **Moreover quantum logic gates are not needed to engineer such MRI imaging dynamics.**

Furthermore if one then expands this basic general equation in the most obvious way as below

$$|\Psi\rangle = |\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle\langle\Psi|\Psi\rangle$$

it encapsulates the concept of an extended form of quantum holographic memory as is shown by the Frobenius-Schur-Godement identity [18], where

$$\langle H_v(\psi, \varphi;.,.)| H_{v'}(\varphi',\psi';.,.)\rangle = \langle\psi\otimes\varphi|\psi'\otimes\varphi'\rangle \quad (v = v' \neq 0)$$
$$= 0 \quad\quad\quad (0 \neq v \neq v' \neq 0)$$

This says that the range of frequencies between v and v' allow an adaptive resonant coupling so specifying a spectrum of very narrow spectral windows, where $\psi,\varphi,\psi',\varphi'$ are the quantum wave amplitudes belonging to the complex Hilbert space $L^2(R,t)$ and $H_v(\psi,\varphi;.,.)$ are the Liouville densities of the corresponding distributions. It follows therefore that there will be little or no cross talk between, for example in the photon case, the asynchronous collective photonic excitation distributions located in the different hologram planes $(R\otimes R,\Omega_v)$, $(R\otimes R,\Omega_{v'})$, where the four wavelet mixing $\psi,\varphi,\psi',\varphi'$ takes place, so as to make subsequent full wavefront holographic reconstruction possible. That is to say so as to constitute a quantum holographic memory that can be both written and read.
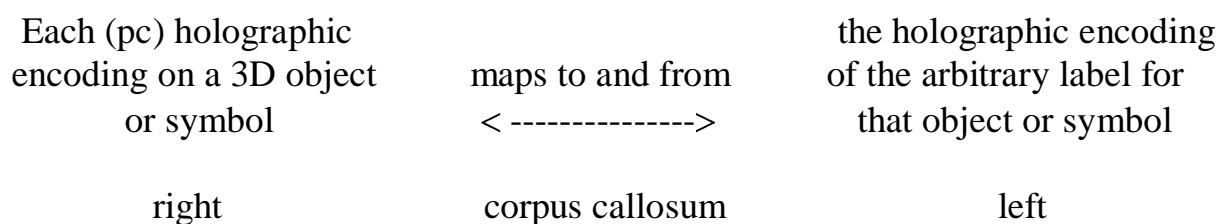
It is worth pointing out that all interactions between particles (including vacuum ones) have the same form with incoming fermion and incoming antifermion (or outgoing fermion) creating a bosonic state at the vertex and that this applies to the equations above, which are parallel to the automatic fermion antifermion fermion antifermion ... structure of the nilpotent operators acting on vacuum. The system thus creates automatic and exact supersymmetry of the fermion and its (own) representation as a boson, see Peter Rowlands paper this ANPA proceedings.

5 Living Systems, DNA and the genetic code, the fundamental basis of human language and the structure of the human brain.

However it is now clear that R&D's novel discovery of a universal nilpotent rewrite system, has implication far beyond physics and cosmology in living systems, etc (see Appendix − Riemann's Hypothesis the basis of a possible proof) In particular it follows from its fundamental nature and previous research, for example, Fractal Structure in DNA Code and Human Language: Towards a Semiotics of Biogenetic Information, Gariaev P. et al [19] that it can be hypothesized that the genetic code (in an explanation relevant to both DNA and RNA!) is such a minimal chemical rewrite system for quantum holographic computation, such that the chemical base pairings of genetic code constitute its two rules or productions. That is to say that the base pairing A = U symbolizes the fact that some initial state must be rewritten as in RNA action where A = T delivers the new symbol, which maybe a single character, a subset alphabet or an entire alphabet. That is, it represents the create operation, so that by contrast G≡C symbolizes the conserve operation, which examines/proof-reads all symbols currently in existence to ensure no anomalies exist as a consequence of the bringing into existence of the new symbol. This rule therefore verifies/maintains the conservation of 3 dimensional chemical structural stability (such that Dirac nilpotence is maintained !!) in the process of the development of the human embryo via cell division ie it defines natural selection. Thus at the commencement of human development, A may be said to symbolize the human individual to be delivered (ie born) as a single stable 3 +1 dimensional chemical unit or structure, once the entire genetic alphabet of that individual, specified by the subset alphabet of the 46 human chromosomes /symbols has been fully realized, or an anomaly occurs such that the development is aborted.

