Surmounting the Cartesian Cut: Torsion Fields, the Extended Photon, Quantum Jumps, The Klein Bottle, Multivalued Logic, the Time Operator Chronomes, Perception, Semiotics, Neurology and Cognition

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We present a conception that surmounts the Cartesian Cut -prevailing in science- based on a representation of the fusion of the physical 'objective' and the 'subjective' realms. We introduce a mathematical-physics and philosophical theory for the physical realm and its mapping to the cognitive and perceptual realms and a philosophical reflection on the bearings of this fusion in cosmology, cognitive sciences, human and natural systems and its relations with a time operator and the existence of time cycles in Nature's and human systems. This conception surges from the self-referential construction of spacetime through torsion fields and its singularities; in particular the photon's self-referential character, basic to the embodiment of cognition ; we shall elaborate this in detail in perception and neurology. We discuss the relations between this embodiment, biophotons and wave genetics. We characterize quantum jumps in terms of the singularities of the torsion potential given by the differential of the complex logarithmic map (CLM) of the propagating wave satisfying the nilpotent eikonal equation of geometrical optics. We discuss the relations between torsion and semiotics, and the torsion singularities as primeval to perception and cognition. We introduce Matrix Logic (ML) from the torsion produced by the nonduality of the True and False Operators, and non-orientable surfaces: Moebius band and Kleinbottle. We identify the extended photon twistor representations derived from the above theory with cognitive states of the Null Operator of Matrix Logic. The CLM that generates the torsion potential is found to be embodied as the *analytical* topographic map representation (TMR) of diverse and integrated sensorial modes in the neurocortex, while the Kleinbottle appears to be the topological embodiment of self-reference in general, is the *topological* TMR. The singularities of the analytical map are the areas of the two-dimensional sections of the neurocortex in which *all* the field orientations are superposed. This is the singularity of the Kleinbottle. We discuss the appearance of vortical torsion structures in the striate neurocortex and its relation with Karman vortices as the 'interiorization' the 'outer' torsion fields which describe the representations of the field of orientations of visual stimuli -as it appears in the hypercolumnar structure in the neurocortex. The Brownian motions diffusion processes produced by the torsion geometries through the CMP have a correlate diffusion processes in the neurocortex that can be associated with developmental morphogenetic growth patterns. We discuss the relations between morphogenesis, neurology and development in particular of the human and mammal heart and self-reference. We relate torsion in ML, the resultant Logical Momentum Cognition Operator and its decomposition into Spin and Time Operators. This relates quantum physics statements into logical statements. Time Operator, is a primeval distinction between cognitive states in this Matrix Logic as its action amounts to

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compute the difference between these states. As a geometric action, Time is a ninety degrees rotation in the 2-plane of all cognitive states. We relate Time to intention, control, will and the appearance of life, and chronomes (time waves and patterns in natural and human systems and phenomenae). We discuss cosmological and anthropological problems from this perspective. We relate Time with the perception of depth considered in the phenomenological philosophy of Merleau-Ponty as a protodimension, and the problem of hemilateral synchronization with universal torsion chronomes (Kozyrev) in terms of the transactional interpretation of quantum mechanics, and the CMP retinotopic representation. We discuss *quantized* time and motion perception in relation with ATP production.

1   INTRODUCTION

In this chapter we shall present a theory in which the 'exterior' [2] world of physics, particularly the constitution of spacetime through the phenomenon of quantum jumps and extended photon structures, is fused with the 'interior' world of perception, cognition and subjectivity at large. This will surmount the Cartesian Cut conception which separates the world into an objective theatre on which consciousness plays a passive role as a bearer of information of the 'exterior' world [3]

Our conception is radically different; it is based on self-reference: The subject cognizes the world and simultaneously establishes himself as a singularity (an irreducible form which is also a process) through cognition and perception stemming from distinctions, differences that make a difference in the sense of Bateson [8]. These are distinctions which on being perceived, cognized, abstracted or interpreted, generate higher-order differences, which amount to the universe of all manifestations, either virtual, processual, operational, algorithmic, formal, conceptual or real; for further developments of an epistemology for science that departs from this notion due to Bateson, see Johansen [52].
Without distinctions in its manifold manifestations, the world would be homogeneous and imperceptible [101], and definitively, there would be no thing or process to cognize nor Cartesian subject to bear cognition, nor consciousness.

Returning to our discussion on the prevailing conception, we wrote as customary 'information' to indicate the Cartesian take on cognition, which erases the ideative aspect of knowledge of a lifeworld (lived world) of all traces of subjectivity. Instead, through the semiotic action of breaking 'information' by introducing the linking sign '-', we indicate the presence of intention as a generative field whose consequence is the emergence of a function derived from cognition, not a mere receptacle which is no more than the subject qua object. The latter introduction is an example of the fact that signs encode energy as discussed by Pattee [83] and Taborsky [123]. Most physicists working towards understanding cognition,

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[2]To surmount the Cartesian Cut we take initially the trend of expliciting its most notorious dualisms, postponing to a section below and to Rapoport [101] and the epistemology by Johansen [52] in which they are unnecessary from the very beginning; they both depart from the primeval notions of distinction and boundary.

[3]Or at best a physical world that arises from information (Wheeler's it from *byte*), yet devoided of subjectivity and in particular of intentionality and thus is still inside of the Cartesian Cut epistemology, or a participant of the quantum measurement that 'collapses' the probability wave function.

apply physical models in their Cartesian mindset. There are several works that propose the origin of consciousness in the *brain's* electromagnetic field; again, the brain, not the body [86, 132, 69], neglecting the knowledge of Traditional Chinese Medicine [78], based in a vortex in-formation interconnected meridian system that regulates *all* physiological processes and embodies emotions organically . [4] McFadden's scientifical, poetical and humane reflections on will are a far cry from the usual academic parlance. Yet, it is framed in the Cartesian mindset, linking will and intention to non-computability of quantum processes on neurons following Penrose [84], not to the action of a time operator as we shall elaborate in the present chapter. The bottomline for this idea of non-computability is the Hypothesis of the Continuum of Mathematics which heavily relies in the Antidiagonal Number Construction of Cantor's Theorem; see page 22 in [42]. We quote N. Hellerstein : "The number thus constructed leads to consider an infinity of infinites; so surely it must, within itself, contain an infinite amount of *information* about all these infinities. Otherwise, the silly thing is just bluffing us !". This *infinite* amount of information of the continuum is what is at stake in Penrose's proposal of consciousness as an *emergent* physical-algorithmic phenomena. [5] Hellerstein dilligently follows the query to conclude in few lines of page 106 that the bluff is evident. Indeed, the Antidiagonal Number has a paradoxical bit at a certain place N, until this place is a mere *finite* dyadic and henceforth it has an infinite paradoxical section made of an identical paradoxical wave [55] that appears in the 4-valued logic that follows from

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[4] As the expression 'venting ones spleen' means, consonantly with this system, to vent ones ire.

[5] Of course, this infinite information idea runs counter with the conception of a quantum space and time, which is the core of torsion, yet remarkably this has escaped the attention of the researchers working in quantum formulations of consciousness: A contradiction in the very cornerstone of a conception which we understand to be ill-formulated. This contradiction is carried further in the attempts to blend quantum physics with Einstein's GR -see [109] for a discussion in terms of phenomenological philosophy and the Kleinbottle- which has null torsion and thus refers to a continuum, alike the one we are presently examining; so GR has to be *quantized*, a futile enterprise till today. In 'Shadows of the Mind', Penrose presents his theory based in the Goedel theorem and still Turing's theory of computation. Penrose addresses the former from its alleged protoform, the paradoxical diagonal construction known as Cantor's Theorem, reaching the proposition that a computation does *and* does not terminate; see page 75 [84]. Would we assume -as Penrose *implicitly* did without noticing that it was tantamount to a particular choice of (Boolean) logic- the principle of non-contradiction of Aristotelian-Boolean logic we would conclude with him that this is not possible and indeed the computation does not terminate and we *do* obtain a protoform of the Goedel Theorem. Now, in a self-referential construction as the one produced by Penrose albeit unacknowledged as such, and as further elaborated by Hellerstein and the present author, the corresponding logic is not Boolean but multivalued; it is the Kleinbottle. In fact there is a number whose computation does terminate (it has dyadic *finite* initial dyadic expansion) *and* also does *not* terminate (the finite dyadic expansion is followed by an *identical* and thus *redundant* -but for the effect of better approximation we could still repeat it as far as we wished- with exception of its first element, infinite paradoxical expansion, and this is precisely the Antidiagonal Number produced by Cantor's Theorem. Hellerstein proves further that in this multivalued logic framework, which essentially coincides with the logic constructed by the present author from the protologic that surges from a primeval distinction and the self-referential extension to the Kleinbottle, there are an *infinite* quantity of real numbers which have this same property and there only exist a *finite* quantity of reals that are actually infinite. For a discussion on self-reference, the Kleinbottle and the need of an ontology which is lacking in Goedel's Theorem we refer to Johansen (2006) [52]. (Our criticism to Penrose's approach is essentially the same as Johansen's: the anchoring to an ontology in which self-reference plays a generative role is lacking and thus the rejection of multivalued logic and self-reference is persued as if they would not be present in the developments). Our departure to reach the understanding of the role of the Kleinbottle presented in the present conception was from this this work.

raising the calculus of distinctions of Spencer-Brown originated from a primeval distinction to encompass a self-referential equation which topologically is the Kleinbottle and from which we derived Matrix Logic [101]. Thus, "Cantor's Theorem is hereby exposed as not only superfluous, but actually ridiculous. The continuum is countable; Cantor's Paradox detects bit-flip at a dyadic. Therefore I propose a down-to-earth alternative to Cantor's tottering cardinal tower; a single countable infinity with paradoxical logic". This he calls, most appropiately, *Mathematics for Mortals*." [6] Hence generalizing to a multivalued logic with paradox, "we get a much more simple theory; a sign of elegance". Thus, the hypothesis of Penrose further raised by many researchers, that non-computability is a source for consciousness and (free [7]) will appears to be ill-conceived as we have just discussed, though it contains in our view some truth in that will and paradoxical time waves that appear in the Antidiagonal Number Construction and most (actually infinite) real numbers are indeed related; see page 107 [42]. Hence, we feel obliged to note that we have just unveiled that time as an operator has appeared in Mathematics conceived as a system through the Continuum Hypothesis. It reappears in the rotational recursive structure of the natural numbers (and in particular in the self-referential primes) in the remarkable work by Johansen [54]. We shall find us here very far here from the trivial sequential notion of linear time parameter, and in particular in its embodiment through the Peano construction of the natural numbers. In distinction to Hilbert's proposal of constructing an axiomatisation for Physics and the working mathematician daily practices, axiomatics can only provide for the algorithmic

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[6]Following our adherence to Merleau-Ponty's and S. Rosen's philosophies in which cognition is embodied, this grounding of abstraction implies an embodiment of Mathematics in the human lifeworld. While Computer Science by definition works with discrete finite numbers which first appeared in Physics through *finite* big numbers, the usual corpus of Mathematics ignores this embodiment which in fact is the core of a Platonian lifeworld, not its denial as usually considered.

[7]The problem of the lack of constraints of an emergent physically-algorithmic will is still a very difficult if not impossible to resolve issue in a Cartesian mindset which ignores the joint constitution of the world and the subject; how can the subject in its finiteness determine the lack of constraints? If it is a matter of asserting its undetermination vis-à-vis a pledged independent reality of his/her subjectivity which is believed to emerge from its undeterminateness, we find that in taking a conceptual route that ignores self-reference then the wished freedom is left undetermined as well and we are lead to a paradoxical situation in which the subject and his/her lack of constraints become tied self-referentially belying the initial conception. No theoretical exercise whatever its mathematical acuteness and complexity as in Penrose's extraordinary corageous and thought provoking works can surmount this problem if it ignores self-reference in its outset. (In fact, Penrose takes a whole chapter III to justify his conclusions and use of Cantor's Theorem, notably using self-referential constructions -and very complex argumentations-, which he claims not be the case.) Which is the absolute Undetermined Source from which the subject can claim its lack of constraints and how is it that the subject can assert the lack of constraints of the Source? This leads to an infinite antiregress of emergence in which the world and the subject are pushed away one from the other -perpetuating the alienation of the Cartesian mindset- in each attempt to assert their claimed independence. This is the disolution of the grounding of an emergent consciouness approach which is very much ingrained in the works by physicists studying consciousness, and of course, is no matter of concern for the working Cartesian scientist. He/she is pleased enough in finding their efficacy in *controlling* the world, without even able to imagine nor grasp that control and will are undisolubly fused to a time operator which is grounded in the Kleinbottle meta-algorithmic fusion of object-with-subject. So their free will in practicing this control is related to a phantasy that transpires hubris which makes of the world a token for predation in which the scientist reinforces its own alienation. We shall reencounter this phantasy in a cosmological (!) setting in our study below of the Myth of Eternal Return as a self-referential system.

rules (the legislation for the formalities [8]) of the game in which Mathematics is daily played on the background of an absent self-referential epistemology. Yet it will never provide for the meta-algorithmic lifeworld. This is another example of the Cartesian Cut emergence antiregress we commented before.

Our proposal in first approximation only requires to ponder what the meaning of intention is to establish the link between will, intention and the time operator; in this chapter we shall propose an explanation of an ancient myth, the Eternal Return, in these terms, as an illustration of an all encompassing cosmology that includes natural and particularly, human systems. In the Cartesian mindset, language is considered to be informational, not in-formational. Interpretation is ontologically inexistent. Subjects qua objects, mere containers of data, i.e. information, and hermeneutics, the inquisitive intention of the subject in search for interpretation for achieving understanding to sustain the logic of her/his own being together to the logic of the Universe with whom the subject are enacting, is neglected for the Cartesian mindset. Thus, the lifeworld of Being is shattered to broken bits which henceforth will force cognitive scientists to frame it in terms of some kind emergence. These shattered bits produced by the act of irreflection will never be recomposed because the Cartesian mindset has no operation-operand to provide for the glueing, nor to mention the Kleinbottle which stands not for a mere reparation but for the lifeworld of Being. So physicalism and emergence -which we have already discussed- or some form of subjectivism will be the core of its paradigmatical framework, or we may encounter a so called 'third way', such as the emergence of the Great Doubt in which the Buddhist conception will want us to disolve [107]. Thus, the subject is turned into an object though a thinking one as in Descartes, yet for which thinking is an untraceable process as in the physicalist emergence proposal, or disappears as in the Great Doubt, Varela's et al proposal in cognitive sciences to surmount the Cartesian Cut. We have already presented a conception which surmounts the Cartesian Cut based on geometrical-logo-physical self-referential fields (torsion fields), phenomenological philosophy, second-order cybernetics (the cybernetics of controlling systems, i.e. which include the controller), multivalued logics, non-orientable surfaces such as the Moebius and Kleinbottle surfaces and its relations to neurology and phenomenological philosophy [101].

In [103] we showed that extended photons are codified as cognitive states in a multivalued Matrix Logic (originally due to A. Stern [121]), which has as particular cases quantum, fuzzy and Boolean logics establishing a relation between quanta and thought. We introduced Matrix Logic in two ways : as the topology of paradox in a protologic (related to the work of Spencer-Brown [119]) which follows from a primeval cleavage-distinction [9] (which thereby

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[8] Musès criticism of the non-standard analysis (A. Robinson, Edward Nelson nowadays) approach to infinitesimals and infinities as purely legislative in distinction of his treatment through hypernumbers [72] is an excellent showoff how the management of this axiomatisation approach becomes a clear example of the infinite antiregress we mentioned before, leading to a vicious circle of unending complexity in ignorance of the fact that the existance of time operators is essential to Mathematics as we encountered above.

[9] This notion of a primeval distinction-cleavage or still of boundary in the sense of the protologic due to Spencer-Brown, was further extended to a 3-valued logic by introducing the semiotic codification of the reentrance of a form on itself (essentially, the Kleinbottle which for the ancient traditions was the Eternal Return Ouroboros, or the Frigian cap (of French Revolution fame) for the Frigian civilization of Anatolia, or still the Pelican Christus [90]) as a third logical value in addition of two other values given by an empty

acts as a semiotic (i.e. through a sign) codification of the torsion quantum field that embodies the fusion of object and subject and the joint genesis of both) in a two-dimensional plane of all potentialities, giving rise to the appearance of a 4-state valued logic in which in addition to the Boolean states we have two primeval time waves enacting self-reference as new paradoxical states, and the topology of torsion fields as the Kleinbottle (of Eternal Return fame). In the second way we introduced Matrix Logic as the logic generated by two times two matrices representing all possible logical operators (not mere scalar connectives) from the torsion that surges from the commutator of the True and False *Operators* that extend the Boolean values and are non-dual (in distinction with Aristotelian-Boolean logic) and from the non-orientability of the Moebius and Kleinbottle surfaces, which thus has superposition topo-logical cognitive states as its foundations. In particular, quantum field operators take a logical representation as nilpotent operators. We established a two-way transformation between the eigenstates of Null Operator of Matrix Logic and the twistors representation of the extended photon arising from the quaternionic wave propagation and eikonal equations and viceversa [103]. Thus, the primeval distinction gives rise to the most fundamental joint constitution of object with subject: the transformation of the quantum photon states into the eigenstates of the Null Operator. We showed that a Logical Momentum Operator, also called the Cognition Operator (since it can be alternatively represented as a variation of cognitive value, basically its derivative), appears from the non-duality of True and False, or still, from the above mentioned non-orientability. We found that the Cognition Operator decomposes as a Spin plus a Time Operators. This allows to express quantum physics statements into logical statements and viceversa. The latter introduces a fundamental Time Operator which represents the most primeval distinction between cognitive states in this Matrix Logic as its action amounts to compute the difference between these states. This Time Operator also is a primeval ninety degrees rotation in the 2-plane of all cognitive states. In this article we shall relate Time to intention-will-purpose, to the origins of life, to the Myth of the Eternal Return as a logo-physical process, and time-waves in natural and in particular human systems (chronomes), especially to the problem of the constitution of stereoscopic vision and the perception of depth. In the phenomenological philosophy of Merleau Ponty depth is a protodimension, and its appeareance in the perception of the Necker cube shows to be related to time and the appearance of multivalued logic, surpassing thus Aristotelian dualism.

Yet, in these previous works, while the role of the Kleinbottle in the neurocortex structure was pointed out, the relation between the theory of the physical world in terms of torsion and that of the world of subjectivity in terms of perception was only summarily introduced to argue the gestaltic identity between the physical theatre, logical and cognitive realms and visual perception embodied in the Kleinbottle. In the present chapter we shall extend our works [101, 103], establishing a relation between the self-referential geometry of spacetime constituted by photon fields (as basic example of torsion fields, essentially vortical fields) to the somatotopic, visual and integrated sensorial modes representation in the

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state without the semiotic codification by the cleavage-distinction and the distinguished state codified by the sign of the cleavage-distinction, which in the Boolean interpretation we intepret them as the usual true and false values [131]; it was still extended to a 4-valued logic by considering the reentrance of a form on itself with a delay [55] from which we derived Matrix Logic [101].

neurocortex. We shall further relate this to the complex logarithm map which will appear both in the characterization of quantum jumps in terms of the singularities of a gradient logarithm of photon waves satisfying the eikonal equations for rays, and will appear also as fundamental to the informational topographic map in the neurocortex as well. We shall see that this mapping from the 'outer' (skin surface, limbs, retina, clochea, integrated body sensorium) to the 'inner' world through a topographic representation on the neurocortex is embodied in two superposed integrated maps, one of them being analytical, the other one topological which can be further related between themselves. The topological map is associated to the non-orientability of the Moebius and Kleinbottle self-referential surfaces. The analytical map is provided by the complex logarithmic function which as in the physical realm, has singularities which have to do with the vortical structures in the neurocortex (more specifically in the so called hypercolumnar structure) and stand for the points in which the orientation mapping given by the logarithmic map becomes multivalued. Yet, this map is the analytical representation of the $3D$ outer body (and its surface) to a $2D$ plane in the neurocortex in which each point codifies a whole hypercolumn vortex which is not anatomically distinguishable [48].

The multivaluedness singular structures of spacetime vortical torsion structures which are the locus for quantum jumps and as such as the most primitive distinctions that make possible the constitution of a spacetime, have in the perceptual mapping transformation given by the complex logarithm an inner representation by the same complex logarithm in which the quantum jumps are turned into multivalued points of orientation representation of the neurocortex. Hence, this conception establishes the embodiment of the Universe jointly with subjectivity, the subject, perception, cognition and thought.