This evidence fits well with the mathematical-linguistic model of Chomsky, that postulates common principles, underlie any language and to concern "a universal grammar" [20]. From Chomsky's view, such "universal grammar" is inherent, i.e. it has some genetic determinants. This is an extremely important circumstance, which once again emphasizes the super-genetic relationship of the DNA semiotic structures and human speech structures. To a limited extent this position has already been partially confirmed in the study cited which shows the similarity of characteristics between the DNA and the human speech. Chomsky is therefore probably right, when he argues that the in-depth syntax constructions which constitute the basis of the language, are passed down from generation to generation, providing each individual with the capacity to learn the language of its ancestors. The fact that a child easily learns any language is then explained through the theory that the grammars of all languages coincide, and the essence of the human language is invariant for all people. But it can now be supposed, that this invariance extends even more deeply, down to that of the

macromolecular semantic ("speech") chromosome structures. Further independent confirmation in relation to the DNA-wave biocomputer [19b] comes from quantum holographic imagery [21,page159 ;16e,page235]. For here, 3 dimensional spatial object images, the observations are phase conjugate (pc) so as to coincide with the 3 dimensional objects themselves, the observed. That is to say, it is the 3 dimensional objects themselves that are the symbols that implicitly label all aspects of experience, the observations, in a universal way for all observers, so as to form the basis of communication between all those observers with a common genetic heritage and sensory apparatus. The bases of all languages in this case are therefore shared arbitrary symbols or semiotic labeling of these objects and their properties such that

Each (pc) holographic encoding on a 3D object or symbol	maps to and from < --------------->	the holographic encoding of the arbitrary label for that object or symbol
right	corpus callosum	left

where such mappings are unique since no two objects can occupy the same position in 3 dimensional space. This mapping schema could then explain the morphology of the human brain which concerns the two brain hemispheres and the corpus callosum, which joins them. That is to say, the right hemisphere that realizes the holographic encodings of the real world, (concerning the geometric continua) is the artistic brain, and the left, that realizes the arbitrary labelings of these real world objects or symbols and their properties (concerning the arithmetic continua), is the logical brain. For in the latter, an essential element of the mapping of such labeling of objects includes numbers and sets and their logical relationship one to the other, where these must be acquired by learning. This mapping schema can therefore be postulated as the basis of Chomsky universal grammar or of the R&D nilpotent rewrite system in the human brain as a neural system, as fundamentally laid down in the genetic code.

The following experiments that any one can perform provide a partial confirmation of this. Snap one's fingers at some distance away from the head and ask where your hearing senses detect the noise of the acoustic snapping. It is outside one's head exactly coincident with the snap itself. That is, the acoustic object image of the snap and the snap itself coincide, which is the definition of a phase conjugate object image. Similarly place a glass on a nearby table and reach out and touch it. Again one's senses of sight and touch are such that, in every particular, in 3 spatial dimensions that they coincide with those of the glass, itself. That both the visual and tactile object images produced by the brain are phase conjugate object images of the glass. And the condition of phase conjugation is a fundamental one, because human or indeed the survival of any living system depends one the finding of any object where it actual is.