Our presentation of this conception and its unfolding in the present article will be completely different to the one presented in [101]. In that work, the unfolding of the conception started with the philosophical aspects, mainly departing from second-order cybernetics to further link with phenomenological philosophy and its relation with (paradoxical) logic, depth perception (departing from the work of M. Merleau-Ponty [75]), time and subjectivity (departing from the work of Heidegger, and more relevant to the present conception, to the works of Hegel [41] and G. Gunther [34]), to finally connect it with the lifeworld embodied in the Klein bottle, following the conception of *radical recursion* in the work by S. Rosen [108]. This previous presentation naturally lead us through the protodimension given by depth as elaborated by Merleau-Ponty and Rosen to visual perception and the Kleinbottle. From those preliminaries we introduced the notion of primitive distinction and its identification as the semiotic codification of a torsion field that generates space, and still time by considering the paradoxical equation in the calculus of distinctions that arises from this primeval distinction. We further introduced the time oscillations that arise from the solutions of this paradoxical equation and the multivalued logic that arises from them. We then introduced Matrix Logic due to Stern [121] to show that it is associated with the torsion in cognitive space introduced by the non-duality of the True and False Operators. We further studied the transformation of cognitive operations into quantum spin operations and viceversa.

In the present chapter we shall follow a completely different unfolding of this conception, starting instead of cybernetics and the phenomenological philosophy and visual perception,

with the most basic embodiment of the fusion of object and subject that embodies (quantum) action and perception as the result of an integrative process of the 'exterior objective' and 'subjective' worlds: the photon. Indeed, the photon is not seen but it is the seeing [139], so at the fundamental level of constitution of reality, action and perception are unseparable which thus appears to be the foundation of coorigination of the world and the subject. [10] So quantum physics will be our departure point and as we have just disgressed, physical reality cannot be separated from perception [63][39] nor from thinking!

Our conception is somewhat related to the concept of *enaction* proposed by Varela and associates [107] for the process of cognition that surmounts the Cartesian Cut by conceiving embodied cognition, following the phenomenological philosophy due to M. Merleau-Ponty [75]. We coincide with these authors that '...the self becomes an objectified subject and a subjectified object'; page 242 [107]). Yet, how is this produced is left unexplained; in particular the relation of enaction and the Kleinbottle is altogether ignored, as well as the essential role of the latter in perception. Indeed, it is quite remarkable that in the conception of Varela [11] no relation between the photon and this fusion of action and perception embodied is proposed; we shall present this relation in this chapter, in fact it will be our starting approach as we shall explain further below. By failing to notice this primeval constitution of the Self, they take the road of Buddhism to elaborate an extreme form of nihilism, in spite of their pledges on the contrary. Based on the primeval 'Great Doubt' of the disolution of Self and thus of the claimed fusion of object-with-subject, which is found to be inexistent but a mysterious illusion that in contradiction with their profession of fusion of object-with-subject in their embodied cognition enaction approach, is left unembodied and an explanation of the origin of its reification undelivered. In this regard, it is remarkable still that in this proposal not even the body's cells embody cognition, due to the fact that they are short lived and thus -in their own words- are similar to the wooden planks of a ship that on decomposition due to the inclemence of the environment and hard use are condemned to ephimery and to be replaced until the ship itself is no longer. Thus, with this conceptual background they are lead to question if the continuously replaced ship in its components is the same one than the previous one to substantiate the permanence of Self. We would like to comment on the Cartesian mindset implicit to their proposal for an embodiment of cognition which has no body for Being. In their take of enaction, Self if biologically grounded should be *inert*: the cells are mere mechanical pieces, and thus time and light as the primal organization fields of fusion of subjectivity and objectivity is disconnected to Self. This runs counter with the knowledge on biophotonics by Popp et al [87] at the time of their writing, that originated in the discoveries of ultraweak photon emission from living systems by Alexander Gurwitsch circa 1923 in the USSR [35], and especially the fact that DNA emits electromagnetic and

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[10]Thus in the photon we find a fusion of Kant's nouminal (the 'objective external' world) and phenomenal (the 'internal' perceptual) realms. Due to the relation between the eigenstates of the null logical operator of Matrix Logic with the twistor representations of the extended photon, we have claimed that the photon is seeing-thinking, due to the above mentioned relation with the cognitive states of the null operator of Matrix Logic, which we named the *mind apeiron* since it embodies all the potential cognitive logical observables [103].

[11]Which is superposed with an apologetics of a particular religion -Buddhism- as a conceptual basis for cognition and sciences at large and still the path to the experience of wholeness which should lead us to the creation of a better world, as well as a philosophy of pragmatics which thus includes ethics.

sound waves [31]. Furthermore, as unveiled by Gariaev and associates, DNA has in the 98 percent strands unparticipating in the biochemical functions (the so-called 'junk DNA') [12], the structure of a language. These findings were confirmed in the work of Mantegna et al [65]. Thus, cells have down to DNA a cognitive structure which is based on the photon's fusion of object-with-subject and its linguistic structure. Thus, interpretation and meaning, as well as intention [13] are biologically grounded in the biophotonic structure-process of DNA [14]; furthermore, communication between distant cells is produced by electromagnetic signals [87][23]. For further crucial studies on the DNA electromagnetic structure-process and its holographic behaviour we refer to Marcer and Schempp [67, 113]. Thus we are lead to suggest that the physical-biological basis for the embodiment of Self is already the (bio)-photon. We shall find this again when discussing the embodiment of perception through neurocortex topographical maps. Returning to the philosophical aspects of Varela's proposal, the achievement of the experience of this Great Doubt is claimed to be the core of Buddhism by its authorities and practitioners, and in particular of these authors' approach to cognitive sciences, leaving their 'enaction' absolutely ungrounded. Remarkably the experience of Great Doubt is through the so-called 'illumination' experience which makes the interpretation and theoretization of their conception that leading to the Great Doubt, a contradiction. In our understanding, the Great Doubt is the specular nihilist image of the positivism of the dualistic approach, in which by taking the principle of no contradiction as its conceptual basis, all the universe of discourse is placed on the positive affirmative truth value which encompasses *all* the universe of discourse, as explained by Gunther, and thus subjectivity and its relation with time and multivalued logics (in particular the ego-complex which Varela and generally Buddhism want to leave groundless) is rendered without an ontological locus in the dualistic approach [34, 101]. This follows a quite puzzling -to this author- tradition of Tibetan Buddhism, in which though light and its experience is discussed extensively [33], yet its fundamental self-referential character is not mentioned altogether (see especially pages 52 and 83 of Guenther's philosophical treatise), to our best knowledge which we confess we are far from being scholarly versed in the subject. Anyway, it is remarkable that the great scientist Varela, which was very close to the maximum exponents of Tibetan Buddhism, would not be aware of this fundamental character of light to omit mentioning it altogether in his work [107]. [15]

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[12]An expression of the hubris implicit to the interpretation of the standard dogma in genetics, yet not uncommon to the practices of scientists of all professions.

[13]In the conception presented in this chapter, language is not a mere conveyor of information, but an informed and in-forming field by its self-referential essential character. It semiotically embodies in-formation as well as produces it, embodying cognition and the will to in-form. Language has an indicative -and in some instances imperative- character, and thus embodies purpose-will-intention. We shall later see the connection of this with time operators and life.

[14]We shall later on discuss the relation between time operators, will and the surgence of life.

[15]All religions, in spite of their cognitive richness, have a fundamental problem: the difficulty of grounding them socially, where the social character already finds its grounds in languages and the intentions embodied by them, and of course, in social organizations as well. Thus the former invariance might perhaps be the hiatus between cognitive states which are not the True state (we are speaking here of a continuum of cognitive states in Matrix Logic which is multivalued) and volition; both are actions and have a perceptual and ideological framework. This hiatus is related to the impossibility of disolving self-reference into the undistinguished -under a primeval cleavage- state, the void to the Buddhist tradition, which is the plenum

Yet, in the present setting related to the fundamental inhomogeneities given by photons as the fundamental case of torsion, and wavefront propagation of singularities which give a non-trivial spacetime which is not based on the notion of metrics but in the primeval notion of distinction and difference producing differences as argued by Bateson [8] which also is the starting point for the epistemology due to Johansen [52]. The evolution of the present article will be on mathematical terms rather than philosophical and perceptual, to which we shall arrive as a byproduct of the present departure with the photon, as the primeval gestalt of a participative universe in which subjectivity is primeval. Then it will be natural to connect the physical notion of quantum jumps as a primeval quantum distinction associated to torsion with visual and somatosensory perception.

Thus this chapter will be separated into three main parts: Firstly we shall present the theory for the constitution of spacetime in terms of photon torsion fields and the relation with quantum jumps, comprising Sections II to IV, which we shall later discuss. Secondly we shall present Matrix Logic in the framework of the torsion in cognitive space that arises from the non-duality of the True and False Operators, and the codification of extended photons as eigenstates of the Null Operator. [16] Let us recall that Matrix Logic was in two possible approaches both related to the Kleinbottle, as we already discussed above, and starting from the torsion that surges from the commutator of the True and False *Operators* that extend the Boolean values and are non-dual (in distinction with Aristotelian-Boolean logic) and from the non-orientability of the Moebius and Kleinbottle surfaces, which thus has superposition topo-logical cognitive states as its foundations. This leads to the definition of a Logical Momentum Operator which decomposes into the sum of a Spin and Time Operators. The former allows to express quantum physics statements into logical statements. The Time Operator represents a distinction between cognitive states in this Matrix Logic as its action amounts to compute the difference between these states. Time Operator also is a primeval ninety degrees rotation in the 2-plane of all cognitive states. This will have a crucial role in the third series of topics that make this article. We shall start by relating this subjective Time Operator to intention-control, to the Myth of Eternal Return as a self-referential process, and to the existence of chronomes, time waves and patterns in natural and human systems and phenomenae. We shall relate Time with the perception of depth considered in the phenomenological philosophy of Merleau-Ponty as the primeval dimension, and relate the problem of hemilateral eyes synchronization with these universal chronomes such as the Kozyrev resonance entanglement due to torsion fields. We shall discuss the relation of time and space perception in terms of ATP's metabolism to ground time perception to the energetics of neurons. We shall extend this to the quantization of time and the appearance of the perception of motion. We shall characterize cognition as the projection

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of all potential states, the Unmanifest, Apeiron. We shall return to this issue further below in relation with chronomes, universal times waves in natural and human systemsAs with religions, any conception needs to be integrally grounded, and the economic and social realms have to be embodied into non-alienating self-organizations. For the studies of second-order economics and the critique of Marx's theory of capital, proposing an alternative grounding for the science of economics and its social implementation, we refer to the work by Johansen [53]; for the electromagnetic potential based geometry of written and spoken language we refer to the work of Doucet [20].

[16] The philosophically inclined reader unincumbed with mathematical intrincacies might skip these sections and proceed to the more conceptual sections that follow.

on the plane of all cognitive states in Matrix Logic of a vortex torsion structure. We shall discuss the relation between the complex logarithmic map that gives rise to torsion potential vortex and its singularities as the fundamental quanta, as the *analytical* map that allows to represent the visual (in the foveal area), somatotopic, motor, auditory and integrated perceptions in a plane in the neurocortex. The singularities of this map are the loci of the two-dimensional sections of the neurocortex in which *all* the field orientations are superposed, yielding another example of the plenumpotence of 0, which already appeared in the light eigenstates of **0**. This is the singularity of the Kleinbottle, the hole for which the whole unfolds to return to the singularity. We shall see that the Kleinbottle yields the *topological* map representation of the sensorium, a topographic map superposed to the analytical complex logarithm to which is related as we shall discuss below. Further, we shall discuss the appearance of vortical torsion structures in the striate neurocortex and its relation with Karman vortices in viscous fluid dynamics as the 'interiorization' the 'outer' torsion fields which describe the representations of the field of orientations of visual stimuli -as it appears in the hypercolumnar structure in the striate neurocortex proposed by Hubel and Wiesel [48]. We shall relate these discontinuities with the natural appearance in the striate neurocortex of the Klein bottle to the enaction of continuity of the representations of orientations. We shall further see that the complex logarithm map lead to diffusion processes in the neurocortex that can be associated with developmental morphogenetic growth patterns. Also we shall discuss the relation between the complex logarithmic map retinotopic representation and its function to integrate elementary eye distinctions to yield the binocular depth perception, thus returning to the integration of torsion vortex fields and stereoscopic vision, and the appearance of time discussed before, but from a neurological point of view that reaffirms its previous quantum explanation as entanglement through a torsion resonance effect. Finally, we shall discuss the relations between morphogenesis and anatomy-physiology and non-orientability in the Moebius and Kleinbottle surfaces, in particular of the human and mammal heart.

In all these developments the Kleinbottle plays a central and generative role, as the embodiment of self-reference and torsion [56], and of thought as much as to neurology. Already in Rosen's work we find that the idea that the origins of his thought on self-reference and paradox can be established in terms of a topological phenomenology that is traced back to Merleau Ponty and Heidegger, which Rosen establishes in terms of the Kleinbottle. In contrast with Aristotelian dualism this (genus 0 Riemann) surface is both open *and* closed, continuous *and* discontinuous, inside and outside are fused since it has a single side, and fundamentally non-orientable. This surface can be seen -in a first approach- as having an uncontained part (the subject), a contained part (the object) and a containing part (space) [56, 108]. Yet, there is an in-formation flow from the uncontained to the contained part which we could inquire if it can be reduced to the Cartesian cut view of space as a container. The Moebius band which is another surface of paradox can be actually realized in three-dimensional space by taking a band, twisting it and glueing its opposite extremes and thus we have a surface of paradox which is non-orientable as the Kleinbottle, but it can still be thought as satisfying the classical figure of object on space independent of the subject (if we disregard the actual twist). Yet, in distinction with the Moebius band, the Kleinbottle

is not a Cartesian object; [17]; those objects are space occupying and space is thus a mere container. The Cartesian conception counters the experimental and theoretical studies in visual perception that go back to the master painters of Renaissance and more contemporarily in the work of Luneburg [63], Heelan (a former student of Heisenberg) [39] and Indow [50]. The construction of the Kleinbottle can be algorithmized as an initial identification of two sides of a rectangle (or more generally by a cleavaged by a distinction plane free of singularities which is thus topologically deformable to a rectangle) by glueing two opposite sides with the same orientation and identifying the other sides having *opposite* orientations which makes this figure impossible to be actually constructed in $3D$ in distinction with the Moebius band which can be seen as contained in space in a Cartesian sense, though it is non-orientable. This creates a topologically imperfect model in $3D$ since a hole has to be produced so that its construction already introduces singularities which then through the in-formation flow produces the whole structure, so that the whole structure is produced from a hole, and this returns to the singularity to complete the flow. Remarkably, this will manifest the torsion embodied in the Kleinbottle jointly with the singularity. This is further related to D. Bohm's holomovement [13][91] and the integrality of the paradoxical structure to his implicate order, while the singularity is related to the explicate structure, in a first approximation. Indeed, in this wholeness surging from a singularity and back to it, what is at stake is the integral structure from which the implicate and explicate orders are instances and interchangeable through the flow [13, 91]. In this sense, our repetitious expression of fusion of object and subject should not be a conceived as a mere reparation of the Cartesian cut, but rather an indication of the integral structure of which both are instances in a process in which they are unseparable. Indeed, this is an holographic structure, and as such is constructed by the neurocortex as we already discussed before. The Cartesian mindset attitude to this would be to view the Kleinbottle as embedded in $4D$ where the hole is no longer necessary and in doing this, the concrete real figure is cast into an idealization which cannot be manifested by the subject (the Cartesian minded mathematician who thus keeps detached from this abstract ideal in-formation now ideally contained in the Cartesian view. Rosen's stance to which we adhere is instead to keep the hole -so that singularities are unavoidable as in quantum physics or already in the geometrical model of the photon we briefly presented above- as the starting point for questioning the Cartesian stance. In distinction with a Moebius band, a torus or any other object in $3D$, the loss of continuity of the Klein bottle is necessary showing that $3D$ space is unable to contain the surface in the Cartesian stance avows for ordinary objects. So instead of abstracting by incorporating a fourth additional dimension (as is the proposal of Special and General Relativity) we keep the hole that produces the wholeness and instead of an additional dimension we think of the depth dimension as the primal dimension which becomes the source for the Cartesian dimension.[18] To resume, the Kleinbottle instead of being contained in space it contains itself and the flow of in-formation (of action, to start with) that is associated to this topology, is the manifestation of this self-containence, this paradoxical situation which becomes real through the production of a singularity which produces the whole structure. By doing this, it supersedes

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[17]In spite of the repeated claims of J. Lacan's acolytes in contradiction of their guru's writings.
[18]This is already apparent in the multivalued perception and logic elicited by the Necker Cube [79, 108].

the Cartesian cut and the Aristotelian dualism, by superseding the dicothomy of container and contained, and in semiotic terms, of interpreter and interpreted. We can additionally discern from the previous discussion, that the in-formation process of self-reference, i.e. of consciousness which through the laws of thought which are not longer those of Aristotelian dualism, transforms the 'outside into the 'inside world (this transformation is the fourth ontological locus that Gunther proposed on surmounting Aristotelian dualism: thought as a process [34]; for further discussion see [101]), and this transformation produces a relation between thought, logic and the physical world (and thus is essentially logo-physical), and topo-logical superposition states have a genetic role, and is further related with the actual process of transformation of the 'outside' and 'inside' realms. Since discontinuity can be seen as the source for wholeness, one can enquire on the role of quantization associated to the topology of the Kleinbottle and the in-formation process that is associated to this singularity and the self-referential topology, and furthermore the role of quantization with regards to the multivalued logic that is associated to this in-formation structure and its paradoxical character. We shall deal with these questions below. Already Rosen established a link between the Kleinbottle and quantization and still with Musès hypernumbers which incorporate not only non-trivial square roots of -1 but also of $+1$, the latter being associated to spinors, and more concretely, with the Pauli matrices of quantum mechanics [108] (2008)[72]), further applied to a cosmology placed in terms of the hypernumbers which are positive square roots of $+1$.

Returning to the issue of the organization of the presentation of the conception in this chapter, the first topic (comprising Sections II-IV) will deal with a geometrical theory for the characterization of quantum jumps in terms of spacetime singularities produced by a torsion field given by a closed yet not exact differential one-form given by the logarithmic differential of a wave function propagating on spacetime as a lightlike singularity described by a nilpotence condition: the eikonal equation of geometrical optics for light rays.[19] We shall show that quantum jumps are produced precisely when the complex logarithm of a wave function that acts as the source of this torsion singularity (a spacetime dislocation) becomes singular due to the nodes of this wave. These geometrical structures with trace- torsion field including the Hertz potential which has subluminal and superluminal solutions of the Maxwell, yield a theory of unification of spacetime geometries, non-relativistic and relativistic quantum mechanics [99], Brownian motions and fluid and magnetofluid-dynamics [95] and the application to obtain representations for the solutions of the Navier-Stokes equation [95, 97], non-equilibrium and equilibrium statistical thermodynamics [96], to a torsion based theory of the electroweak interactions [105] and still the strong interactions as characterized by Hadronic Mechanics [100]. [20] The relations between torsion and the Coriolis force have

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[19]The reader unincumbent with mathematical complexities may give it a try skipping the first topic and proceed to the second one in Section V and VI.

[20]To resume, torsion appears with a Janus face as the logo-physical-geometrical field which is incorporated into the codification by signs of the non-integrable equations of constraint that bridge the epistemic cut (and thereby allow for memory, measurement, and control in systems theory) [83], as the primitive distinction in the calculus of distinctions in the protologic of Spencer-Brown, which together with the Klein bottle they generate Matrix Logic derived from a non-dualistic approach through paradox leading to multivalued logics and quantum superposition in cognition [101]. In this work, quantum field operators described by nilpotent hypernumbers, are associated to logical operators, establishing thus a connection between quantum field

been studied in [96, 37], and those of torsion and spin in classical mechanics in [104].

Let us examine in the final paragraphs of this Introduction, the background for the first part of this article. In his theory of gravitation that stemmed from his criticism of General Relativity (GR), V. Fock showed that light rays described by the eikonal equations of geometrical optics, were at the basis for the possibility of introducing 'objective' [21] space-time coordinates and furthermore for the construction of a theory of gravitation based on characteristic hypersurfaces of the Einstein equations of GR [28]. These equations being hyperbolic partial differential equations have propagating wavefronts that arise as singularities of spacetime which are identical to the wavefronts singular solutions of Maxwell's covariant equations of electromagnetism: they are all characterized by the solutions of the eikonal equation. These singular propagating fields stand for the inhomogenities of the otherwise uniform spacetime that the geometry of GR based on metrics lead to; this is also a common feature with of a theory of spacetime conceived in terms of Cartan geometries with torsion (which is more fundamental, as the Bianchi equations show [29]) rather than the curvature produced by a metric. Without inhomogenities it is impossible to give sense to a geometrical locus as argued by Fock and separately, from a perspective based on torsion in [101]. In fact, Fock further proved that the Lorentz transformations of special relativity arise together with the Moebius (conformal) transformations as the unique solutions of the problem of establishing a relativity principle for observers described by inertial fields. As showed by Fock, it is *not* the Lorentz invariance of the Maxwell's equation what makes Lorentz invariance so important in special relativity paving the way to a diffeomorphism invariant theory of gravitation which Einstein insisted in relating to special relativity, but rather the fact that the *singular* solutions of the Maxwell equations are invariant by the Lorentz transformations and still, by the full conformal group. We must recall, that already in 1910, Bateman discovered the invariance of Maxwell's equations by this fifteen dimensional Lie group. The equivalence class of reference systems transformable by Lorentz transformations preserve the singular solutions which further have the essential property of being the invariance of the fusion of subject-with-object singularities propagating at a finite constant invariant speed equal to c [28]. The velocity of light waves is no longer constant for observers transformable under conformal transformations, but can be infinite [2]. Thus, for all observers related by a Lorentz transformation, if any one would identify a propagating discontinuity with velocity c, all of them would likewise identify the phenomena. Thus, while the Maxwell equations are well defined with respect to *all* diffeomorphic observers, the singular solutions with speed c are well defined for all *Lorentz* group related observers. Most importantly, the singular sets $N(\phi) = \{x \in M : \phi(x) = 0\}$ were introduced by Fock

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theory, nilpotents and multivalued logics. Nilpotence, which in our view should be called as plenumpotence as much as the vacuum should be called the plenum, has a crucial role in the nilpotent universal rewrite system [111].

[21]Fock's takes an approach based in dialectical materialism. In the phenomenological philosophical and dialectical approach by the present author for surmounting the epistemic cut, the photon is not an 'objective' particle, but the very signature of the fusion of object with subject, the latter being absent in the geometry of GR and unacknowledged by Fock due to his mantainance of the epistemic cut .

in terms of scalar fields which are solutions ϕ of the eikonal equation

$$(\frac{\partial\phi}{\partial x})^2 + (\frac{\partial\phi}{\partial y})^2 + (\frac{\partial\phi}{\partial z})^2 - (\frac{\partial\phi}{\partial t})^2 = 0, \tag{1}$$

which in the more general case of a space-time manifold provided with an arbitrary Lorentzian metric, say g, can be written as $g(d\phi, d\phi) = 0$, from which in the case of g being the Minkowski metric lead to the light-cone differential equation $(dt)^2 - (dx^1)^2 - (dx^2)^2 - (dx^3)^2 = 0$. Notice that eq. (1) is a nilpotence condition on the field $d\phi$ with respect to the Lorentzian metric g. But while the Maxwell equations are invariant by these two groups (Lorentz and Moebius-conformal) transformations, one could look for propagating waves that remain solutions of the propagation equation determined by the metric-Laplace-Beltrami operator, $\triangle_g$, which we shall describe below- under arbitrary perturbations, i.e. instead of considering solutions of the wave equation $\triangle_g\phi = 0$, which form a linear space, we want to investigate the class of solutions which are further invariant under action given by composition of arbitrary (with certain additional qualifications) perturbations f (real or complex valued) acting on the ϕ's by composition, $f(\phi)$ that verify the same propagation equation: $\triangle_g f(\phi) = 0$. Notice that in these considerations we are concerned with singularities propagating on spacetime which is seemingly torsionless; we shall prove in the course of this work that this is not the case: The composite functions $f(\phi)$ and the ϕ themselves will be shown to generate torsion under certain conditions to be established below. We start introducing the geometrical-analytical setting with torsion.

2 RIEMANN-CARTAN-WEYL GEOMETRIES WITH TORSION FIELDS AND THEIR LAPLACIANS

In this section that follows [102] M denotes a smooth compact orientable n-dimensional manifold (without boundary) provided with a linear connection described by a covariant derivative operator $\tilde{\nabla}$ which we assume to be compatible with a given metric g on M, i.e. $\tilde{\nabla}g = 0$. Given a coordinate chart (x^α) $(\alpha = 1, \ldots, n)$ of M, a system of functions on M (the Christoffel symbols of $\tilde{\nabla}$) are defined by $\tilde{\nabla}_{\frac{\partial}{\partial x^\beta}}\frac{\partial}{\partial x^\gamma} = \Gamma(x)^\alpha_{\beta\gamma}\frac{\partial}{\partial x^\alpha}$. The Christoffel coefficients of $\tilde{\nabla}$ can be decomposed as $\Gamma^\alpha_{\beta\gamma} = \left\{{\alpha \atop \beta\gamma}\right\} + \frac{1}{2}K^\alpha_{\beta\gamma}$ [7,9,10]. The first term in this decomposition stands for the metric Christoffel coefficients of the Levi-Civita connection ∇^g associated to g, i.e. $\left\{{\alpha \atop \beta\gamma}\right\} = \frac{1}{2}(\frac{\partial}{\partial x^\beta}g_{\nu\gamma} + \frac{\partial}{\partial x^\gamma}g_{\beta\nu} - \frac{\partial}{\partial x^\nu}g_{\beta\gamma})g^{\alpha\nu}$, and $K^\alpha_{\beta\gamma} = T^\alpha_{\beta\gamma} + S^\alpha_{\beta\gamma} + S^\alpha_{\gamma\beta}$, is the cotorsion tensor, with $S^\alpha_{\beta\gamma} = g^{\alpha\nu}g_{\beta\kappa}T^\kappa_{\nu\gamma}$, and $T^\alpha_{\beta\gamma} = (\Gamma^\alpha_{\beta\gamma} - \Gamma^\alpha_{\gamma\beta})$ the skew-symmetric torsion tensor. We are interested in (one-half) the Laplacian operator associated to $\tilde{\nabla}$, i.e. the operator acting on smooth functions, ϕ, defined on M by (see [95, 97])

$$H(\tilde{\nabla})\phi := 1/2\tilde{\nabla}^2\phi = 1/2g^{\alpha\beta}\tilde{\nabla}_\alpha\tilde{\nabla}_\beta\phi. \tag{2}$$

A straightforward computation shows that $H(\tilde{\nabla})$ only depends in the trace of the torsion tensor and g, so that we shall write them as $H(g, Q)$, with

$$H(g, Q)\phi = \frac{1}{2}\triangle_g\phi + \hat{Q}(\phi) \equiv \frac{1}{2}\triangle_g + Q.\nabla\phi, \tag{3}$$

with $Q := Q_\beta dx^\beta = T^\nu_{\nu\beta} dx^\beta$ the trace-torsion one-form and where $\hat{Q}$ is the vector field associated to Q via g: $\hat{Q}(\phi) = g(Q, d\phi) = Q.\nabla\phi$, (the dot standing for the metric inner product) for any smooth function ϕ defined on M; in local coordinates, $\hat{Q}(\phi) = g^{\alpha\beta}Q_\alpha \frac{\partial\phi}{\partial x^\beta}$. Finally, $\triangle_g$ is the Laplace-Beltrami operator of g: $\triangle_g\phi = \mathrm{div}_g\nabla\phi$, $\phi \in C^\infty(M)$, with div_g and ∇ the Riemannian divergence and gradient operators ($\nabla\phi = g^{\alpha\beta}\partial_\alpha\phi\partial_\beta$), respectively; of course, on application on scalar fields, $\tilde{\nabla}, \nabla^g$ are identical: it is in taking the second derivative that the torsion term appears in the former case. Thus for any smooth function, we have $\triangle_g\phi = (1/|det(g)|)^{\frac{1}{2}}g^{\alpha\beta}\frac{\partial}{\partial x^\beta}(|det(g)|^{\frac{1}{2}}\frac{\partial\phi}{\partial x^\alpha})$. Thus $H(g,0) = \frac{1}{2}\triangle_g$, is the Laplace-Beltrami operator, or still, $H(\nabla^g)$, the laplacian of Levi-Civita connection ∇^g given by the first term in eq. (3). The connections $\tilde{\nabla}$ defined by a metric g and a purely trace-torsion Q are called RCW (after Riemann-Cartan-Weyl) connections with Cartan-Weyl trace-torsion one-form, hereafter denoted by Q [95, 97].

3 The Quantum Jumps Functional and Torsion

In the following we shall take g to be a Lorentzian metric on a smooth time-oriented space-time four-dimensional manifold M which we assume compact and boundaryless; we have the associated volume n-form given by $\mathrm{vol}_g = |det(g)|^{\frac{1}{2}}dx^1 \wedge \wedge dx^2 \wedge dx^3 \wedge dx^4$, where (x^1, x^2, x^3, x^4) is a local coordinate system. The solutions of the wave equation constitute a linear space. Furthermore, the germ of solutions of the wave equation in a neighborhood of a point form a linear space. Thus , the algebra generated by a single solution of the wave equation

$$\triangle_g\phi = 0, \tag{4}$$

consists of solutions of this equation if and only if ϕ satisfies in addition the eikonal equation of geometrical optics

$$(\nabla\phi)^2 := g(\nabla\phi, \nabla\phi) = 0. \tag{5}$$

Indeed, if f is of class C^2 (twice differentiable) and ϕ is real-valued, or still, if f is analytic and ϕ is complex valued, then the following identity is valid

$$\triangle_g(f(\phi)) = f'\triangle_g\phi + f''(\nabla\phi)^2. \tag{6}$$

The solutions of the system of equations

$$\triangle_g\phi = 0 \tag{7}$$
$$(\nabla\phi)^2 = 0, \tag{8}$$

are called monochromatic waves. They represent pure light waves; we discussed already above their relevance. A set of monochromatic waves having the structure of an algebra, will be called a monochromatic algebra. In Fock's approach, they are called *electromagnetic signals* [28]. Notice that the eikonal equation is a nilpotence condition for $d\phi$, the differential

of ϕ, or equivalently its gradient, $\nabla\phi$, under the square multiplication defined by the metric. From the identity $e^{-i\phi}\triangle_g e^{i\phi} = i\triangle_g\phi - (\nabla\phi)^2$, we obtain , if $\triangle_g\phi = 0$, $(\nabla\phi)^2 = -e^{-i\phi}\triangle_g e^{i\phi}$, Let us consider the mapping $\phi \to e^{i\phi} = \psi$ which transforms the linear space of solutions of the wave equation into a multiplicative $U(1)$-group, in which the kinetic energy integrand in the lagrangian functional $(\nabla\phi)^2$ is transformed into $-\frac{\triangle_g\psi}{\psi}$, which has the familiar form of the quantum potential of Bohm, yet in a relativistic domain [13, 98]. If the ϕ are real valued, then the ψ are bounded and we can embed the above group in the Banach algebra under the supremum norm that it generates under pointwise operations and further completion [6]. To distinguish between them we call the original linear space the functional phase space $\mathbf{S}$ and the Banach algebra defined above as the algebra of wave states $\mathbf{A}$, or simply the functional algebra of states. It is simple to see that the critical points of the functional

$$J(\psi) = \int \frac{\triangle_g\psi}{\psi}\mathrm{vol}_g \tag{9}$$

are those ψ which satisfy

$$\triangle_g\ln\psi = 0, \tag{10}$$

i.e., those whose phase function satisfy the wave equation. Those intrinsic states will be called *elementary states*. The new representation has two advantages over the original one. It is richer in structure and in elements, as $\mathbf{S}$ is mapped into a subset of the set of invertible elements Ω of $\mathbf{A}$, and so, by taking logarithm pointwise, on the elements of Ω, we obtain an enlargement of $\mathbf{S}$ by possibly multivalued functions. The second advantage , that actually justifies the whole construction, is that the integrand of the lagrangian $-\frac{\triangle_g\psi}{\psi}$, when integrated, exhibits jumps across the boundary $\partial\Omega$ of Ω. These jumps do correspond to kinetic energy changes, but in the interpretation of the integrand as a quantum potential, these changes represent a change due to the holographic information of the system present in the whole Universe, in D. Bohm's conception [13]. Let $\mathbf{A}$ be a Banach algebra of continuous complex-valued functions defined on a four-dimensional Lorentzian manifold (M, g), containing the constant functions, closed under complex-conjugation, with the algebraic operations defined pointwise and the supremum norm and containing a dense subset $\mathbf{A_2}$ of twice differentiable functions which are mapped by the Laplace-Beltrami operator $\triangle_g$ into $\mathbf{A}$. Assume further $f \in \mathbf{A}$ is invertible with inverse $f^{-1} \in \mathbf{A}$ if and only if $\inf_\mathrm{M}|f(x)| > 0$. The set of invertible elements is denoted by Ω. Furthermore, assume a positive linear functional, denoted by λ such that $\lambda : \mathbf{A_2} \cap \Omega \to C$ (the complex numbers) defined by

$$\lambda(\phi) = \int \frac{\triangle_g\phi}{\phi}\mathrm{vol}_g \tag{11}$$

The critical elements of λ are those u such that

$$\mathrm{div}(\frac{\mathrm{grad}u}{u}) = 0, \quad i.e. \quad \frac{\triangle_g u}{u} - (\frac{\mathrm{grad}u}{u})^2 = 0. \tag{12}$$

If the linear functional is strictly positive, i.e. $\lambda(\phi) = 0$ if and only if $\phi \equiv 0$, these two identities are to hold in $\mathbf{A}$, otherwise in the sense of the inner product defined by λ on $\mathbf{A}$.

By eq. (12) the set $\mathbf{C}$ of critical points of λ is clearly a subgroup of Ω. The monochromatic functions of $\mathbf{A}$ are as before, those $w \in \mathbf{A}_2$ satisfying the system of eqs. (7, 8) and their set is denoted by $\mathbf{M}$. From eq. (10) the composition function given by $f(w)$ belongs to $\mathbf{M}$ again if f is an analytic function on a neighborhood of the set of values taken by w on M. Since by eq. (12) $\mathbf{M} \cap \Omega \subset \mathbf{C}$, we have that $uf(w) \in \mathbf{C}$ if $w \in \mathbf{M}$ and $f(w) \in \Omega$. The spectrum $\sigma(v)$ for any $v \in \mathbf{A}$, is defined by $\sigma(v) = \{z \in C/|v - ze| \notin \Omega\}$ and therefore, by a previously assumed property, is the closure of the set of values $v(x)$ taken by v on M. It is obviously a compact non-void subset of $\mathbf{C}$. Ω has either one or else infinitely many maximal connected components, of which Ω_0 is the one containing the identity, e, defined by $e(x) \equiv 1$. Two elements f, h belong to the same component of Ω, if and only if $fh^{-1} \in \Omega_0$. Further, $f \in \Omega - \Omega_0$ if and only if its spectrum $\sigma(f)$ separates 0 and ∞. The logarithm function, as a mapping from $\mathbf{A}$ into $\mathbf{A}$ is defined only on Ω_0. With these preliminaries, we can now show that the quantum jumps arise as a generalized form of the standard argument principle. [22]

Theorem. Let $u \in \mathbf{C}, w \in \mathbf{M} \cap \Omega$, i.e, it is an invertible monochromatic function. Denote by $H_1, H_2, \ldots,$ the maximal connected components of the complement of $\sigma(w)$. Then there exists fixed numbers $q_i, i = 1, \ldots,$ depending on u and w only, such that for any function $f(z)$ analytic in a neighborhood of $\sigma(w)$ and with no zeros in $\sigma(w)$, we have

$$\lambda(uf(w)) = \lambda(u) + \sum_i (N_i - P_i)q_i, \tag{13}$$

where N_i, P_i are the number of zeros and poles, respectively, of f in H_i, $i = 1, 2, \ldots$. In particular choosing $\alpha_i \in H_i$, the q_i are given by

$$q_i = 2 \int g(\frac{\nabla u}{u}, \frac{\nabla w}{w - \alpha_i}) \mathrm{vol}_\mathrm{g}, i = 1, 2, \ldots. \tag{14}$$

Proof.[23] Let $f = f(w) \in \mathbf{M}$ with $f(z)$ as in the hypothesis. A computation yields

$$\frac{\triangle_g(uf)}{uf} - \frac{\triangle_g u}{u} = 2g(\frac{\nabla u}{u}, \frac{\nabla f}{f}), \tag{15}$$

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[22]The following result [102] is a simpler geometrical version of a theorem proved by Nowosad in the more intricate setting of non-compact manifolds and functionals on generalized curves in L.C. Young's calculus of variations for curves with velocities having a probability distribution (Young measures) [80]. In our approach that surmounts the epistemic cut, we are interested in a particular Riemann surface, the Klein bottle, which is nor closed nor open. It is a surface of paradox from which multivalued logic is derived allowing to establish a remarkable relation between logic, twistors, quantum mechanics and its second quantization, and still nilpotent hypernumbers, and that it will further appear in neurological maps. We may consider the embedding of this surface in a compact submanifold of Minkowski space and we are in the situation of the theorem below without the need of intrincate variational problems nor the full Minkowski space. The latter in its unboundedness corresponds to a conception of spacetime which is associated to the Cartesian approach and its epistemic cut that is surmounted by considering torsion as a self-referential construction of spacetime, logic and cognition [101].

[23]An example. Take a compact submanifold of Minkowski space and plane waves with adequate boundary periodicity conditions. Take $u = e^{ik.x}, w = e^{ik_0.x}, k_0^2 = 0, k_0.k \neq 0$ and the spectrum $\sigma(w) = S^1$, where S^1 is the unit circle; then $\lambda(u) = -k^2$ (minus the mass squared) and eq. (13) becomes $-\lambda(e^{ik.x}f(e^{ik_0.x})) = k^2 + 2(k_0.k)(N - P)$, where N and P are the number of zeros and poles of f inside of the unit circle.

which we note that it is another way of writing

$$\frac{\triangle_g(uf)}{uf} = \frac{1}{u}H(g, \frac{df}{f})(u),\tag{16}$$

where we have introduced in the r.h.s. of eq. (15) the laplacian defined in eq. (3) by a RCW connection defined by the metric g and the trace-torsion Q $= \frac{df}{f}$. Integrating eq. (15) yields,

$$\lambda(uf) - \lambda(u) = 2\int g(\frac{\nabla u}{u}, \frac{\nabla f}{f})\text{vol}_g.\tag{17}$$

In particular this shows that q_i in eq. (14) are well defined. From (17) one gets directly

$$\lambda(ufh) - \lambda(u) = [\lambda(uf) - \lambda(u)] + [\lambda(uh) - \lambda(u)]\tag{18}$$
$$\lambda(uf^{-1}) - \lambda(u) = -[\lambda(uf) - \lambda(u)],\tag{19}$$

where $h = h(w)$ as well as we recall $f = f(w)$, are the composition functions, from now onwards. Now if $f \in \Omega_0$, then $\ln f \in \mathbf{A}$ and $\nabla \ln f = \frac{\nabla f}{f}$, which substituted in eq. (17) gives, upon integration,

$$\lambda(uf) - \lambda(u) = 2\int g(\frac{\nabla u}{u}, \nabla \ln f)\text{vol}_g = -2\int f\text{div}_g(\frac{\nabla u}{u})\text{vol}_g = 0,\tag{20}$$

by eq. (12). Hence

$$\lambda(uf) = \lambda(u), \quad \text{if} \quad f \in \Omega_0.\tag{21}$$

If now f, h belong to the same component of Ω we can write $uh = (uf)(hf^{-1})$, and since $hf^{-1} \in \Omega_0$, the previous result yields

$$\lambda(uh) = \lambda(uf).\tag{22}$$

This shows that $\lambda(uf(w))$ is locally constant in Ω as f varies in the set of analytic functions. Let now $f(z) = z - \nu$ with $\nu \in H_i$. Then $z - \nu$ can be changed analytically into $z - \alpha_i$ without ν leaving H_i, which means that $w - \nu e$ and $w - \alpha_i e$ are the same connected component of Ω, with $e \equiv 1$. Therefore from eqs. (22, 17) and eq. (14) follows that

$$\lambda(u(w - \nu e)) - \lambda(u) = q_i,\tag{23}$$

and by eq. (22)

$$\lambda(u(w - \nu e)^{-1})) - \lambda(u) = -q_i.\tag{24}$$

On the other hand, if ν belongs in the unbounded component of the complement of $\sigma(w)$, we may let $\nu \to \infty$ without crossing $\sigma(w)$ so that

$$\lambda(u(w - \nu e)) - \lambda(u) = 2\int g(\frac{\nabla u}{u}, \frac{\nabla w}{w - \nu e})\text{vol}_g$$
$$= \lim_{\nu \to \infty} 2\int g(\frac{\nabla u}{u}, \frac{\nabla w}{w - \nu e})\text{vol}_g = 0.\tag{25}$$

Therefore, if $f(z) = c_0 \Pi_{i=1}^{N}(z - a_i).\Pi_{j=1}^{p} \frac{1}{z-b_j}, c_0 \neq 0, a_i, b_j \notin \sigma(w)$, then eq. (13) follows from eqs. (18, 24, 25) In the general case , if $f(z)$ is an holomorphic function in a neighbourhood of $\sigma(w)$,without zeros there, we can find a rational function $r(z)$ such that

$$|f(z) - r(z)| < \min_{\sigma(w)}|f(z)| \text{ in } \sigma(w), \tag{26}$$

by Runge's theorem in complex analysis. Then, $r(z)$ has no zeros in $\sigma(w)$ too, and $r(w)$ and $f(w)$ are in the same component of Ω, so that eq. (13) holds for $f(w)$ too. The proof is complete.