Furthermore this structure of the brain, [16e, page235] shows how the human brain is able to assign meaning to human language by providing each name or symbol uniquely with a meaning by means of the object and its properties, with which each stored phase conjugate object image would be associated. And this must be the true power of the human brain that it is able to process meaning ie process words not just syntactically but by their semantics, as known from each human beings actual geometric/holographic experience. Furthermore although such experience will be subjective in part since it takes from the reference frame and viewpoint of that individual, there always remains a fundamental mechanism, the 3D objects of the real world themselves known through their phase conjugate object images, which provides the common medium for all objective human communication. That is to say in the case of the glass or any other object that all parties may reach out to touch, so as to see, hear, or to smell the object in question so as to determine the truth about it as stated by the other parties, or nowadays to determine exactly the nature of those properties through common scientific instrumentation and experiment. The process known as science.

6 Conclusion

The evidence that the structure of the cosmos, the genetic code, the human brain, and human language corresponds to quantum mechanics as determined by the generalized nilpotent Dirac equation, and to the complementary semantic theory of quantum holographic pattern recognition specified by the corresponding three dimensional nilpotent Heisenberg Lie Group [7,22] is therefore a well determined testable scientific hypothesis. Further these two nilpotent representations correspond to the required division of the nilpotent quantum mechanical state space into its Clifford/fermionic and Lie/bosonic parts.

In particular, from Kilmister's Brouwerian Foundation of the Combinatorial Hierarchy (CH), based on Conway's generator for the surreals, section 2 above and the extensive body of ANPA CH research, it can be hypothesized that the CH is itself a nilpotent computational rewrite system for quantum physics based on the two symbols 0 and 1, and thus from section 3 corresponds to another of Wheelers' well known prescient conceptions that of "It (the cosmos) from bit". Bastin's highly intuitive pre-CH conception that there must exist a computational foundation for quantum physics that lead ANPA quite correctly to the CH was thus completely correct.

Appendix Riemann's Hypothesis – the Basis of a Possible Proof?

This appendix presents a novel physical perspective within which the idea for a proof of the Riemann Hypothesis is described based on the discovery by R&D of the universal computational **nilpotent** rewrite system, and the fact, as shown by Deutsch that universal computation is now recognized to be fundamentally a physical process.

The perspective
Quantum Coherence/non-locality is the sole origin of the **nilpotent** quantum cosmology presented above, and as the 4 vector representation indicates, this cosmology is general relativistic. A conclusion:-
i) in strong agreement with all the evidence of experimental cosmological & elementary particle physics, for there exists no confirmed experimental evidence of incompatible physics beyond, and
ii) much in favour that the condition of **nilpotency** provides, such as a zero vacuum energy, which is the unaccounted for stumbling block to current cosmological theory.

It therefore hypothesized from all the above evidenced already presented that Nilpotence is the key to proving the Riemann Hypothesis.
In particular **nilpotence** is exceptional in determining both the amplitude & phase of the quantum state vector, where phase is known to encode geometric information i.e. that of 3+1 space-time as in a (quantum) hologram, as proposed in some current cosmological theory. It cannot be a coincidence therefore that at the empty cosmological origin postulates above, there is both the spatial and temporal quantum coherence necessary for holographic full wave front reconstruction. A adaptive resonant process, described as in actual nuclear magnetic resonance medical imaging (NMRI), by the 3 dimensional **nilpotent** Heisenberg Lie group, the algebra of which defines the Heisenberg uncertainty! This (uncertainty) together with the **nilpotence**, implies there is, respectively, both quantum (coherent) self-interference and the necessary corresponding zero energy reference frame or wave, for quantum holography, as discovered by Schempp [33, etc], to take place. That is to say this cosmological origin would indeed constitute a quantum hologram, from which the cosmos itself comes into being, by full wave front reconstruction as in fact is evidenced by its 3D spatial dimensionality from scientific measurement.

The Concept of the Proof
The concept of the proof therefore arises from the properties the nilpotent quantum mechanical state space of the above hypothesized cosmology or physical system.
For it is again no coincidence, that both the **nilpotent** Dirac and Heisenberg representations coexist as the fundamental basis of this system, for in its quantum mechanical state space, they are, respectively, the required division of

that **nilpotent** space into its fermionic/Clifford and Lie/bosonic representations, where, for example, the description of quantum holography remarkably arises from the fact that in relation to quantum phase only phase difference is of physical importance, because each quantum state vector is only defined up to an arbitrary constant phase (i.e. is arbitrary up to an isomorphism). That is to say :-

i) the quantum holographic image encoding/decoding procedure must necessarily involve coherent mixing with a quantum reference signal beam, which defines its reference frame, and this is the role, which the 3D Heisenberg **nilpotent** Lie group G plays with regard to 3D space in 3+1 space-time. Moreover G possesses the required inverse dual G′ so as to ensure this encoding/decoding is indeed possible, as is known to be the case from NMRI,

ii) in this **nilpotent** system, it must therefore be constant arbitrary phase which represents quantum coherence, so as to constitute the "phaseonium" with the potentiality of the infinite degrees of freedom necessary to its Quantum Carnot Engine (QCE) evolution[11], which is indeed universal (see below, and note that 'constant' means invariant i.e. fixed as in a fixed past rather than forever unchanging), and

iii) the complementary Clifford/fermionic state space, the Pauli exclusion principle tells us, provides the canonical labeling required such that the quantum holographic image informational processing constitutes computation. That is to say, the gauge invariant geometric phases appropriate to the entire nilpotent state space and more particularly the quantum holography must, by the exclusion principle, all lie on the line spin ½ and so can be identified with the zeros of the Riemann Zeta function. The Pauli exclusion principle, together with the universality of this nilpotent state space, which corresponds to the universal computational nilpotent rewrite system as found by R&D, thus show the Riemann Hypothesis to be true! Moreover the universal rewrite nilpotent system confirms R&C's finding that the nilpotent Dirac equation has a proper time. The nilpotent state space therefore has global time reversal asymmetry as is implied by its QCE evolution. Thus not only do the distribution of the primes specified by the Zeta function play a game of chance representing the optimum strategy for survival in the specified proper time evolution, but the 3 dimensional structures which correspond to each zero of the Zeta function, are universal invariants/constants of the entire state space! That is, to say, the Zeta function constitutes a standing wave in the space, and this standing wave which concerns a mapping of all the integers, is therefore the projection of universal quantum onto universal digital, computation.

Conversely in any quantum mechanical state space, because of the required division of the space into its Clifford/fermionic and Lie/bosonic parts, the Pauli exclusion principle implies there must always exists unique 'global' fermionic spin states lying on the line spin ½, and that such states, must, if the Riemann Hypothesis is true, necessarily define zeros of the Zeta function so as to constitute the 'global' nilpotents of that space, where quantum coherence is

necessarily non-zero. That is to say the 'global' gauge invariant phase[10] corresponding to each zero will have quantum holographic properties, and be such that at this zero, phase conjugation[7] can take place. Remarkably too, while at each of these zeros there is locally time reversal symmetry, because of the Pauli exclusion principle, they are susceptible to re-arrangement in a definite order, so it can be postulated, they have a proper global time ordering.

References

1 Rowlands Peter and Diaz Bernard, 2003, A Computational Path to the Nilpotent Dirac Equation, Symposium 10, International Conference for Computing Anticipatory Systems, HEC Liege, Belgium, August 11-16, 2003, International Journal of Computing Anticipatory Systems, editor Daniel Dubois, in press.

2 Rowlands Peter, 2003, Symmetry Breaking and the Nilpotent Dirac Equation, Symposium 10, International Conference for Computing Anticipatory Systems, HEC Liege, Belgium, August 11-16, 2003, American Institute of Physics Proceedings of the International Conference of Computing Anticipatory Systems, editor Daniel Dubois, in press.

2a Rowlands P. and Cullerne J.P. 1999 A derivation of particle structures and the Dirac Equation from fundamental symmetries, Proceeding of the 20th annual meeting of the Alternative Natural Philosophy Association (ANPA), Wesley House, Cambridge, editor K.Bowden,155-191. contact is via anpa-discussions-subscribe@yahoogroups.com

2b Rowlands P. and Cullerne J.P. 2001, Nilpotent Representations of the Dirac Algebra, Proceeding of the 22th annual meeting of the Alternative Natural Philosophy Association (ANPA), Wesley House, Cambridge, editor K.Bowden, 99-106.