Observations. The quantization formula (13) tells us how the basic functional changes when we perturb the elementary state u into $uf(w)$ with f analytic near and on $\sigma(w)$. Changes occur only when zeros or poles of $f(z)$ reach and eventually cross the boundary of $\sigma(w)$, and these changes are integer multiples of fixed quanta q_i, each one attached to the hole H_i whose boundary is reached and crossed, while u, v remain fixed. Two more aspects are important. The first one being that the actual jump is measured modulo the product of the q_i by a classical difference (where by classical we stress we mean that it is the substraction, in distinction of the quantum difference given by the commutator of operators) of poles and zeros; at the level of second quantization quantum jumps appear in terms of the difference of the creation and annihilation operators which defines a time operator in a logic in which the commutator of the true and false logical operators coincide with their classical difference, establishing thus a non-null torsion in cognitive space [101]. The second aspect is the actual form of the q_i which are given by integrating the internal product of the trace-torsion one-form $Q = \frac{du}{u}$ defined by the critical state u, with another almost logarithmic differential of the form $dw/(w - \alpha_i)$.

3.1   THE APPEARANCE OF TORSION

Let C_u denote the linear operator $h \to uh, h \in \mathbf{A}, u \in \Omega$. The very simple analysis above hinges on the fact that $C_u^{-1} \circ \triangle_g \circ C_u - C_{\frac{\triangle_g u}{u}}$ is a derivation on the germ $\mathbf{F}(w)$ of functions of w (see eq. (11) and still eq. (16) to see how it is related to the torsion geometry), which are analytic in a neighbourhood of $\sigma(w)$, and it could have been performed abstractly without further mention to the special case under consideration. The general abstract theory of variational calculus extending the functional λ for quantum jumps when specialized to second order differential operators, say $\triangle_g$ or still $H(g, Q)$, shows that the condition $w \in \mathbf{M}$ in not only sufficient but also necessary in order to the quantum behaviour of λ occur [80].

The set of linear mappings $C_{f^{-1}}$ of $\mathbf{A}$ defined by $h \to f^{-1}h, h \in \Omega$, f defined on M, is a group which maps each connected component of Ω onto another one. In terms of functions defined on M it changes locally the scale of the functions, i.e. the ratio of any function at two distinct points is changed in a given proportion, and it therefore a gauge transformation of the first kind. Under this transformation we have that

$$\triangle_g \to C_{f^{-1}}\triangle_g C_f = \triangle_g + 2\frac{\nabla f}{f}.\nabla + \frac{\triangle_g f}{f} = 2H(g, \frac{df}{f}) + 2V_f, \tag{27}$$

where $H(g, \frac{df}{f})$ is the RCW laplacian operator of eq. (4) with trace-torsion 1-form $Q = \frac{df}{f}$

and $V_f = \frac{\triangle_g f}{f}$ is the relativistic quantum potential defined by f^2 [98]. Now noting that for vectorfields $A = A^i \partial_i, B = B^i \partial_i$, with $A^i, B^i, i = 1, \ldots, 4$ complex valued functions on M, with the hermitean pairing defined by the metric g on M, i.e. $\int g(\bar{A}, B)\text{vol}_g = \int g(B, \bar{A})\text{vol}_g$ so that $A^\dagger = \bar{A} = \bar{A}^i \partial_i$. Therefore for the gauge transformation $d \to d + \frac{df}{f}$, since $\triangle_g = -d^\dagger d$ (see [9,10,15]), we further have the transformation

$$-d^\dagger d \to -(d + \frac{df}{f})^\dagger (d + \frac{df}{f}) = -(d^\dagger + (\overline{\frac{df}{f}}).)(d + \frac{df}{f}). \tag{28}$$

where $d^\dagger$ is the adjoint operator, the codifferential, of d with respect to this hermitean product so that $d^\dagger = -\text{div}_g$ on vectorfields [29]. If we assume that $\overline{(\frac{df}{f})} = -\frac{df}{f}$, so that $|f(x)| \equiv 1$ and thus f is a phase factor, $f(x) = e^{i\phi(x)}$, i.e. a section of the $U(1)$-bundle over M then the r.h.s. of eq. (28) can be written as

$$-(d^\dagger - \frac{\nabla f}{f}.)(d + \frac{df}{f}) = \triangle_g + 2\frac{\nabla f}{f}. + (\frac{df}{f})^2 + \frac{\triangle_g f}{f} - (\frac{df}{f})^2$$

$$= (\triangle_g + 2\frac{\nabla f}{f}.) + \frac{\triangle_g f}{f} = 2H(g, \frac{df}{f}) + \frac{\triangle_g f}{f} = C_{f^{-1}} \circ \triangle_g \circ C_f. \tag{29}$$

Consequently, if f is a phase factor on M, then under the gauge transformation of the first kind $h \to f^{-1}h$, the change of $\triangle_g$ into $C_{f^{-1}} \circ \triangle_g \circ C_f$ can be completely determined by the transformation $d \to d + \frac{df}{f}$ which is nothing else than the gauge-transformation of second type, from the topological (metric and connection independent) operator d to the covariant derivative operator $d + \frac{df}{f}$, of a RCW connection whose trace-torsion is $\frac{df}{f}$, equivalent to the gauge transformation $d \to d + A$ in electromagnetism [29].

In summary, when f is a phase factor, the gauge transformations of the first and second type are equivalent, and gives rise to the exact Cartan-Weyl trace-torsion 1-form. Whenever the metric g is Minkowski or positive-definite, these gauge transformation produce a transformation of a Brownian motion with zero drift to another Brownian motion with drift given by $\frac{\nabla f}{f}$. The node set of f, which coincides with the locus of quantum jumps, becomes an impenetrable barrier for this Brownian motion [7]. If we further impose on f the condition similar to the one placed for the electromagnetic potential 1-form, A, to satisfy the Lorenz gauge $\delta A = 0$, i.e. $\delta(\frac{\text{grad}f}{f}) = 0$, we find that this is nothing else than the condition on f to be an elementary state i.e. a critical point of the the functional $\lambda(f)$ given by (11). Therefore, when f is a phase factor, both the first and second kind of gauge transformations are equivalent and they give rise to a Cartan-Weyl one-form $Q = \frac{df}{f}$.

When $\frac{df}{f}$ cannot be written globally as $d\ln f$, f is said to be a non-integrable phase factor. When f belongs to the algebra $\mathbf{A}$, this is equivalent to saying that f does not have a logarithm in $\mathbf{A}$, which means that $f \in \Omega - \Omega_0$. In any case, the 2-form of intensity $F = d(\frac{df}{f})$ is always identically 0 because $\frac{df}{f}$ can be *locally* written as $d\text{Log}f$, where Log is a pointwise locally defined logarithm determination.[24]

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[24]The relation between Cartan torsion, singularities and dislocations in condensed matter physics is well known [57].

Consider now all the connected components Ω_α of Ω. Any such component can be transformed into Ω_0 by a gauge-transformation of the first kind: it suffices to take $f \in \Omega_\alpha$ and consider $h \to f^{-1}h$, which is indeed a diffeomorphism of Ω. This choice of the component, is a choice of gauge, and of course, there is no preferred gauge. That is, the topological operator d of one observer becomes the covariant derivative operator $d + \frac{df}{f}$ of a RCW connection for the other observer. We can interpret the difference of gauges as being equivalent to the presence of the trace-torsion 1-form $\frac{df}{f}$ in the second's observer referential. However as the electromagnetic 2-form $F \equiv 0$, this is an instance of the Aharonov-Bohm phenomena: non-null effects associated with identically zero electromagnetic fields. As we said before, this difference has a Brownian motion correlate in which null drift for the former is transformed into the drift $\frac{\nabla f}{f}$ which at the level of random dynamics is a non-trivial transformation. In fluid-dynamics as described by the Navier-Stokes equations for a velocity vector field u, there is a similar transformation from a drift independent purely noise Brownian process in which the velocity is subsumed in a laplacian with no interaction non-linear term as a purely diffusive process, into the Navier-Stokes Brownian process with drift given by u; see [95] (2002).

That there appear non-null effects is checked by our previous analysis of the functional $\lambda(uf(w))$, where u is any elementary state and f, besides being a phase factor, is also monochromatic. In this case λ, which is locally constant depends on which $\Omega_\alpha f$ belongs to, that is to say, on the choice of the gauge.

Finally, according to the two ways of interpreting a linear operator (as a mapping on the vector space or as a change of referential frames) we have two possibilities. Indeed let $w \in \mathbf{M}$ and let $f_t(w), t \in [0,1]$ with $f_t(z)$ analytic in a neighbourhood of $\sigma(w)$, be a continuous curve on $\mathbf{A}$. For any $u \in \mathbf{C}$ we consider the curve of elementary states $uf_t(w)$; we described in eq. (13) the behaviour of $\lambda(uf_t(w))$ along this curve. In particular we considered $uf_t(w)$ as a perturbation,or excitation, of u evolving in time (here time may not be the time coordinate of a Lorentzian manifold but the universal evolution parameter introduced first in quantum field theory by Stuckelberg, and further elaborated by Horwitz and Piron [14].) We can also regard $u \to C_{f_t(w)}u$ as a continuous curve of gauge transformations of first kind acting on a fixed elementary state u, which, when f_t crosses $\partial\Omega$, determines a change of gauge. When that happens, f_t cannot be made a phase factor for all t obviously, so that no electromagnetic interpretation can be given all along the evolution in t. However if, say, the initial states f_0 and f_1 are phase factors (i.e. $|f_i(x)| \equiv 1, i = 0, 1$), this change of gauge is equivalent to the appearance of a non-trivial trace-torsion one-form, which we can interpret as an electromagnetic potential, between the initial and final states. In any of these interpretations a non-null effect is detected by a jump in λ as given by eq. (13); this quantum transition is interpreted in the first case as an excitation of the state u, and in the second state as a change of gauge of u, materialized by the appearance of the corresponding Cartan-Weyl one-form as an electromagnetic Aharonov-Bohm potential with zero intensity and non-null effects [1]. Thus, in this interpretation, quantum jumps are the signature of a non-trivial geometrical structure, the appearance of torsion.

3.2 SINGULAR SETS

Finally we examine the dimensions of singular sets $N(f)$ of monochromatic functions. Recall that a C^2 real or complex-valued function f defined on (M, g) is a monochromatic wave, $f \in \mathbf{M}$, if it satisfies the system given by eqs. (7,8). In the real-valued case, all C^2 functions of f, and in the complex case, all analytic or anti-analytic functions of f belong to $\mathbf{M}$ again, by eq. (4) (we changed here our notation there, pointing precisely to $f = f(w)$ for $w \in \mathbf{M}$, as above) . If f is real, smooth and $df \neq 0$, then $N(f)$ is locally three-dimensional. If it is complex and $\mathrm{Re}(f)$ and $\mathrm{Im}(f)$ are functionally independent $N(f)$ is two-dimensional. Yet the Newtonian picture of a photon as an isolated point-like singularity moving with the speed of light in the vacuum, requires a one-dimensional singular set $N(f)$. Can we achieve this by going to hypercomplex, say quaternionic functions, or still Musès' hypernumbers which are rich in divisors of 0? The answer to the former question is negative; in the quaternionic framework, the photon is a propagating three-dimensional singularity with lower dimensional singularities, but still undivisely extended [103]; we shall present these issues in the following section.

3.3 PARTIAL CONCLUSIONS TO THESE SECTIONS

This initial part of the present work started by considering the fundamental role of spacetime singularities and particularly light rays in establishing the physical world jointly with the act of (self) perception of the subject: Indeed, the photon is not seen, but is about seeing [139]. We argued that this allows for a start the introduction of spacetime itself, in terms of the fundamental role that differences and more generally inhomogeneities play. In our presentation we argued in terms of what originally appeared to be two distinct conceptions for producing this joint constitution of reality and the subject. The first conception relied on the self-referential role of the photon as a singularity which embodies the fusion of reality and perception, while the second one relied on torsion, which is also linked to self-reference [101]. Light rays are described by the eikonal equations which appear as wave-front singularities in the Maxwell and Einstein's equations of electromagnetism and General Relativity, respectively. Quantum jumps play a fundamental role in this joint constitution of physics and consciousness, as they appear as fundamental differences from which space-time is constructed as a physical reality while in visual perception they have a fundamental role. Without these quantum jumps, cognition as the difference produced from a primeval difference [101] in the sense of Bateson would not occur [8]; an epistemology for science that departs from Bateson was elaborated by Johansen [52] . While propagating waves play a primeval role, the notion of closure by composition by perturbations lead us to consider the action of analytical or alternatively C^2 functions on them, which produced that the propagation equation was supplemented by the eikonal equations for light rays, and thus we were lead to the class of monochromatic functions.[25] Thus we were able to give a formula

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[25]It is crucial for the later connection of the developments presented in the previous sections with perceptual codification in the neurocortex to remark that what is accessible to the visual and still peripheric sensory systems such as the skin are precisely the family of all perturbations waves that we have discussed in the previous sections. This will be the starting point to connect the physical and the physiological realms. With

that characterizes quantum jumps and further discovered that these compositions produce a torsion potential. These jumps occur whenever the perturbation ceases to be non-zero and thus become the locus for the singularities of the logarithmic map, establishing thus the generative role of 0. We shall reencounter in Sections VI and VII below, this generative role of 0, as a quantum-logical operator with all zero entries in Matrix Logic which is further associated with quantum fields. It will also appear in the visual complex logarithmic map representation in the neurocortex where the singularities appear as the loci where the orientation field provided by the map can take all possible values, thus becoming multivalued in those singularities. In this setting the lightlike singularities are non-pointlike extended structures which we shall represent by twistors ; in turn these twistors appear to be the eigenstates of the null quantum-logical operator, which can still be represented by cognitive states and viceversa [103].In the course of this work we discovered that propagating lightlike singularities which are fundamental to the establishment of special relativity, electromagnetism and still General Relativity produce a torsion potential, and thus the two approaches which the present work took as its unfolding rationale became unified. Furthermore, this potential which becomes singular in its node sets acts as the drift of Brownian motions which cannot penetrate the infinite barrier posed by these singularities. Furthermore. we established that this torsion potential naturally produces an Aharonov-Bohm effect which is further associated with the quantum jumps so that non-null effects, fundamental differences in the sense discussed above are manifested in spite that the electromagnetic fields produced by the torsion potential is null.

Remarkably, the complex logarithm map plays a fundamental role in a topographical geometrical model of visual perception [114] in which the singularities of the topographical orientation visual mapping -an order parameter as in superconductivity-, is associated to the singularities of vortex dislocations [115], i.e. trace-torsion singularities which we shall discuss below). These singularities lead to a topological solution of the topographical visual map in terms of the Klein bottle [122] [126] which is the basis for multivalued logics and its relation with quantum mechanics and quantum field operators [101]. Furthermore, it leads to Gabor wavelet holographical representations on the visual cortex [66] substantiating the holographic quantum paradigm due to Pribram in neurophysiology [88]. The complex logarithm has been carried to quantum holography in terms of the coadjoint orbits representations of the Heisenberg group in quantum mechanics, and has lead to important technological developments, in the work due to Schempp [113].

In considering the semiclassical theory of gravitation, quantum jumps produce discontinuities in the energy-momentum tensor leading to the existence of a cosmological time associated with a quantum-jumps time, in a *global* canonical decomposition of spacetime [74]. This approach due to Mashkevich departs from the incompleteness of the Cauchy problem for the Einstein equations of GR: they provide only six equations for the ten components of the metric. For curved spacetime, Mashkevich proved that the diffeomorphism invariance of the solutions of the Einstein equation is not valid; only in the case of Ricci flat spacetime this is assured. This underdetermination is resolved by the canonical comple-

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respect to the auditory system, it is important also to remark that the complex logarithmic function which acts on monochromatic waves is also the topographic representation of this sensory mode [114, 115, 124].

mentary conditions, which in the semiclassical approach are provided by nonlocal quantum jumps whilst in Fock's theory they are provided by four equations as eq. (4), the so-called harmonic coordinates.Thus, according to Mashkevich, quantum jump nonlocality is essential for GR, they occur in nonempty spacetime where the underdetermination problem arises and actually solves this problem. Furthermore, quantum jumps lead to a universe with complete retrodiction in which only partial prediction is possible [74]. This establishes a remarkable relation, which requires further ellucidation, with the theory of anticipatory systems introduced and developed by Dubois and others [21].

For closing remarks to this section, we note that quantum jumps were obtained here in terms of the quantum potential which stands for an holographic in-formation of the whole universe.

4 MONOCHROMATIC HYPERCOMPLEX FUNCTIONS

In this Section we shall discuss the problem of the impossibility of localizing the photon as a point-like structure and determine its geometrical-analytical characterization following [80] and [103] in which detailed proofs can be found. The starting basic issue is that for f defined on M as above, it can be proved that $N(f)$, the node set of f reduces to a single set. Let us introduce the quaternionic units $\vec{i_1}, \vec{i_2}, \vec{i_3}$ given by the multiplication rules

$$
\begin{aligned}
\vec{i_1}\vec{i_2} &= \vec{i_3}, \vec{i_2}\vec{i_3} = \vec{i_1}, \vec{i_3}\vec{i_1} = \vec{i_2} \\
\vec{i_j}\vec{i_k} &= -\vec{i_k}\vec{i_j}, k \neq j, \vec{i_k}^2 = -1, j, k = 1, 2, 3.
\end{aligned}
\tag{30}
$$

Notice here that we could chose here the logical quaternions introduced before, and thus the structures we shall produce below, can be conceived as spacetime structures which are both 'inner' and 'outer' representations of the self-referential character of photons (though the neutrino is also considered below). We shall introduce the notation $(\phi, \psi) \in \mathbf{M}$ to mean that $\phi, \psi \in \mathbf{M}$ (i.e. they satisfy eqs. $(7, 8)$) *and* furthermore

$$
g(\nabla\phi, \nabla\psi) = 0,
\tag{31}
$$

which is the requirement that any algebraic combination of ϕ, ψ belong in $\mathbf{M}$ as well. It will also be assumed that ϕ and ψ are functionally independent, to rule out the trivial cases. We then have the following theorem.

Theorem 1. Any monochromatic quaternion valued function F defined on (M, g) is determined by a triple of real valued functions (ϕ, f, ρ) such that

$$
(\phi, f + i\rho) \in \mathbf{M}, \quad \text{i.e. } g(\nabla\phi, \nabla f + i\nabla\rho) = 0,
\tag{32}
$$

and each of ϕ, f, ρ satisfy the system

$$
\triangle_g \kappa = 0, \quad (\nabla\kappa)^2 = 0,
\tag{33}
$$

has the form

$$
F = f + \rho[\vec{i_1}G(\phi) + \vec{i_2}H(\phi) + \vec{i_3}P(\phi)]
\tag{34}
$$

where G, H, P are real valued functions satisfying

$$P^2 + H^2 + G^2 = 1. \tag{35}$$

Thus, F is a section of a $R \times R \times S^2$-bundle over (M, g), where S^2 denotes the two-dimensional sphere. [26]

4.1 MAXIMAL MONOCHROMATIC ALGEBRAS

A monochromatic algebra is called maximal monochromatic if it is not a proper subalgebra of a monochromatic algebra. The importance of maximal monochromatic algebras in our context is obvious, in particular with respect to the question of singular sets. The main result in this respect is the following [80].

Theorem 2. The maximal C^2 algebras in (M, g) are precisely those generated by a single pair (see eq. (31))

$$(\phi, f + i\rho) \in \mathbf{M}, \tag{36}$$

with ϕ, f, ρ real, and are constituted by C^2-functions of the form

$$\xi(f, \phi, \rho) + \eta(f, \phi, \rho)[\vec{i_1}K(\phi) + \vec{i_2}H(\phi) + \vec{i_3}P(\phi)] \tag{37}$$

in the quaternionic case, and

$$\xi(f, \rho, \phi) + i\eta(f, \rho, \phi), \tag{38}$$

in the complex case, where for each fixed ϕ, $\xi + i\eta$ is an intrinsic analytic (or antianalytic) function of $f + i\rho$, the C^2-dependence on ϕ is arbitrary and $K^2 + H^2 + P^2 = 1$, with K, H, P of class C^2, but otherwise arbitrary. Thus, in the quaternionic case, it is given by a C^2-section of a $R \times R \times S^2$-bundle over M. In the complex case, non intrinsic functions are allowed.

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[26] We have constructed the quaternions in terms of logical operators in Matrix Logic [101]. So, we can represent this result as either an 'objective' space representation of the objective-subjective photon, or as a 'subjective' representation of it in terms of a quaternionic structure which stems from the laws of thought; [101]. Remarkably, from the quaternions in any representation, be that the logical quaternions in Matrix Logic [101] or the usual ones built by Hamilton as unrelated to logic , we can obtain some cosmological solutions. Indeed, the natural metric in the Lie group of the invertible quaternions can be parametrized as the closed Friedmann-Lemaitre-Robertson-Walker metrics [129] which constitute one of the most important classes of solutions of Einsteins equations and furthermore, as the Carmeli metric of rotational relativity. We recall that the latter was introduced to explain spiral galaxies rotation curves and 'dark matter' [15]. We stress that these derivations do *not* require solving the Einstein's equations of GR but are intrinsic to the quaternions, or if wished, to Matrix Logic. This raises the question on what are we actually representing: is it an 'outer' world, or a Kleinbottle cosmology of fusion of the physical and the noetic realms, as this chapter claims to be the case.

4.2 GENERAL FORM OF SINGULAR SETS AND THEIR PHYS-ICAL INTERPRETATIONS

We are now in conditions for completing the objective of this section, namely, the characterization of the node set of complex and quaternionic monochromatic function. According to the above results the most general form for singular sets N of monochromatic complex or quaternionic functions is given by the conditions

$$
\begin{aligned}
\xi(f,\rho,\phi) &= 0, \\
\eta(f,\rho,\phi) &= 0, \quad (\phi, f + i\rho) \in \mathbf{M}
\end{aligned}
\tag{39}
$$

Although N is locally at least two-dimensional we have now the possibility of locating a higher-order zero on a bicharacteristic line.

For instance, the singular set of $\phi.(f + i\rho)$ is the union of the 2-dimensional set defined by $f = \rho = 0$, and the 3-dimensional set $\phi = 0$, and since $(\nabla\phi)^2 = 0$, their intersection $f = \rho = \phi = 0$ is a bicharacteristic line carrying an isolated zero of higher order. The corresponding phase function has a higher order singularity located at a single point in three-space, moving with the speed of light along the singular line $f = \rho = 0$, accompanied by the wave-front singularity $\phi = 0$.

Observations This result is remarkable in many ways. Firstly, in the present analytic approach, it is apparent that the photon cannot exist per-se as a point-like singularity, since in fact the most general maximal monochromatic algebra is three-dimensional when we go to the quaternionic case and then we can describe it as built in the larger singularity. Thus, we have in a four-dimensional Lorentzian manifold, three real dimensions to describe the eikonal wave discontinuities. We have associate them with spinors and twistors, which themselves are related to conjugate minimal surfaces [27]

4.2.1 PHOTON, NODAL LINES, MONOPOLES

Until know we have described the singular sets of quaternionic and complex solutions of the eikonal and wave propagation equations. We have discussed already the fact that the case of the photon is not that of an 'objective' particle but the actual fusion of object-with-subject. The extended character of the photon was understood in terms of this fusion and the extended character of the subject. It is the prerogative of the subject to establish from this a coordinate system, i.e. to use light-singularities as a way to establish a primeval coordinate system, and this is in fact what sentient beings do. [28] A typical case is to

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[27]This is most remarkable since it points out to the existence of a Platonian world, with generic geometrical surfaces associated to the fusion of object-with-subject which the absorbed photon is.

[28]This was one of the main points of Fock's critique to Einstein's General Relativity [28], that it is a theory of uniform space, and thus singularities are needed to establish a real spacetime. We have discussed already that the primeval distinction that encodes the torsion field is such a singularity. Thus, in analyzing the hyperbolic nature of the Einstein's partial differential equations of GR and the Maxwell equations, Fock was lead to propose as a starting point the eikonal and propagation wave equations, whose wavefronts correspond precisely to propagating singularities, that we have further associated with torsion. Though we cannot because of lack of space show that this is the case, i.e. that from the form of maximal monochromatic quaternionic functions we can indeed establish a coordinate system where the functions that produce this

establish a Cartesian coordinate system $(x, y, z, t) \in R^{1,3}$ (in Minkowski space) given by taking

$$f + i\rho = y + iz, \tag{40}$$

and

$$\phi = f(r) - t, \text{with} r = (x^2 + y^2 + z^2)^{\frac{1}{2}}, \tag{41}$$

and f is a monotonic function of the radius r. In this case, for the function

$$(y + iz)(f(r) - t) \tag{42}$$

the singular set consists of a spherical wave front in 3-space moving with the speed of light and cutting the singular x-axis $y = z = 0$ at a single point in the positive semi-axis $0 \leq x$, where therefore lies a higher-order singularity. This higher-order singular point, piloting a lower order singular spherical wave, along a lower order singular line is now liable to represent the photon, conceived as a moving point singularity carrying energy, in agreement with the experimentally observed corpuscular behaviour of the photon at a metallic plate, and obtain pictures of its trajectories in cloud chambers). On the other hand the weaker singularity carried by the spherical wave front $f(r) - t = 0$ is responsible for the diffraction patterns in the typical slit experiments, according to Huygenss law of propagation of singularities (eikonal equation), and so accounts for the experimentally observed wave nature of the photon. In this way the purely analytical characterization of the maximal monochromatic algebras leads us unequivocally, to the correct conclusions as regards the physical nature of the photon and express its dual wave-corpuscular nature as a simple mathematical fact.

The line $y = z = 0$ in 3-space carries a singularity too, but this is a standing one, independent on time, and therefore, its presence is detected through different effects. Actually this line is so-called a nodal line of the wave function $\phi \equiv y + iz$ ([12]) or a dislocation line of the planes of constant phase of ψ. Around this line occur vortices of the flux of the trace torsion one-form $d\ln\phi$ of the phase function (when the circulation of this flux around a nodal line is non-zero), described in detail by Hirschfelder [44]. Alternatively Dirac found these nodal lines when considering singularities of wave functions, upon imposing the only requirement that the complex-valued functions ψ (in our example equal to $y + iz$) be single-valued and smooth, but not necessarily with single-valued argument, and then quantized them in terms of the winding number of the vector-field $(\nabla\ln Re(\psi), \nabla\ln Im(\psi))$ along a closed curve around the line. He then found that one could remove the non-zero circulation by means of a gauge transformation of the second kind, and that the electromagnetic vector potential associated with this transformation was precisely the same electromagnetic

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form act as a coordinate system! This can be established without recourse to an ad-hoc non-geometric energy-momentum tensor as Einstein's inception of it in GR, but using the energy-momentum tensor of the electromagnetic field, giving thus a self-referential construction of the metric by solving the Einstein's equations with light a source for matter described by curvature derived from the metric in the Levi-Civita connection, according to Einstein [80]. Thus, the metrics are not primitive to the constitution of spacetime; as we have already argued, it is the joint constitution of spacetime and the subject through torsion as a logo-physical sign and field.

potential produced by a magnetic monopole at the initial point. He then equated the effect of the circulation around the nodal line in the original gauge to the effect of a monopole in the new gauge. His quantization by the winding number is actually just a special case of the general quantization theorem above, and his gauge interpretation is thus a concrete exemplification of the meaning of the analysis given there.

The variety of types of singular sets defined by the representation given in eq. (38) is very great, as exemplified in the pioneering work by Nye and Berry [12]. Besides the singular sets that we previously identified with the photon (spherical wave front plus a nodal line) there is also a remarkable singular set of the monochromatic wave constructed out of $\phi = f(r) - t$ and $f + i\rho = y + iz \in R^{1,3}$, by the following sum

$$\epsilon e^{i\omega[f(r)-t]} - (y + iz), \epsilon > 0. \tag{43}$$

Its singular set is given by

$$y = \epsilon\cos\omega[f(r) - t], z = \epsilon\text{sen}\omega[f(r) - t]. \tag{44}$$

This represents an helicoidal line lying on the cylinder $y^2 + z^2 = \epsilon^2$, and moving with (variable) speed of light along its tangent direction at each of its points. (For simplicity, we can assume that $f(r) = t$ in order to get a better visualization: the speed is then constant and the helicoid has then a constant step.) Taking $y - iz$ instead, we get a screw motion with opposite handedness. The singular set is thus a moving screw in 3-space that can be right or left handed, and may carry the energy associated with a quantum jump, as shown above. It seems therefore that a monochromatic wave line like this can represent appropiately a right or left handed neutrino, concretely identified with its singular set. It has then quite distinct properties from those associated with a photon. For it is given by an infinitely long moving right of left handed helicoidal line in 3-space (which by the way, it is a minimal surface; more on dislocations and minimal surfaces and turbulence, shall be presented elsewhere) while the photon is given by a point piloting a spherical wave. In particular if the singular screw line of above is associated with an elementary state u and carries energy E, it also carries the angular momentum $\epsilon^2 E\omega/c^2$ directed along a x-axis, in the given referential. Hence the neutrino carries angular momentum while the photon does not. On the other hand, according to this description, the neutrino should not have (primary) diffraction patterns as the photon does, which should explain why it is so difficult of detect.

4.2.2 DISTINCTION OF MAXIMAL MONOCHROMATIC ALGEBRAS AND THEIR TWISTOR REPRESENTATIONS

Lemma 2. The maximal monochromatic algebras $\mathbf{M_1}$ and $\mathbf{M_2}$ with generators $(f, \phi + i\psi)$ and $(\tilde{f}, \tilde{\phi} + i\tilde{\psi})$ respectively, are distinct if and only if

$$g(\nabla f, \nabla \tilde{f}) = 0. \tag{45}$$

Consider the generators $(\phi, f + i\rho) \in \mathbf{M}$ of a maximal monochromatic algebras. The vectorfields $\nabla\phi$ and $\nabla(f + i\rho)$ are, respectively, real and complex isotropic fields, mutually

orthogonal on (M, g); here M is a generic spin-manifold provided with a Lorentzian metric g. By the previous analysis $\nabla\phi$ is given by a spin vectorfield ω^A in the spinor form

$$\nabla\phi = \omega^A\bar{\omega}^{A'} \quad (\text{or} - \omega^A\bar{\omega}^{A'}). \tag{46}$$

and since $\nabla(f + i\rho)$ is isotropic and orthogonal to $\nabla\phi$ then we have

$$\nabla(f + i\rho) = \omega^A\bar{\pi}^{A'}, \tag{47}$$

where π^A is another spin vectorfield. Consequently the pair $(\nabla\phi, \nabla(f + i\rho))$ of vectorfields is completely determined by the ordered pair of spin vectorfields

$$(\omega^A, \pi^{A'}), \tag{48}$$

but we have a fourfold map here since we have already altogether four different ways of building the vectorfields according to eq. $(46, 47)$ out of the ordered pair given by (48). The correspondence (46), extended to complex vectors shows that the second choice in (46) reverses $\nabla\phi$ from, say , a future-pointing isotropic vector to a past-pointing isotropic vector while in (46) it chooses the complex-conjugate $\nabla(f - i\rho)$ instead of $\nabla(f + i\rho)$, reversing the roles of analytic and anti-analytic functions, which means inversion of handedness. Choosing locally a given time orientation and a given handedness, corresponds to a particular choice of the assignements in eqs. $(46,47)$. The ordered pair (48) of spin vectorfields at a point in (M, g) is called a local twistor and the corresponding field a local twistor field. From the twistor field we determine the real and complex vectorfields by eqs. $(46, 47)$, which, upon integration yield an equivalent pair $(\phi, f + i\rho)$. This means that we can characterize completely a maximal monochromatic algebra (and consequently the light quanta it represents) in terms of a twistor field with divergence freee associated vectorfields. This can be of course produced, by working from the start with coclosed differential forms. The new representation is even richer as it has built in an extra degree of freedom, namely, polarization, due to the factor $e^{i\phi}$ mentioned before. This result, showing that we have identified as light quanta are indeed given by twistor fields, substantiates the belief of Penrose that twistors are the appropiate tool to describe zero rest-mass particles and to effect the connection between gravitation and quantum mechanics. Further below we shall see that this connection extends to the laws of thought.

5 SELF-REFERENCE, THE KLEINBOTTLE, TORSION, MATRIX LOGIC, THE LAWS OF THOUGHT AND THE TWISTOR REPRESENTATION OF THE COGNITIVE PLENUM

Up to know we have elaborated a theory of torsion and photons, which is presented as a theory of an 'objective' realm that has its standing in the Cartesian cut mindset of a world in which subjectivity does not participate, or altogether does not exist in the universe

of discourse. Yet, we have shown that both torsion and the photon are very closely related to self-reference, and thus to consciousness [101]. Furthermore, the semiotic codification of torsion as a distinction sign produces in incorporating paradox, a multivalued logic which is associated with the Kleinbottle and time waves [101]. From this logic, it was proved that the most general matrix-tensor logic that has as particular cases quantum, fuzzy, modal and Boolean logics [121] stem from these time waves. In this theory which stems from abandoning the scalar logic theory of Aristotle and Boole, promoting it to logical operators, we find that the Kleinbottle plays a fundamental role as an in-formation operator, which coincides with the Hadamard gate of quantum computation. The role of this gate is to transform the vector Boolean states to superposed states, the latter being associated with the torsion of cognitive space and the non-orientability of this space due to its constitution in terms of the self-referential non-orientable Moebius and Kleinbottle surfaces. Furthermore, the logical Cognition Operator which leads to quantization of cognition is generated by the torsion produced from the commutator of the TRUE and FALSE logical operators which self-referentially gives the difference between these two operators, as we shall see below. The picture that stems is that Matrix Logic can be seen as the self-referential logical code which stands at the foundation of quantum physics to which is indisolubly related. We have elaborated the relations between matrix logic, self-reference, non-orientability and the Kleinbottle, nilpotent hypernumber representations of quantum fields that represent some logical operators. Thus, in this theory, matter quantum field theories are logical operators, and viceversa, and a transformation between quantum and cognitive logical observables has been established; this theory has produced a new fundamental approach to the so-called mind-matter problem , establishing its non-separateness, and the primacy of consciousness which thus cannot be purported to be an epiphenomenon of physical and more complex fields [101]. By promoting the 'truth tables' of usual Boolean logic to matrix representations, the founder of Matrix Logic A. Stern was able to produce an operator logic theory in which logical operators may admit inverses, and the operations of commutation and anticommutation are natural [121]. Furthermore, logical operators can interact by multiplication or addition and, in some cases, being invertible [], they yield thus to a more complex representation of the laws of thought that the one provided by the usual Boolean theory of logical connectives which is called the *Intelligence Code*. The latter can be related to Quantum Mechanics for two-state sytems as we shall describe below. Matrix Logic is naturally quantized, since its eigenvalues take discrete values which are $\pm 1, 0, 2, \pm\phi$, with ϕ the Golden number [121]. In this setting, the null quantum-cognitive observable is the 2×2 matrix, $\mathbf{0}$, with identical entries given by 0; the latter is the *Mind Apeiron* as we discussed in [103] which we shall retake below. The relation with quantum field operators and this observable which represents the apeiron observable, is their role in polarizing this cognitive-quantum apeiron through non-null square roots which can be represented by nilpotents (we rather prefer to call them plenumpotents), i.e. hypernumbers whose square is $\mathbf{0}$. [29] In distinction with the

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[29]We shall later encounter the plenumpotence of the Mind Apeiron when discussing the Myth of Eternal Return as a self-referential process. The present theory shares with the *nilpotent universal rewrite system* due to Rowlands and further extended to biology as the *Code of Life* by Hill [111] [43] , an understanding of the generative role of 0. The theory of these authors (which has no time operator) is constructed in terms of recursion, which in their context is the *reduction* of self-reference to the 'objective' side of the Cartesian Cut,

other cognitive-quantum observables, is that the eigenstates of **0** are no longer quantized, but rather give an orthogonal complex two-dimensional nullvector space. In this way the plenum is no longer represented by a single point, **0**, but rather becomes an extended object or zero-brane. This will allow to map the twistor representations of the extended photon presented in (48) with its representation in a cognitive state and viceversa!

Let us present this briefly in this Section. If we consider a space of all possible cognitive states (which in this context replace the logical variables) represented in this plenum as the set of all Dirac bras $< q| = (\bar{q} \ q)$, where $\bar{q} + q = 1$ [30], is a continuous cognitive logical value not restricted to the false and true scalar values, represented by the numbers 0 and 1 respectively. In fact, q can take arbitrary values as we shall elaborate further below. Still, the standard logical connectives admit a 2×2 matrix representation of the their 'truth tables' and now we have that for such an operator, L, we have the action of L on a ket $|q> = \begin{pmatrix} \bar{q} \\ q \end{pmatrix}$ is denoted by $L|q>$ alike the formalism in quantum mechanics, and still we have a scalar truth value given by $< p|L|q >$, where $< p|$ denotes another logical vector. We can further extend the usual logical calculus by considering the TRUE and FALSE operators, defined by the eigenvalue equations $\text{TRUE}|q> = |1>$ and $\text{FALSE}|q> = |0>$, where $|1> = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ and $|0> = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ are the true and false vectors. It is easy to verify that the eigenvalues of these operators are the scalar truth values of Boolean logic. We can

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not the full embodiment of self-reference with physics, semiotics, multivalued logic, perception, cognition and neurology. The reduction of self-reference to recursion in this theory is produced as an empowerment of semiotics. More specifically, mathematical symbols -conceived independently of the embodied energetics and nonintegrability claimed by Pattee [83] and Taborsky [123] which we associated to torsion and multivalued logics [101]- are presented as a self-writing system of the objective world- This system, if conceived free of subjectivity as in Aristotelian dualism which is already implicit to the reduction of self-reference to recursion, may actually produce the illusion of this independence. This is the usual conception of the Platonic realm in which most fertile and original mathematical, artistic and creative works claim to find/receive their origin. In this chapter we are presenting a very different conception, which does not deny this realm, but rather integrates it into the full fusion of the objective and subjective realms and its embodiment as a lifeworld, in which life and world are richer than abstractions, but rather a supraobjectivity and suprasubjectivity: embodiment at *all* scales. The relations between this very remarkable theory and the present work will hopefully be presented elsewhere.

[30]Notice that a difference with the definition of qubits in quantum computation, is that for them we have the normalization condition for complex numbers of quantum mechanics. In this case, the values of q are arbitrary real numbers, which leads to the concept of non-convex probabilities. While this may sound absurd in the usual frequentist interpretation, when observing probabilities in non-orientable surfaces, say, Moebius surfaces, then if we start by associating to both sides of an orientable surface -from which we construct the Moebius surface by the usual procedure of twisting and gluing with both sides identified- the notion of say Schroedinger's cat being dead or alive in each side, then for each surface the probability of being in either state equals to 1 and on passing to the non-orientable case, the sum of these probabilities is 2. While this is meaningless in an orientable topology, in the non-orientable case which actually exist in the macroscopic world, this value is a consequence of the topology. In this case, superposed state ' being alive and being dead' or 'true plus false' which is excluded in Aristotelian dualism, is here the case very naturally supported by the fact that we have a non-trivial topology and non-orientability. As for the case of negative probabilities, we see in the previous example that -1 is the probability value complement of the value 2.

represent these operators by the matrices

$$\text{TRUE} = \begin{pmatrix} 0 & 0 \\ 1 & 1 \end{pmatrix}, \text{FALSE} = \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix} \tag{49}$$

These operators are non-self adjoint; in distinction with usual (hermitean) quantum observables, logical operators are generally non-hermitean although they may have representations as quantum field operators and viceversa. A consequence of this non-hermiticity is that in contrast with the trivial duality of the true and false scalars of Boolean logic, 1 and 0 respectively (which is represented by the relations $\bar{1} = 0$ and $\bar{0} = 1$), by defining the *complement* $\bar{L}$ of a logical operator L, by $I - L$, where I is the identity operator, hence $\overline{\text{TRUE}} \neq \text{FALSE}$ and $\overline{\text{FALSE}} \neq \text{TRUE}$. This notion of complementarity when restricted to scalar fields coincides with the dual operation of Boolean logic transforming conjuction into disjunction and viceversa which affirms the principle of non-contradiction (i.e. a proposition *and* its negation are false) of Aristotelian-Boolean logic, and thus the previous result proves the non-duality of TRUE and FALSE.