See also at xxx.lanl.gov

the Dirac algebra and its physical interpretation, with J. P. Cullerne
arXiv:quant-ph/00010094

Applications of the nilpotent Dirac state vector, with J. P. Cullerne
arXiv:quant-ph/0103036

A foundational approach to physics
arXiv:physics/0106054

The Dirac algebra and grand unification with J. P. Cullerne
arXiv:quant-ph/0106111

QED using the nilpotent formalism, with J. P. Cullerne

arXiv:quant-ph/0109069

The group structure bases of a foundational approach to physics, with J. P. Cullerne and Brian D. Koberlein

arXiv:physics/0110092

3 Alling N. 1988, Foundations of the Analysis over Surreal Numbers, Mathematical Studies, 141, North Holland, Amsterdam.

4 Conway J.H. 1976, On Numbers and Games, Academic Press, London.

5 Clement B.E.P., Coveney P. and Marcer P. 1993, Surreal Numbers and Optimal Encodings for Universal Computation as a Physical Process: an Interpretation of the Genetic Code . CCAI Journal, 1, 1/2, 149-164

6 Dirac P.A.M. 1947, The Principles of Quantum Mechanics, Clarendon Press, Oxford.

7 Schempp W. 1992 Quantum Holography and Neurocomputer Architectures, Journal of Mathematical Imaging and Vision, 2, 279-326.

8 Feynman R.P. and Hibbs B.J. 1965, Quantum Mechanics and Path Integrals, McGraw-Hill, New York.

9 Jessel M. 1954 Compte Rendu Academie des Sciences, Paris, 239, December, 1599-1601. in French, first actual contribution to the theory of Huygens'principle. This paper lead Jessel to the discovery of anti-waves, and to investigate in particular to those of anti-sound, ie the dynamic annihilation of sound throughout an entire three dimensional spatial domain.

9a Jessel M. 1981, Secondary Sources and Their Energy Transfer Acoustic letters 4, 9, 174-179

Note:- In Fatmi et a. 1990, Theory of Cybernetic and Intelligent Machines based on Lie Commutators, International Journal of General Systems, 16, 123-164, based on Fatmi H.A.and Resconi G.'s New Computing Principle, Il Nuove Cimento, 1988, 101b February, 230-242, and Fatmi and Young R.W.s' definition of Intelligence, 1970 Nature 228, 97 the cycles of the machine are also, as was first proposed by one of its authors Resconi "fueled" by entropy in the sense of Scully et al. That is to say that in relation to the Universe as a QCE that entropy constitutes the basis of its universal information metric in respect of the fuelled natural structure.

10 Berry M V 1989 The Geometric Phase, Scientific American, December, 26-32.

10a Resta R. 1997 The Geometric Phase, Europhysics News,28,19, also Manini 2001 http://www.sissa.it/~manini/berryphase.html Berry's geometric phase: a review,03/05,1-9.

11 Scully M. O. et al 2003, Extracting Work fro a Single Heat Bath via Vanishing Quantum Coherence, Science, 299, 7th February, 862-864. 10.1126/science.1078955.

11a Zurek W.H. 1998 Algorithmic randomness and Physical Entropy, Physical Review A, 40, 8, 4731-4751.

11b Zurek W.H. 1989 Thermodynamic cost of computation, algorithmic complexity, and the information metric, Nature, 341, 14th September, 119-124.

12 Chapline G. 1999, Is Theoretical Physics The Same Thaing as Mathematics? Elsevier Physics Reports, 315, 95-105.

13 Wheeler J.A. 1986, Physics as Meaning Circuit: Three Problems, Frontiers of Non-equilibrium statistical Physics, editors Moore G.T. and Scully M.O. Plenum Press, New York

13a Landauer R. 1986, Computation and Physics: Wheeler's Meaning Circuit? Foundations of Physics, 16, 6. June, 551-564.