We note that the spaces of bras and kets do not satisfy the additivity property of vector spaces -while keeping the property that one is the dual of the other- due to the fact that normalization is not preserved under addition. A superposition principle is necessary. If $|p <$ and $|r >$ are two normalized states, then the superposition defined as follows

$$|q >= c|p > +\bar{c}|r >, \quad \text{where} \quad \bar{c} + c = 1, \tag{50}$$

also defines a normalized logical state. We can interpret these coefficients as components of a logical state $|c >$ or still a probability vector, termed denktor, a German-English hybrid for a thinking vector. The normalization condition is found as follows: Multiply the states $|p >$ and $|r >$ by $\bar{c}$ and c, respectively. By definition, the normalization condition on the sum $|q >$ with coefficients $\bar{c}, c$ leads to

$$\begin{pmatrix} \bar{q} \\ q \end{pmatrix} = c \begin{pmatrix} \bar{p} \\ p \end{pmatrix} + \bar{c} \begin{pmatrix} \bar{r} \\ r \end{pmatrix} = \begin{pmatrix} c\bar{p} + \bar{c}\bar{r} \\ cp + \bar{c}r \end{pmatrix}, \tag{51}$$

yet, since $\bar{q} + q = c\bar{p} + \bar{c}\bar{r} + cp + \bar{c}r = c(\bar{p} + p) + \bar{c}(\bar{r} + r) = c.1 + \bar{c}.1$ and thus $c + \bar{c} = 1$ since $|q >$ is a normalized state by assumption. So through this superposition principle is that we can give a vector space structure to normalized cognitive states. We now can identify under these prescriptions, the tangent space to the space of bras (alternatively, kets) with the space itself. [31]

5.1 TORSION IN COGNITIVE SPACE, THE KLEINBOTTLE, QUANTUM MECHANICS AND QUANTUM FIELD THEORY, LOGIC AND HYPERNUMBERS, THE COGNITION, TIME AND SPIN OPERATORS

Returning to the vector space structure provided by the superposition principle, and thus the identification of its tangent space with the vector space itself, it follows that a

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[31] Here it is simple to see that if $|q >, |q' >$ are two superpositions, then for any operator L, $L|(q + q') >= L|q > +L|q' >$.

vector field as a section of the tangent space can be seen as a transforming a bra (ket) vector into a bra (ket) vector through a 2×2 matrix, so we can identify the tangent space which with the space of logical operators. We have as usual the commutator of any such matrices $[A, B] = AB - BA$ and the anticommutator $\{A, B\} = AB + BA$. In particular we take the case of $A = \text{FALSE}, B = \text{TRUE}$ and we compute to obtain

$$[\text{FALSE}, \text{TRUE}] \quad = \quad \text{FALSE} - \text{TRUE}, \tag{52}$$

$$\{\text{FALSE}, \text{TRUE}\} \quad = \quad \text{FALSE} + \text{TRUE}. \tag{53}$$

Thus in the subspace spanned by TRUE and FALSE we find that the commutator that here coincides with the Lie-bracket of vectorfields defines a torsion vector given by the vector $(1 \quad -1)$, and that this subspace is integrable in the sense of Frobenius: Indeed $[\text{FALSE}, \text{TRUE}], \text{TRUE}] = [\text{FALSE}, \text{TRUE}]$ and $[[\text{FALSE}, \text{TRUE}], \text{FALSE}] = [\text{TRUE}, \text{FALSE}]$. Furthermore, on account that $\text{TRUE}^2 = \text{TRUE}$ and $\text{FALSE}^2 = \text{FALSE}$, i.e. both operators are idempotent, then the anticommutators also leaves this subspace invariant.

The remarkable aspect here is that the quantum distinction produced by the commutator, exactly coincides with the classical distinction produced by the difference (eq. (52)), while the same is valid for the anticommutator with a classical distinction which is represented by addition (eq, (53)). We notice that in distinction of quantum observables, these logical operators are not hermitean and furthermore they are noninvertible. Furthermore, we shall see below how this torsion is linked with the creation of cognitive superposed states, very much like the coherent superposed states that appear in quantum mechanics. Now, if we denote by M the commutator $[\text{FALSE}, \text{TRUE}]$ so that from eq. (52) we get

$$M = \begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix}, \tag{54}$$

we note that it is nilpotent, (in fact a nilpotent hypernumber, since $M = \epsilon_2 + i_1 = \sigma_z + i_1$)

$$M^2 = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \equiv \mathbf{0}, \tag{55}$$

thus yielding the identically zero matrix, representing the universe of all possible cognitive states created by a non-null divisor of zero, which thus creates a polarization of this plenum precisely through the fact that the torsion is a superposed state which cannot be fit into the scheme of Boolean logic but can be obtained independently by the loss of orientability of a surface which thus allows for paradox. Since M coincides with the classical difference between TRUE and FALSE, which are not hermitean, then we can think of this non-invertible operator as a *Cognition Operator* related to the variation of truth value of the cognitive state, as we shall prove further below that $M = -\frac{d}{dq}$.

We would like to note that this polarization of the plenum $\mathbf{0}$ is not unique, there are many divisors of $\mathbf{0}$, the plenum, for instance the operator

$$\text{ON} = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix} := a^\dagger, \tag{56}$$

and

$$\text{OFF} = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} := a \tag{57}$$

satisfy

$$a^2 = \mathbf{0}, (a^\dagger)^2 = \mathbf{0}, \tag{58}$$

and furthermore, $\{a, a^\dagger\} = I$, so they can be considered to be matrix representations of creation and annihilation operators, $a^\dagger$ and a as in quantum field theory. In fact, if we consider the wave operators given by the exponentials of $a, a^\dagger$ we have

$$e^a = I + a = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} = \text{IMPLY}, e^{a^\dagger} = I + a^\dagger = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix} = \text{IF}, \tag{59}$$

where IMPLY $=\rightarrow$ is the implication, and IF $=\leftarrow$ is the converse implication: $x \leftarrow y = \bar{x} \rightarrow \bar{y}$. Thus the implication and the converse implication logical operators are both wave-like logical operators given by the exponentials of divisors of $\mathbf{0}$, and in fact they are derived from quantum field operators of creation and annhilation in second-quantization theory, $a^\dagger$ and a, respectively, which in fact can be represented by nilpotent hypernumbers. Indeed, $a = \frac{1}{2}(\epsilon_3 - i_1) = \frac{1}{2}(\sigma_x - i_1)$ and $a^\dagger = \frac{1}{2}(\epsilon_3 + i_1) = \frac{1}{2}(\sigma_x + i_1)$; see [101].

Now we wish to prove that the interpretation of M as the logical momentum operator is natural since $M = -\frac{d}{dq}$. Indeed,

$$-\frac{d}{dq}|q> = -\frac{d}{dq}\begin{pmatrix} 1-q \\ q \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} = \begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix}\begin{pmatrix} \bar{q} \\ q \end{pmatrix} = M|q> \tag{60}$$

so that for any normalized cognitive state $|q>$ we have the identity

$$M = -\frac{d}{dq}, \tag{61}$$

which allows to interpretate the cognitive operator as a kind of logical momentum.Thus, in this setting which is more general but less primitive than the calculus of distinctions, it is the non-duality of TRUE and FALSE what produces cognition as variation of the continuous cognitive state. We certainly are here with a situation that is far from the one contemplated by Aristotle with his conception of a trivial duality of (scalar) true and false, and which lead the elimination (and consequent trivialization) of time and of subjectivity, as argued in [101].

Now consider a surface given by a closed oriented band projecting on the xy plane. Thus to each side of the surface we can associate its normal unit vectors, (1 0) and (0 1). Suppose that we now cut this surface and introduce a twist on the band and we glue it to get thus a Moebius surface. Now the surface has lost its orientability and we can identify one side with the other so that we can generate the superpositions

$$< 0| + < 1| = < (1 \quad 1)| = < S_+|, \quad < 0| - < 1| = < (1 \quad -1)| = < S_-|. \tag{62}$$

which we note that the latter corresponds to the torsion produced by the commutator of TRUE and FALSE operators. Theses states are related by a change of phase by rotation

of 90 degrees. What the twisting and loss of orientability produced, can be equivalently produced by the fact that TRUE and FALSE are no longer as in Boolean logic and the Aristotelian frame, they are no longer dual and what matters is their difference, which in the case of scalar truth values does not exist. The other state also can be interpreted as a state that represents the fact that the states as represented by vectors, have components standing for truth and falsity values which are independent, so that the Aristotelian link that makes one the trivial reflexive value of the other one is no longer present: they each have a value of their own. In that case then $(0\ \ 0)$ is another state, 'false and true' (which is the case of the Liar paradox as well as Schroedinger's cat), which together with $(1\ \ 1)$, 'nor false nor true' state together with $(0\ \ 1)$, true, and $(1\ \ 0)$ false states we have a 4-state logic in which the logical connectives have been promoted to operators.

Now consider for an arbitrary normalized cognitive state q the expression

$$
\begin{aligned}
[q, M]|q> &= [q, -\frac{d}{dq}]|q> = -q\frac{d}{dq}|q> + \frac{d}{dq}q|q> = -q\frac{d}{dq}\begin{pmatrix} 1-q \\ q \end{pmatrix} \\
&+ \frac{d}{dq}\begin{pmatrix} q-q^2 \\ q^2 \end{pmatrix} = \begin{pmatrix} q \\ -q \end{pmatrix} + \begin{pmatrix} 1-2q \\ 2q \end{pmatrix} = |q>,
\end{aligned}
\tag{63}
$$

for any normalized cognitive state q so that we have the quantization rule

$$
[q, M] = I,
\tag{64}
$$

where $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, the identity operator. Instead of the commutation relations of quantum mechanics $[q, p] = i\hbar$ for $p = -i\frac{\partial}{\partial q}$ and those of diffusion processes associated to the Schroedinger equation, $[q, p] = \sigma$ where $p = \sigma\frac{\partial}{\partial x}$ with σ the diffusion tensor given by the square-root of the metric g on the manifold with coordinates x on which the diffusion takes place so that $\sigma \times \sigma^\dagger = g$ [94], we have that the commutation of a normalized cognitive state with the cognitive (momentum) operator is always the identity yielding thus a fixed point. Indeed, consider the function $F_M(q) = [q, M]$, then $F_M(F_M(F_M(FM(\ldots))))(|q>) = |q>$, for any normalized cognitive state $|q>$. Thus, $F_M(q)$ defines what is called in system's theory an eigenform, albeit one which does not require infinite recursion but achieves a fix point already in the first step of the process, by the formation of the commutator $[q, M]$. This is the structure of Self, which whatever operation may suffer by the action of logical operators, it retains its invariance by the quantization of logic as expressed above by eq. (64).

Now we want to return to the superposed states, S_+ and S_-, the latter being the torsion produced by the commutator of the TRUE and FALSE operators, to see how they actually construct the cognitive operator. First a slight detour to introduce the usual tensor products of two cognitive states, $|p><q|$ which as the tensor product of a vector space and its dual is isomorphic to the space of linear transformations between them, we can think as an operator L acting by left multiplication on kets and by right multiplication on bras. So that if $L = |p><q|$ then $<y|L|x> = <y, p><q|x>$, for any $<y| = \bar{y}<0| + y<1|$ and $|x> = \bar{x}|0> + x|1>$, where $<x|y> = \delta_{xy}$ equal to 1 for $x = y$, and equal to 0 for $x \neq y$

and $\sum_i |x_i><x_i| = I$. Then,

$$M = |S_+><S_-|, \tag{65}$$

which shows that the cognitive operator that arises from the quantum-classical difference between the True and False operators can be expressed in terms of the tensor products of the superposition states, being the sum of the true and false states and the torsion produced in the quantum commutator of the TRUE and FALSE operators.

Starting with the logical momentum or still Cognition Operator, M, that satisfies $[q, M] = I$ for any cognitive variable q, we can link the quantization rule in cognitive space to the quantization rule of Bohr-Sommerfeld. The logical potential carrying the logical energy could be linked to the Bohr energy of atomic structures in the following way: $\infty(k) = \oint M dq = 2\pi(n + 1/2) = k\pi$, where q is a logical variable (if it is zero than the contour integral runs a full great circle on the Riemann sphere of zeros), n is the winding number specifying the numbers of times the closed curve runs round in an anticlockwise sense; n runs the bosonic numbers $0, 1, 2 \ldots$ and $(n+1/2)$ the fermionic numbers, $\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$. The topological potential is an odd multiple $(2n + 1)\pi$ of the elemental (topo)logical phase π and is $\hbar^{-1}$ times the Bohr energy of the quantum oscillator: $\oint p dx = 2\pi\hbar(n+1/2)$, where the position and momentum operator satisfy the standard quantum commutation relation: $[x, p] = i\hbar$. As we see, the topological potential, multiplied by the factor $\hbar$, gives the Bohr quantum energy opening up the possibility to treat atomic structure as a dynamical logic in a fundamental sense, where quantization stems from the closed topology or self-observation feature at this fundamental level of reality. Another interesting conjecture which follows is, since matter, as energy, ($E = mc^2$) is a topologically transformed logical energy, the mass of an object is basically the information contained in the holomatrix which projects it out from the ground state.

Let us now introduce the operator defined by

$$\triangle = a - a^\dagger \tag{66}$$

so that is follows that its matrix representation is

$$\triangle = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}. \tag{67}$$

and furthermore

$$\triangle = \rightarrow - \leftarrow . \tag{68}$$

We shall call $\triangle$ the TIME operator. Note that alternatively we can define TIME by changing the sign in the above definition. [32] We notice that it is unitary and antisymmetric:

$$\text{TIME}^\dagger = \text{TIME}^{-1} = -\text{TIME}. \tag{69}$$

As an hypernumber TIME $= -i_1$, minus the unique 2×2 matrix representing a 90 degrees rotation, the old commutative square root of -1 from which complex numbers appeared.

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[32]Remarkably, $-2i$TIME is the hamiltonian operator of the damped quantum oscillator in the quantum theory of open systems; see N. Gisin and I. Percival, arXiv:quant-ph/9701024v1. In this theory based on the stochastic Schroedinger equation the role of torsion is central [99].

The reason for considering this operator given by the difference of nilpotents is because it plays the role of a comparison operator. Indeed, we have

$$< p|\text{TIME}|q > \quad = \quad \bar{p}q - \bar{q}p = (1-p)q - (1-q)p = q - p = \bar{p} - \bar{q}. \qquad (70)$$

TIME appears to be unchanged for unaltered states of consciousness:

$$< q|\text{TIME}|q >= 0, \qquad (71)$$

and if we have different cognitive states p, q, then $< p|\text{TIME}|q >\neq 0$. So this operator does represent the appearance of a primitive difference on cognitive states, and it is antisymmetric and unitary. It is furthermore linked with a difference between annihilation and creation operators and thus stand for what we argued already as a most basic difference that leads to cognition and perception: the appearance of quantum jumps. Without them, no inhomogeneities nor events are accesible to consciousness, and even the very nature of self-reference as consciousness of consciousness requires such an operator for the joint constitution of the subject and the world. Thus its name, TIME operator; it stands clearly in the subject side of the construction of a conception that overcomes the Cartesian cut, yet a subject that has superposed paradoxical states.

Let us consider next the eigenvalues of TIME, i.e. the numbers λ such that $\text{TIME}|q >= \lambda|q >$; they are obtained by solving the characteristic equation $\det|\text{TIME} - \lambda I| = \lambda^2 + 1 = 0$, so that they are $\lambda = \pm i$ with complex eigenstates

$$\begin{pmatrix} 1 \\ i \end{pmatrix}, \begin{pmatrix} i \\ 1 \end{pmatrix}. \qquad (72)$$

They are not orthogonal, but self-orthogonal; thus, they are spinors, and the complex space generated by them generates a two-dimensional null space. We diagonalize TIME by taking

$$\begin{pmatrix} 1 & i \\ i & 1 \end{pmatrix} \text{TIME} \begin{pmatrix} 1 & i \\ i & 1 \end{pmatrix}^{-1} = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix} \qquad (73)$$

so that

$$\text{TIME}_{\text{diag}} = \begin{pmatrix} i & 0 \\ 0 & -i \end{pmatrix} \qquad (74)$$

which as an hypernumbers we have that $\text{TIME}_{\text{diag}} = i_2$, so that $\text{TIME}^2_{\text{diag}} = -I$. We want finally to comment that TIME is not a traditional clock, yet it allows to distinguish between after and before ($\rightarrow - \leftarrow$), forward and backwards. There is no absolute logical time, nor a priviliged direction of it. To have a particular direction it must be asymetrically balanced towards creation or annihilation. This can be computed as the complement of the operator phase[33]

$$\overline{cos(2a^\dagger) + sen(2a^\dagger)} = a^\dagger - a, \qquad (75)$$

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[33]The complement of a logical operator L, is defined by $\bar{L} = I - L$.

from which it follows that TIME $= \overline{\leftarrow^2} = \rightarrow - \leftarrow$, as we stated before.

Let us now retake the Cognition Operator M and decompose it as

$$M \quad = \quad \text{TIME} + \sigma, \quad \text{or still} \tag{76}$$

$$\begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix} \quad = \quad \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}. \tag{77}$$

Then we have that

$$< q|M|q > = < q|\sigma|q > . \tag{78}$$

Indeed, since $< q|\text{TIME}|q > = 0$, so that the proof of eq. (78) follows. Furthermore we note that

$$< q|\sigma|q > = \bar{q}^2 - q^2 = (\bar{q} - q)(\bar{q} + q) = \bar{q} - q. \tag{79}$$

from the normalization condition. Note here that the identity given by eq. (79) is a kind of quadratic metric in cognitive space which due to the normalization condition looses its quadratic character to become the difference in the cognitive values: $\bar{q} - q = 1 - 2q$ which becomes trivial in the undecided state in which $\bar{q} = q = \frac{1}{2}$.

The role of σ is that of a SPIN operator, as we shall name it henceforth, which coincides with the hypernumber ϵ_2 (or as a Pauli matrix is σ_z), so that $\sigma^2 = I$ the non-trivial square root of hypernumber $I = \epsilon_0$, which is the usual Pauli matrix σ_z in the decomposition of a Pauli spinor in the form $\sigma_x e_x + \sigma_y e_y + \sigma_z e_z$, for e_x, e_y, e_z the standard unit vectors in R^3 and we write their representations as hypernumbers

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} = \epsilon_3, \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} = \epsilon_1, \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} = \epsilon_2. \tag{80}$$

We can rewrite this average equation $< q|M|q > = < q|\sigma|q >$ as an average equation which the l.h.s. takes place in cognitive space of normalized states $|q >$ and the r.h.s. in a Hilbert space of a two-state quantum system, say, spin-up $\psi(\uparrow)$, spin-down $\psi(\downarrow)$, so that the generic element is of the form

$$\psi = \psi(\uparrow)|0 > + \psi(\downarrow)|1 > . \tag{81}$$

Indeed, if we write

$$|q > = \overline{\psi(\uparrow)}\psi(\uparrow)|0 > + \overline{\psi(\downarrow)}\psi(\downarrow)|1 >, \tag{82}$$

then the r.h.s. of eq. (79) is $\bar{q}^2 - q^2$, with $\bar{q} = \overline{\psi(\uparrow)}\psi(\downarrow)$, and $q = \overline{\psi(\downarrow)}\psi(\uparrow)$, so that eqs. (76, 78) can be written as

$$< q|M|q > = < \psi|\sigma|\psi > \tag{83}$$

where the average of M is taken in cognitive states while that of the SPIN operator is taken in the two-state Hilbert space. [34]

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[34] According to Conte, "quantum mechanics is a theoretical formulation that necessarily includes also the cognitive function as it is shown by using a Clifford algebraic formulation of this theory. Therefore, quantum mechanics is also a physical theory of cognitive processes and of the profound existing link between cognitive dynamics and physical reality per se" [17].

We revise the previous derivation for which the clue is the relation between cognitive states $|q>$ and elements of two-state of Hilbert state $|\psi>$ is that the former are derived from the latter by taking the complex square root of the latter, so that probability($|0>$) $= \bar{q} = \overline{\psi(\uparrow)}\psi(\uparrow)$ and probability($|1>$) $= q = \overline{\psi(\downarrow)}\psi(\downarrow)$, so that $<\psi|\sigma|\psi> = \bar{q} - q = (\bar{q}-q)(\bar{q}+q) = \bar{q}^2 - q^2$. Therefore, by using the transformation between real cognitive states q defined by the complex square root of ψ, i.e. $q = \bar{\psi}\psi$, we have a transformation of the average of the cognitive operator M on cognitive states on the average of the spin operator on two-states quantum elements in Hilbert state, i.e. eq. (76). This is a very important relation, established by an average of the Cognition Operator (which transforms an orientable plane into a non-orientable Moebius surface due to the torsion introduced by M, as represented by eq. (62), and the spin operator on the Hilbert space of two-state quantum mechanics. It is an identity between the action of the cognizing self-referential mind and the quantum action of spin. Thus the cognitive logical processes of the subject become related with the physical field of spin on the quantum states. This is in sharp contrast with the Cartesian cut, and we remark again that this is due to the self-referential classical-quantum character of M as evidenced by eq. (62) which produces a torsion on the orientable cognitive plane of coordinates (true, false) to one which is torsioned to yield a superposed state, S_-. The relation given by eqs. (72, 76) establishes a link between the operations of cognition and the quantum mechanical spin. This link is an interface between the in-formational and quantum realms, in which topology, torsion, logic and the quantum world operate jointly. Yet, due to fact that for the Klein bottle there is no inside nor outside, the exchange can go in both ways, i.e. the quantum realm can be incorporated into the classical cognitive dynamics, while the logical elements can take part in the quantum evolution. Indeed, if we have a matrix-logical string which contains the momentum product, say, $\ldots < x|A|y><q|M|q><z|B|s> \ldots = \ldots < x|A|y><\psi|\sigma|\psi><z|B|s> \ldots$. Thus, the factor $<\psi|\sigma|\psi>$ entangles with the rest of the classical logical string creating a Schrodinger cat superposed state, since we have a string of valid propositions where one may be the negation of the other

There is still another very remarkable role of these superposed states in producing a topological representation of a higher order form of self-reference, produced from oppositely twisted Moebius surfaces. So we shall consider the Cartesian modulo 2 sum of the superposed states

$$\mathcal{H} := |S_+> \oplus |S_-> = \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}, \tag{84}$$

which we call the topological in-formation operator which is an hypernumber; indeed, $\mathcal{H} = \sigma_x + \sigma_z = \epsilon_3 + \epsilon_2$. We could have chosen the opposite direct sum or still place the minus sign on the first row in any of the columns and obtain a similar theory, but for non-hermitean operators unless the minus sign is on the first matrix element. Notice that it is a hermitean operator, which essentially represents the topological (or still, logo-topological) in-formation of a Kleinbottle formed by two oppositely twisted Moebius surfaces. [35] The in-formation

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[35] Alternatively we can introduce instead of $\mathcal{H}$ another in-formation matrix for the Kleinbottle, namely

$$.\mathcal{H} := |S_+> \oplus |S_-> = \begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix}, \tag{85}$$

matrix satisfies $\mathcal{H}\mathcal{H}^\dagger = \mathcal{H}\mathcal{H}^{-1} = 2I$. We recognize in taking $1\sqrt{2}\mathcal{H}$ the Hadamard gate in Quantum Computation [4], which due to the introduction of the $\frac{1}{\sqrt{2}}$ factor is hermitean and unitary. Now we have two orthogonal basis given by the sets $\{|0>, |1>\}$ and $\{|S_->, |S_+>\}$ of classical and superposed states respectively, the latter un-normalized for which a factor $\frac{1}{2}$ has to be introduced but still does not give a unitary system as in quantum theory. An important role of the Kleinbottle is precisely to transform these orthogonal basis, from classical states to superposed states which are nor classical nor quantum, but become quantized by appropiate normalization with the $\frac{1}{\sqrt{2}}$ factor. Indeed,

$$\mathcal{H}|0>= |S_+>, \mathcal{H}|1>= |S_->, \tag{86}$$

and

$$\frac{1}{2}\mathcal{H}|S_+>= |0>, \frac{1}{2}\mathcal{H}|S_->= |1>. \tag{87}$$

In the logical space coordinates $(true, false)$ we have rotated the state $|0>$ clockwise by 45 degrees through the action of $\mathcal{H}$ and multiplied it its norm by 2, and for the state $|1>$ we have rotated it likewise after being flipped. In reverse, the superposed states are transformed into the classical states by halving the in-formation matrix of the Kleinbottle, producing 45 degrees counterclockwise rotations, one with a flip. Now classical and quantum states are functionally complete sets of eigenstates spanning each other. The classical states $|0>$ and $|1>$ can be easily determined to be the eigenstates of AND, and and the superposed states $|S_->, |S_+>$ are the eigenstates of NOT. It is known that the logical basis of operators $\{\text{AND}, \text{OR}\}$ is functionally complete, generating all operators. Hence our system of classical and superposed (or still, quantum by appropiate normalization by $\frac{1}{\sqrt{2}}$) eigenstates constitute together a functionally complete system: all operators of matrix logic can be obtained from them. This system is self-referential. Furthermore, there are operators which produce the rotation of one orthogonal system on the other orthogonal system. The logical differentiation operator M defined by the commutator [FALSE, TRUE] or still eq. (61) transforms classical states $|x>= \bar{x}|0> +x|1>$ into $|S_-$ and still the anticommutator $\{\text{FALSE}, \text{TRUE}\}$ which coincides with the matrix $\mathbf{1} = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$ transforms $|x>$ into $|S_+>$, i.e.

$$M|x>= |S_->, \mathbf{1}|x>= |S_+>. \tag{88}$$

which can be rephrased by saying that M evidences on its action on a classical state the torsion in the quantum commutator of FALSE and TRUE while the ONE operator $\mathbf{1}$ trans-forms $|1>$ into $\begin{pmatrix} 1 \\ 1 \end{pmatrix} = |S_->$. Since both M and $\mathbf{1}$ are non-invertible, we shall use instead the fact that $\mathcal{H}^{-1} = \frac{1}{2}\mathcal{H}$, so that in addition of the transformation by the Kleinbottle of the classical basis in eq. (86), the reversed transformation from the superposed to the classical states is achieved by

$$\frac{1}{2}\mathcal{H}|S_+>= |0>, \frac{1}{2}\mathcal{H}|S_->= |1>. \tag{89}$$

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which is non-hermitean.

Yet, we stress again that these transformations are not unitary which is easily resolved by the $\frac{1}{\sqrt{2}}$ factor and then we have a transformation of classical into quantum states and viceversa. In the latter case, the renormalized Kleinbottle acts like a quantum operator producing coherent quantum states, a topological Schroedinger cat state which does not decohere.

6 THE EIGENSTATES OF THE NULL OPERATOR, COGNITIVE APEIRON, THE EXTENDED PHOTON AND THEIR TWISTOR REPRESENTATIONS

We have discussed the eigenstates of some logical operators, and now we discuss the eigenstates of the mind apeiron, namely the 2×2 identicaly zero matrix, which we denoted as $\mathbf{0}$. In distinction with the other logical operators the eigenstates of $\mathbf{0}$ (as a linear transformation from C on C, so that $\mathbf{0}$ becomes a point of C^2, its origin) are no longer quantized, but rather give an orthogonal complex two-dimensional nullvector space. [36] In this way the plenum is no longer represented by a single point, $\mathbf{0}$, but rather becomes an extended object or zero-brane. This phenomenon is well known in complex Clifford bundles. To create the correct complex vector bundle we modify C^2 to make different fibres (unit 2-spheres) disjoint, with no common origin. To achieve this we replace the origin of C^2 by a copy of the entire Riemann sphere, so that instead of having just one zero, we have a whole Riemann spheres worth of zeros, one for each fiber, giving the zero section of the bundle. This procedure is known as blowing up the origin of C^2, which amounts to take a projective subspace of $C^2 \times S$, with S the Riemann sphere (i.e. the complex projective space $CP(1)$), defined as the set of all elements of the form $\{(z_1, z_2, \xi) \in C^2 \times S / z_1 = z_2\xi\}$. Since zero is now allowed on the fibres, continuous cross-sections of the bundle exist [19].[37] These cross-sections represent the spinor (and twistor) fields on $S \simeq S^2$, the two-dimensional sphere, giving a 2- complex-dimensional vector space, which can be mapped to the 2-dimensional logic space of matrix logic by stereographic projection. We shall apply now this to the twistor representation of the extended photon through the maximal monochromatic algebra as described by $(46, 47)$ which has an equivalent representation as a pair of divergenceless orthogonal spinor vectors $(\omega^A, \pi^{A'})$, $A, A' = 1, 2$ by (48). By stereographic projection of this twistor representation of the extended photon, we obtain a basis of cognitive space, or

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[36] We have already seen this an identical situation in the eigenstates of TIME. Thus the eigenstates of the mind apeiron are given by a nilpotence condition alike the eikonal equation; we shall see that this likeness is in fact an identity

[37] The blowing up of the origin, transforming its point-like structure to yield a manifold has profound consequences. For example, the blowing up of the origin in R^2 is the Moebius surface, which as we already saw is basic to the Intelligence Code. Two oppositely twisted Moebius bands generate the Kleinbottle, the high order surface of paradox, whose matrix representation, up to a normalizing constant, is the Hadamard gate of Quantum Computation, which together with the phase conjugator, allows to generate all quantum gates [4]. In taking in account that DNA performs quantum computation [38] as the works of Peter Gariaev and associates shows [31] and its relation to holography [67] [71] which is already performed by sensory processing cells of the human neurocortex, evidences the relevance of the importance of this gate and the multivalued logic we presented above which is derived from the Klein bottle; see [101] and references therein.

viceversa: We can use the Boolean basis $< 0|$ and $< 1|$, or still the superposed states $< S_+|$ and $< S_-|$, to represent the maximal monochromatic algebra by taking the inverse of the stereographic projection; in any case via the normalized Kleinbottle Hadamard in-formation matrix, we generate all the operators of matrix logic. In this we see how the extended photon which we purported to be a subjective-objective fused structure is represented as a basis for cognitive space, and conversely, from cognitive space we are able to codify the maximal monochromatic algebra representation of the extended photon. This establishes the full self-referential construction of a world which is perceived through quantum jumps, i.e. distinctions, or still, in terms of cognitive states that belong to states of cognition of the mind. Yet, we have seen above that the role of the Planck constant $\hbar$ is precisely to connect the transformation of the quantum world into the world of the mind, bridging thus the material and mind domains. The Riemann sphere is not only instrumental to codify this joint constitution by codifying the extended photon as a cognitive state, it is also the manifold in which the logarithmic function takes multivalued complex values to quantize the quantum jumps in terms of the different branches of the logarithm, allowing thus to codify the 'outer' and 'inner' worlds. For further ellaborations in relation to the transactional interpretation of Quantum Mechanics, cosmological Kozyrev torsion fields and entanglement, and brain synchronization in binocular vision, and the visual and somatosensory representations on the neurocortex we shall elaborate below. [39]

7 THE SURMOUNTAL OF THE CARTESIAN CUT AND ITS MANIFOLD MANIFESTATIONS

7.1 TORSION, THE PRIMEVAL DISTINCTION, THE KLEIN-BOTTLE, COGNITION, CONTROL, WILL AND TIME OPERATORS

While current science has been built in terms of the Cartesian Cut in its manifold expressions, we have unveiled a lifeworld that surmounts the Cartesian Cut which stems from incorporating into the very foundations of the constitution of space,time, thought, cognition and perception, the essential phenomenon which is the basis for consciousness: self-reference.

In second-order cybernetics self-reference trascends the cut between observer and controlled system by the semiotic codification through a primeval distinction (in the sense of the calculus of distintions of Spencer-Brown) of the torsion geometry associated to the anholonomic variables (controlling variables that cannot be separated from the system that

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[39]For a different conception in terms of Endophysics we refer to [110], and to the theory of fractal time due to S.Vrobel [133]. Remarkably, inasmuch matrix logic has a projective structure as well as the eigenstates of the mind apeiron, Saniga has proposed a theory of altered mind states in terms of Cremona transformations which arise as well as blowups [14]. For a geometric formulation of noetic space we refer to Amoroso [3].

they control) variables which Pattee considered precisely -we say, paradoxically- to encode the Cartesian Cut [83, 101]. This fuses subject-with-object into an implicate *and* explicate (in the sense of Bohm) meta-algorithmic process-form which is the Kleinbottle [101, 13]. Departing from this primeval semiotic codification of torsion through a distinction on a plane, this introduces two states: the 'empty' undistinguished state which is given by the plane itself of all potential undistinguished states (the plenum, rather than the void in spite of being empty to perception) and the 'distinguished' state codified as the distinction sign. The cleavage of the state of all potentialities under the distinction sign generates a process through the sign as a boundary that sets an 'outer' and 'inner' domains and thus the distinction becomes a logo-physical generator; this establishes a non-dual process of content and context mutual transformation, in which the distinction is both operand and operator, and form and function fuse. By functioning as a boundary, this transversion of the sign-boundary is an abstraction of osmosis, which is related to torsion [97]. In terms of logic, in first examination this leads to Aristotelian-Boolean logic [119]; on raising this distinction through self-referential paradox we obtain the Kleinbottle [95] and to the generation through time-waves of a 4-state logic from which was derived Matrix Logic [101]. This reverses completely the historical Western tradition of disregarding paradox as nonsensical, which was thus be proved at the basis of logic. Again, this is possible because content and context conform an holonomic process-structure, rather than distinct related instances.

This participatory constitution of the geometry of space and time stands in sharp distinction with the Cartesian Cut in which space is exterior to the subject and a mere container of objects, while time is also considered to be external, though in General Relativity it is constrained by relations with the space variables. In Aristotelian thought, the cradle of Western scientific thought, we have as its backbone a dualist conception which expresses itself in the two-valued logic and the principle of non-contradiction, which is no longer valid in matrix logic nor the calculus of distinctions with paradox. This eliminates subjectivity from the universe [101]. Hegel's stance is that the elimination of time is related to the principle of non-contradiction, consistently with the findings in our work that its violation leads to time-waves. Further, in Matrix Logic time appears as an operator, TIME which we introduced in eq. (66), which is the matrix representation of the commutative square root of minus one which is the basis of imaginary numbers, an anticlockwise $\frac{\pi}{2}$ rotation in the cognitive plane of all cognitive (vector) states which we encountered above. We have seen already that the quantization of any cognitive value and Self as a fixed point of any cognitive state cognition arises from the Logical Momentum (Cognition) Operator, M, defined by the commutator of the False and True Operators -not (dual) scalars as in Boolean logic- which decomposes as $M = \text{TIME} + \text{SPIN}$. A torsion vector appears in two guises: as the coefficients of the self-referential structure produced by these operators, and as a superposed state of the difference between the normal unit vectors to a Moebius surface, i.e. it is given by $S_- = (1 \quad -1)$, while the anticommutator of these operators yield their sum with coefficients hence given by the other superposition state given by the sum of the normal unit vectors [40]. Now, we recall that $M = |S_+ > < S_-|$, the tensor product, and the direct sum modulo 2 yields the Kleinbottle in-formation matrix, $\mathcal{H} = |S_+ > \oplus |S_- >$, which is non-other than the

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[40][False, True] = False − True ≠ 0; {False, True} = False + True

Hadamard gate of quantum computation; both played a major role in the theory. From the association of SPIN with space torsion and since TIME is a rotation on the cognitive plane generated by the true and false states, it is clear that cognition is represented by a vortex structure-process projection on two-dimensional cognitive space! We shall see later on that this is the case of somatosensory and visual codification in the neurocortex, in which each point of the planar neurocortex codifies through a whole columnar arrangement on which a Karman vortex structure is occuring.

7.2 CONTROL, WILL, SELF-REFERENCE, LIFE AND THE TIME OPERATOR OF MATRIX LOGIC

We want to explore the relation between will and TIME as introduced in Matrix Logic which is a self-referential operator (either by distinguishing two arbitrary cognitive states by computing their difference or by geometrically being a simple ninety degrees rotation, which thus if iterated by another three rotations leads to the identity) in a self-referentially constructed logic that has at its roots the Kleinbottle. This will be of paramount importance in examining later the role of time and self-reference in cosmological and human systems, and basically with regards to the existence of time waves -that we already discussed in [101] that are appearing in very diverse natural (and particularly , human) systems (including Mathematics), and cosmology as well.

We start with a disgression on the construction of number systems from the notion of primeval distinction. Indeed, with this concept of distinction and its interpretation as a boundary, we can construct numerical systems in the so-called boundary mathematics [51]. To construct the complex numbers as spatial forms, only three distinctions are necessary to generate them. Hence, this conception under this extra provision of three distinctions allows to construct the number system which allows to treat time and subjectivity : the imaginary numbers [121]. Furthermore, the time oscillations which in the present theory with a single distinction and the Kleinbottle generate the 4-state imaginary logic of the calculus of distinctions which itself generates Matrix Logic, appear without recurring to the paradoxical equation that leads to the Kleinbottle, as an oscillation of the empty state and the *phase form* (which appears to be its self-inverse) created by the juxtaposition of the three distinctions. If we think of each spatial distinction and its meaning as a boundary initiating a process which has a time interpretation as is the calculus of distinctions, then we have three different time distinctions associated to these three spatial boundaries. The first distinction creates a primeval cleavage, space, and the process of going through it, velocity; the second distinction creates a cleavage on the velocity, i.e. acceleration as a process through it, and finally the third distinction creates a cleavage on the accelerations which as a process introduces the time derivative of acceleration, thus a third order time derivative on the original plenum undifferentiated empty state is associated to the three cleavages which allow us to construct Matrix Logic, and hence relate it to quantum field theory and the Kleinbottle. But a third order time derivative introduces a derivative of force which is not associated with determinism but rather with control, which is absent in Newtonian physics due to the fact that it cannot be used to predict. Yet, it is related to control, and thus has an element extraneous to the Newtonian conception, since it is a subjective element linked

to will, intention, purpose, which are essential characteristics of life, by which monads (i.e. entities which come to be through the semiosis of having a primeval distinction constituting their identity) can become autopoietic [101, 131]. Without will, intention, purpose, action would be purely deterministic and thus it would not be related to self-organization and self-reference, and thus the quantum world would be inexistant, and as we discussed already, this would be tantamount to the disolution of Being.

Remarkably, A.Young -following a lead by Eddington- introduced a $2D$ flat space (a plane which we can trivially identify point to point with the space of cognitive states in Matrix Logic) of phase representation (basically, a circle or better still a *cycle* in the complex plane) , the cycle of action, which stands in place of *processual time* [41] as related to *action*, by rotations in the range of 0 to 2π (where we recall that the 2π *uncertainty* factor appears already in quantum physics [42] in the commutator relation $[p, q] = 2\pi h$); Young

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[41] Young points out that it processual time is about *timing*, or, in our terms, through a willful operation by and through time which in our conception is embodied in the joint constitution of spacetime and subjectivity. There is conception of a time operator with different roots that the present one, proposed by the Austin-Brussels school leadered by Prigogine [89, 5]; for lack of space we shall, unfortunately, not discuss it here.

[42] In Eddington's theory of processes, it is value of the curvature of space in the hypersphere with the added phase dimension, thus unifying quantum physics and gravitation. Eddington's approach departs from considering that both waves (as in the present theory) and curvature (as in General Relativity, GR) can be used to represent energy and momentum distributions, and they should not be confused. We have shown in the first part of this chapter and in several works [95, 97, 98, 99, 96] that spacetime geometry is associated to waves and it is fundamentally quantum , in distinction with GR, and yet in consonance with Fock's interpretation of energy-momentum densities associated to propagating singularities. These torsion geometries can be introduced by simple scale transformations on reference frames of *flat* spacetime by the action of wave functions [94, 105]. So, in distinction with GR, spacetime can be metrically flat and yet have a non-trivial geometrical structure, which we have seen is fundamentally quantum and related to the fusion of an objective and subjective realms, which of course, is absolutely absent in GR. An essential manifestation of these geometries is the appearance of Brownian motions as spacetime constituting quantum fluctuations, fusing geometry and randomness [94], which the latter itself is both 'objective' and 'subjective' [11]. Thus, scale uncertainties play a basic role since they will yield uncertainties on the distribution of energy-momentum; in this conception, these uncertainties are unseparable to the joint constitution of spacetime and subjectivity through torsion . Since probability distributions come in conjugate -in the sense of complex numbers- pairs, their product gives the probability distribution of energy-momentum, and the variable conjugate to the scale is the *phase*, such as appears in the Schroedinger equation and its connection with torsion generated Brownian motions which have both a future-oriented and past-oriented waves [99]. So time is already incorporated in these probability distributions [94]. Since there is to be considered the case of a reduction of scale to particular eigenvalues, the scale is related to momentum and the phase as a coordinate. This phase coordinate (basically the imaginary exponent S of the relativistic Schroedinger wave function [96]) is represented as a fifth-coordinate to (now flat) spacetime; metrics have no role whatsoever on this generation of spacetime; as the Bianchi structure equations show, torsion is more primitive than curvature [30]. Thus, scale and phase are invariant by Lorentz transformations. The scale uncertainty is a fluctuation of the standard, actually creating spacetime starting out of the undistinguished plenum. These fluctuations are reflected in the measured characteristics of the system. If we take as the original standard to be provided by angular momentum, thus scale momentum is an angular momentum and the corresponding phase coordinate is an angle. So *fluctuations* of the phase assume a value between 0 and 2π in which the fluctuations take a uniform distribution over the whole range of 2π. This range takes the role of providing a fundamental scale upon which it is possible to pass from the quantum discrete domain to one in which we can assume continuity. We note here that fluctuations are described in terms of probabilities. Yet, as stressed by Costa de Beauregard, the concept of probability is jointly objective and subjective, " providing the hinge around which matter and mind interact"; [11]. So there is a fusion of objective and subjective realms in the introduction of the space of phases.

with unique insight associates this phase with a *choice* of timing. We observe here that Young takes the direction of action to be anticlockwise and we can as well introduce the time operator TIME in Matrix Logic, with the opposite definition as well, and we thus coincide with Young's determination of direction of rotation and thus of processual time. In the elaboration by Young of the setting due to Eddington, the null rotation establishes space (with dimensions of length, L) , the first ninety degrees rotation velocity (dimensions, $\frac{L}{T}$, L length, T universal time [45, 46, 47]), the iteration establishes acceleration (dimension $\frac{L}{T^2}$) and the third iteration which amounts to a $\frac{3}{4}$ turn of the full cycle establishes control, which requires a third-order derivative in T since the velocity and acceleration require first and second-order derivatives in T, respectively. Thus, a three time iteration from the initial position that stands for space distinction, by three ninety degrees turn, leads to control and thus to will, and by applying a final turn, we return to the initial distinction, which is space, and the rebirth of action. (This fourth turn is the Eternal Return of self-reference by the action of self-control, and thus it represents the jump from first-order to second-order cybernetics [131] where now action and self-reference are identified bringing forth the joint creation of spacetime and subjectivity [101].) This can be seen in taking in account that since $T^4 = 1$ (the fourth derivative is the identity, yielding position since the action of control is purposefully applied in view of a spatial coordinate) in the space of phases; the control of force is parametrized by the multiplication of their units, i.e. by computing the multiplication of control with that of force: $\frac{L}{T^3}\frac{ML}{T^3} = \frac{ML^2}{T^5} = \frac{ML^2}{T}$, the units of action. In our conception, in regards to the previous introduction of TIME in Matrix Logic (which is a $\frac{\pi}{2}$ anticlockwise rotation in the cognitive plane of bras and kets), this is the second-order second-order cybernetic self-referential action by which we return to the initial point of the cycle, by applying a final ninety degrees rotation, the action of TIME applied on TIME^3 to yield TIME$^4 = I$, the identity. [43] This coincides with the action of processual time to return to Self: Self-reference, returning to space -the initial distinction-, closing thus a 4-cycle in phase-space; see page 51 in Young [139].