14 Turing A.M 1936 On Computable Numbers with reference to the Entscheidungdproblem, Proceedings of the London Mathematical Society, 2, no42, 230-265 and 544-546

14a Deutsch D. 1985 The Church-Turing principle, and the universal quantum computer, Proceedings of the Royal Society of London, A400, 97-117.

15 von Neumann J. 1966, Theory of automata: construction, reproduction, homogeneity, Part II of "The Theory of Self-Reproducing Automata editor Burks A.W. University of Illinois Press, Urbana, Illinois.

16 Perus M. and Bischof H. 2003, The Most Natural Procedure for Quantum Image Processing, Symposium 10, International Conference for Computing Anticipatory Systems, HEC Liege, Belgium, August 11-16, 2003, International Journal of Computing Anticipatory Systems, editor Daniel Dubois, in press.

16a Perus M. 1996 Neuro-Quantum Parallelism in Brain-Mind and Computers, Informatica 20,173-183

16b Pribram K.H. 1991 Brain and Perception: Holonomy and Structure in Figural Processing. Lawerence Eribaum Associates, New Jersey.

16c Sutherland J. 1999, Holographic/Quantum Neural Technology, Systems and Applications, ISCAS 313-334, http://www.andcorporation.com

16d Clement B.E.P. et al. 1999 The Brain as a Huygens' Machine, Informatica 23, 389-398

16e Marcer P and Schempp W.1998, The Brain as a Conscious System, International Journal of General Systems, 27, 1/3, 231-248

17 Schempp W. 1998 Magnetic Resonance Imaging, Mathematical Foundations and Applications, John Wiley, New York., see also http://www.civm.duke.edu

17a Binz E. and Schempp W. 2000 Creating Magnetic Resonance Images, Proceedings of the Third International Conference on Computing Anticipatory Systems, International Journal of Computing Anticipatory Systems, 7, 223-232.

17b Binz E. and Schempp W. 2000 A unitary parallel filterbank approach to Magnetic Resonance Tomography, American Institute of Physics Proceedings 517, of the Third International Conference on Computing Anticipatory Systems, editor Dubois D. August 9-14, 1999 Liege Belgium 406-416.

18 Schempp W. 1993, Bohr's Indetermincy Principle in Quantum Holography, Self-adaptive Neural Network Architectures, Cortical Self-Organization,

Molecular Computers, Magnetic Resonance Imaging and Solitonic Nanotechnology, Nanobiology 2, 109-164.

19 Gariaev P. Birstein B. Iarochenko A. Leonova K.A. Marcer P. Kaempf U. Tertishy G. 2002 Fractal Structure in DNA Code and Human Language: Towards a Semiotic of Biogenetic Information, International Journal of Computing Anticpatory Systems , Volume 12, 255-273

19a Marcer P. and Schempp W. 1986 A Mathematically Specified Template for DNA and the Genetic Code, in terms of the physically realizable Processes of Quantum Holography, Proceeding of Greenwich (University) Symposium on Living Computers, editors Fedorec A. and Marcer P. 45-62.

19b Gariaev P. Birstein B. Iarochenko A. Leonova K.A. Marcer P. Kaempf U. Tertishy G. 2001 The DNA-wave Biocomputer Fourth International Conference Computing Anticipatory Systems, Journal of Computing Anticipatory Systems,10, 290-310

19c Marcer P. and Schempp W. 1998 The Model of the Prokayote Cell as an Anticipatory System Working by Quantum Holography, International Journal of Computing Anticipatory Systems, editor Dubois D. CHAOS, 2, 307-315.

20. Chomsky N. 1975. Reflections on Language, New York,

21. Marcer P. and Mitchell E. 2001, The Physical Nature of Consciousness, Advances in Consciousness Research, editor Van Loocke P., John Benjamins, Amsterdam. 145-174.

22. Schempp W. 1986, Harmonic Analysis on the Heisenberg Group with Applications in signal theory, Pitman Notes in Mathematics, Series 14, Longman Scientific and Technical, London.