These ideas were crucial to the development by Young of the control system for the helicopter. As Young remarks with outstanding insight, control is the essential property of *life*; its being is related to purpose-intention and volition, in other words, to will, and as such it is anticipative yet uncomplete, requiring another $\frac{\pi}{2}$ rotation in phase-space to reach back to the self, i.e. to become self-referential. Thus we return to our previous disquisitions, in which we associated purpose-intention to a time operator as the meaning of these nouns clear suggest. Young still associates this to the fourth level of descent of processes on which degrees of freedom are progressively lost starting with the self-referential photon as the exponent of the highest potentiality, and we find an evolution from homogeneity (the photon being the sole example, the source of all inhomogeneities as we elaborated already) to inhomogeneity (say, complex molecules, DNA, etc.) as the fundamental units from which Life emerges, and which Young with great insight associates with will as an essential precondition. So Young argues in regards to the cycle in the space of phases

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[43]That time might operate in the quantum domain producing interference (and thus indeed is associated with control), is an experimentally verified fact; its theoretical framing is due to Horwitz; see [47], and references therein.

(processual time) that on reaching self-referentially to the identity, we find a final degree in which the monads (i.e. the entities formed by the primeval distinction) start to buildup their own structure countering the action of increasing entropy, as is the case of complex molecules, such as the case of viruses, through timing. In our conception, as we have seen above, this is due to the action of TIME on the control phase. In Young's view, in this evolution from the photon which has the maximal degree of freedom and from which a process of individuation starts into the more complex structures as those that we associate with Life, such as complex molecules which have the lesser degree with respect to the photon which is the building process from which all more complex structures are formed of, there occurs a return by willful action (i.e. self-control) by which complex molecules chose their processual timing to counter the environment in which the monads are in exchange relation through their primeval boundaries, exercising their sole freedom left to reverse the condemning determinism initiated by the first two derivatives in universal time, through control and self-control.[44] Thus, in Young's interpretation, they achieve through a process of increasing individuation, the full freedom to counter the environment and assess their initial distinction with which the process was initiated. This process of individuation to a higher complexity is thus the time operator's action returning to Self. This is, for the process-form of Life, a manifestation of the Myth of the Eternal Return, which we shall elaborate further below. We must recall here that the initial process that lead to the TIME operator which we have identified with the processual time of any system defined by a boundary initiating by this the multivalued logic that arises from paradox, is the Kleinbottle. Therefore, the topology of the time operator embodied in all systems and particles of any scale in their phase dimension which leads to control and self-control, is the Kleinbottle. We shall reencounter it when dealing with the physiology and growth process of the neurocortex, sensorial codification and self-referential growth of bodily organs. [45]

7.3   CHRONOTOPOLOGY, THE MYTH OF THE ETERNAL RE-TURN, SELF-REFERENCE, TIME OPERATORS AND THE KLEINBOTTLE

Chronotopology is a far reaching concept which was first proposed by Musès in his outstanding work 'Destiny and Control in Human Systems' [73] in which he anticipates a theoretical framework for the understanding of time patterns and structures (chronomes), and their relation with psychological archetypes. The initial discussions in this pioneering work focuse on natural systems which are found to have non-linear forms-functions to later proceed to analyze human systems. Musès was very much concerned that -to his understanding-

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[44]We are exercising a very different conception than the emergent non-computability conception due to Penrose for which Life will be another unexplained emergent factor requiring others and thus ad nauseum.

[45]One can ponder on the possibility of Mathematics (as a system) having a time operator acting through rotations which is further related to self-reference. We already discussed in the Introduction that this is already the case of the Continuum Hypothesis [42] and also the generative structure of the natural numbers and in particular of *all* primes, from a planar structure of an original set of natural numbers, which by rotations produce the complete system simply by recursion [54] .

Mathematics was not the adequate language for human systems, and in this unique work he proceeds to analyze a very ancient myth. Musès shared with Young the idea that myths are accounts of processes and as such they should be studied. Myths have played a fundamental role in framing human history and till today they continue to do so. Polymath Raju proceeds one step ahead to Musès in his fundamental work, 'The Eleven Pictures of Time', to show that the action of myths is all pervasive, up to the point that contemporary theoretical physics is very much framed in terms of them. In particular, the reigning conception that time is a mere parameter without any functional role, and furthermore it is *linear* instead of having a non-trivial topology is one such conception that has its roots in the political managing of myths. Raju traces this prevailing conception to political-theological-religious issues that were decided in the Council of Nicea, at Byzantium, circa 340 C.E.; this linearity has far reaching implications even in framing our socioeconomical and cultural mindset and organizations [93]. This present chapter is intended to be a contribution to correct these apriori's which are not of the Kantian type but rather forcefully implicit to our lifes due to decisions that acted out an all encompassing anthropological engineering operation, which hundreds of years later is still efficaciously weaved well enough into the present mindset [46] to the point of have gone unnoticed for our current generation at least, until Raju's work, to the author's best knowledge. Returning to Musès studies in interpreting myths as processes, he chose one myth which has a cosmological setting, but embraces all natural systems including human, of course. Musès claims that his rendering of the myth in question goes back to civilizations dated thousands of years ago, was the result of his arduous -and non-conformist with respect to other scholars take- investigation in the Tayyibite Shi'a tradition of Islam, preserved in Medieval Yemen traditions and manuscripts dispersed through European libraries [32]; Musès in addition of being an outstanding mathematician (alas, not recognized as such but by too very few) was a man of extraordinary qualifications and insight. It is none other than the Myth of Eternal Return in a particular setting which is absolutely awesome to read and which proceeding from the conception presented in this chapter, we shall unfold in terms of self-reference. Musès account is very different to the more popular and somewhat naive account due to Eliade [26] in which there is no systemic approach. Musès processual approach was focused in trying to clarify a most difficult problem: To elicit and understand the origin of Evil (and consequencely also of Redemption) which he links to the will of a Third-Intelligence-Entity produced from differentiation of the Unmanifest, to self-referentially fuse with Apeiron and control it. The Unmanifest (which in Greek philosophy corresponds to Apeiron), the field of all potentialities, in our conception is the undifferentiated state which upon introducing a primeval cleavage (torsion) will embody the fusion of object with subject and the cocreation of world and subjectivity as in Spencer-Brown's protologic. The introduction of this primeval cleavage in this myth finds its expression in the First-Intelligence-Entity ('Aql, in Arabic) which is associated to Mind (with its entire gamut, including understanding, insight and spirit, is also called Sabiq, the one who goes before time or space; according to Musès, in German corresponds to *Vernstand* rather than *Vernunft*), placing the first differentiation in subjectivity, as a transform of the Unmanifest,

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[46]Who has not encountered the proverbial fool that passionately utters "Bing-Bang" to triumphally hastely mumble next "God"?

Apeiron. Our interpretation that follows from our conception, it comes before time or space because it embodies the will of the fusion of subject with object in an integral process that finds its reification as both space and time and mind, now as the psyche of Apeiron, in the account by Musès. The Second-Intelligence-Entity is a further stage of differentiation, produced by an emanation of the First-Intelligence-Entity, and thus light is brought into the world as *will* (which we have already related to the action of a time operator in all systems following Young's musings) of trascendence through its reification implicit in Mind. The Third-Intelligence-Entity, according to Musès, is a further emanation of the Unmanifest, " is called *Adam Ruhani* (in Hebrew), or the Spiritual Prototype of humanity, in whose image we were formed. Thus the Third-Intelligence is the Divinity of our universe which has not yet come into Being". Its attainment is Redemption. "It corresponds to the great Anthropos Megos of Valentinian Gnosis". We continue, Musès: "Now there was no problem even conceivably arising with the first two Intelligences who realized that the source of their being was in the Unmanifest". Further, "...the main line of the dénouement of the origin of Evil in respect to the nature of Time, the Third Divine Entity sought to encompass its own origin and to plumb the very depths of being(s)- a route that perforce have to lead into the Unmanifest, the Mistery of Mysteries that by its very nature cannot be unveiled with impunity to the one so seeking; the veiling is inherent and necessary for the eternal provision of being... No manifest being can contain the Unmanifested". We already observed [101] that in the present conception of this chapter, the undistinguished protological state cannot be merged with the distinguished one under the primeval distinction, unless both states would logically collapse into nothingness together with the 'objective' and 'subjective' realms. Musès: "The Third Divine Entity dreamed such a dream of finding that source explicitly and *controlling* [47] it to be within himself (as he mistakenly thought was the case with the Second and First-Intelligences)". Thus the Third Divine Entity willed to dissolve into the Unmanifest while keeping the will to self-referentially complete its own cycle. "That dream and wish momentary, had on the level of *power and perception* dire consequences, the first of which was *retarding* of the consciousness of the Third Intelligence by reason of this thus introduced blockage or fallacy that by nature could not advance, but only hold back.....The reason for such grave consequences of a released desire on the part of the Third-Archangelic-Power is bound with the fact embedded in ancient traditions preserved in Homeric Greece of the mere wish or propensity of a god being equivalent to the determined or implementing focussed will of man". (Here we find an issue that we will reencounter later -when discussing visual hemispheric synchronization to attain stereoscopic vision-, namely the idea of hierarchies of Kleinbottles which we recall require a certain Planck action 'constant' -since it is multivalued as in [81] to establish themselves as primeval distinctions reentering in different stages, a fusion of macrocosmos (a god) with microcosmos (man-woman), for better illustration). Musès: " But the implications go deeper, since the reason that it is so depends on the facts that the gods are not in our kind of time". (Again, the issue of a hierarchy of Kleinbottles that we have just claimed). "Duration of things [48], yes, and changes , too- but all without

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[47]Our italics, which we introduce to remark that we already related control to a distinctive logo-physical action which is related to subjectivity and TIME operation.

[48]We here reencounter time as duration as in Bergson's critique to the time parameter of Einstein [10, 11]. Yet, according to Costa de Beauregard, Bergson's duration is still associated with a linear topology in

waiting time, which is the chief characteristic of what humans call our time. We must wait for any idea or plan to be enacted and then mature to fruition or full manifestation". We remark here that in Musès' interpretation, the wish to *control* the source, the Unmanifest, was the source for Evil, and that *timing* (here again the time operator introduced in the discussion of Eddington-Young phase space) is crucial for the manifestation of the Divinity implicit in the Third Intelligence Entity. Thus timing is essential to the very process of evolution as the unfolding of the primeval distinctions into the manifest forms-functions that make the universe, and is the will of complex structures to reverse determinism by seeking to self-referentially determine themselves through self-organization countering the increase of entropy, as proposed by Young. Recall that in the previous section we have linked intention-control to the action of the time operator acting in the third state (aceleration) to produce and thus control variations of acceleration : The first distinction created space from Apeiron, the second one created velocity, the third one created acceleration and the fourth created control which was the final distinction since further iteration returned to the original distinction, since the fourth time derivative gives the identity. We repeat, the rotational action on the fourth distinction (control, derivative of acceleration, the third time derivative of space, will, Self) with the final recursion by TIME returns this fourth cleavage, control, to the identity through self-control, which is embodied in the formula $\text{TIME}^4 = I$). Coincidently, Musès will find in the Third-Intellingence-Deity's attempt to return and control the Infinite undifferentiated Plenum the origin of the time-operator. The impossibility in achieving this goal, resides in that the TIME Operator returns the controlling Self to itSelf, which as we have just showed, it returns to Identity, being thus self-referential: $\text{TIME}^4 = I$. Hence, its achieved goal by this final recursive action retakes the already cleavaged state that fuses the objective and subjective realms in cocreation, but *cannot return* to the undistinguished state; the Null Operator in Matrix Logic (the mind apeiron) whose eigenstates are identified with the twistor representations of the extended photon that is at the basis of the joint constitution of objectivity and subjectivity, plays its role. The Unmanifest is thus unreachable through the direct action of TIME and thus timing comes to Being and Becoming of all systems. [49] To Musès, this impossible fusion produced the reification of evil and

his belief that the future can in no sense pre-exist and in his insistence on the irreversibility of physical causation [11], which contradicts the Myth of Eternal Return. We shall later reencounter a quantization of time perception following Bergson's intuitions. For a elaboration on a hierarchy of causation which appears to be the one corresponding to chronotopology and includes physical causation as a particular case, we refer to the epistemology by Johansen [52]. We shall not, due to lack of space, enter into considerations of this fundamental problem, though we shall touch upon it along our presentation of our conception.

[49] Then, as it is impossible to return through the action of TIME to the origin, the Mind Apeiron **0**, the only way of returning to it is through the manifold polarizations of 0 and **0**, the mind apeiron. Particularly, through the nilpotent (self-referential) polarizations. We have presented very important nilpotent polarizations already: the Cognition Operator, M, produced by the torsion of cognitive space, which contains TIME and SPIN in its decomposition, being the most important one. So, embedded in the Cognitive Operator resides the timing that allows systems to self-organize countering the increase of entropy; notice that this is a topo-logo-physical process. Thus, we can return to the Mind Apeiron by considering in addition to TIME also SPIN, and thus now their sum gives the Cognition Operator, M, which being nilpotent, $M^2 = \mathbf{0}$, the return to **0** is achieved! Hence, SPIN plays a fundamental role in the evolutionary individuation process that in the Myth of the Eternal Returning to Matrix Logic, SPIN and M in their action on either cognitive and quantum states that to exchange quantum and cognitive computations through averages; see eq. (83) and the following paragraph. We recall that M has together with the identity **1** the fundamental role of

the downfall (we prefer to term it an unfolding) of the Third-Intelligence-Entity in a process of individuation which in seven distinct logo-physical-psyche-archetypical phases will regain full self-reference, completing thus the Eternal Return in which the Tenth-Intelligence-Entity returns to the Third-Intelligence-Entity which is not the same state as the initial departure; in completing its full process of individuation beings become Being. Thus Redemption is achieved in this amazing cosmology fully developed in terms of the fundamental principles we have proposed in this work, differentiation, time-operator, self-reference, paradox and the Kleinbottle. [50] In sharp distinction with the usual dualistic platitudes that place Evil as dual to God-ness, justifying thus the former and countering by this take the natural action of Time, for Musès -and the present conception as well- there is a fundamental asymmetry, which is the parasitic character of Evil vis- à-vis Deity. Indeed, without that asymmetry, the recursion would be a repetition of sameness (in fact, there would not be any recursion!), the trivial homogeneity which we claimed to be imaginary and the Return would be unachievable because the process of individuation, under the condition of homogeneity would not come to be because it requires an initial cleavage to start with. Thus, following Musès conception of chronotopolgy and its manifestations in natural and human systems, TIME and the Kleinbottle are the operators and operands of the Eternal Return and the individuation of God and Nature. [51]

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projecting the Boolean states to the superposition states as characterized by eq. (88) whose addition modulo 2 allows to retrieve the Hadamard quantum gate representation of the Kleinbottle ; see eq. (84) and thus the self-referential process of creation is manifested. Also, the eigenstates of $\mathbf{0}$ which we associated to the twistor representations of the photon that arose from the propagation wave and nilpotent equation of geometrical optics with which we started the developments of this chapter. Other very important polarizations have been presented in the universal nilpotent rewrite system due to Rowlands and Hill, which we have briefly discussed already. Thus, Self can return to ItSelf but not to the Origin (the Mind Apeiron) through the action of TIME, and torsion as the embodiment of Self-reference establishes TIME included in a polarization of the Origin which establishes Cognition. The multiple polarizations and in particular the interchangeability of M and SPIN in logo-quantum computations, yield the basis for the several (seven in Young's rendering of natural systems [139] and in the Myth of the Eternal Return which Musès describes) differentiation stages that accompany and produce the return of the Third-Intelligence Entity to ItSelf. As we can see, the full reentrance of the present conception into itself and the emanation of it from the origin, are thus produced.

[50]Musès further relates these ten Intelligence-Entities with the ten spheres of Kabbalah.

[51]The content of this myth is somewhat common to many religions though with different cosmologies, and incorporated into some ideologies, as is the case of the the communist society for Marx and his acolytes. It appears as the hope of reaching a state in which Wisdom, Justice, Beauty and Goodness reign on Earth yearned by all kind hearted people. Even in some inspiringly beautiful literature works: The return of the self-ostracized-king-to-be Aragorn in reaching self-awareness of his royal being, in Tolkien's trilogy; in philosophy, as is the case of S. Rosen's reflections on the Apeiron's self-forgetfullness that achieves self-redemption in the process of individuation to return to full self-awareness and, of course, in Nietzsche. It is further more remarkable that the conception of Musès on the origin of evil, in principle finds a reflection in the seven different divinities (in the Babylonean pantheon) archetypes and their taxonomy and operation through time waves and historical-cultural patterns that was uncovered in the work of mathematician-sophiologist Pales (together in joint critical examinations and reconfirmation of his findings by his critics at the Slovakian Academy of Sciences) Pales. The existence of cultural time patterns was discovered by sociologist Sorokin [118], they are present as well in economics (the Kondriatev cycles) and more recently in the most diverse natural systems [36, 117]. This is the contemporary scientific field of *chronomics*. These findings point out to the universality of anticipative, incursive and hyperincursive phenomenae in the sense of Dubois [21] which are examples of the chronotopological differentiations. We shall return to chronomics in relation with in-formation, designed and natural systems such as visual perception.

7.4 IN-FORMATION, TORSION FIELDS, SEMIOTICS, INTER-PRETATION, SUBJECTIVITY, DESIGNED AND HUMAN SYSTEMS, TIME WAVES AND CHRONOMES

In the present self-referential conception no device or designed object is psycheless. We promptly add that this psychological character is on the homo-sapiens-faber side of the Cartesian Cut constituting the device and further relating to it, and not in its the atoms, molecules, parts, nor the material aggregate of them and their constitutive relations that appears as a distinct object. [52] Indeed, etimologically, 'design' means to signify, an intention which has a semiotic materialization which is the codification of energy, as Pattee argumented [83]; we have argued that this primeval sign is the primitive logo-physical-perceptual torsion field. For a deep study on the dynamics of semiosis, its social interpretation and perception, its logical valorization and its architecture as a gestalt we refer to the work by Taborsky [123].

To avoid misunderstandings of our statement of the psychological character of deviced objects, we shall provide an example to illustrate that it has to do with in-formation, cognitive states and interpretation and thus, we reiterate, belongs to the subjectivity realm. The example is provided by the testimonies of one of the bleakest pages in human history; we believe it clarifies the previous statement. According to the Spanish narratives, upon the arrival of the Spaniard conquerors to the site of the Inca emperor of Perú, Atahualpa, following their initial criminal incursions, they introduced themselves in a rather multivalued paradoxical -in some levels- way. According to the narratives, a priest accompanying the invaders uttered to the emperor -through the services of a translator- a demand that he should acknowledge the over-all rule of their Love-based creed and their king, and proceeded to deliver the Bible to him. (As we know all too well, religious creeds no less than ideologies, have been used and abused to provide the legitimization of unconfessable drives.) Atahualpa grabbed what for *him* was a priori a mere object, examined it meticulously, and dropped it with contempt. What followed was a carnage of the Inca population by the invading forces and Atahualpa's own demise. To Atahualpa in-formed and handy with the intrincacies of knots and its mathematics (as suggested by archeological findings) yet un-informed on the Spaniards' perversely manipulated creed and its valorative, political and power implications in place (though surely he did understand what was meant by the act of delivering to him the object, a demand of surrender and more), there was no message conveyed by the invaders as the Bible was no message to *him*. For the Spaniards, the message was delivered

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[52]Though following our previous discussion, *all* systems have a time operator which is essential to their constitution and regulation so there is a will of all entities. While we also add that the self-referential character Kleinbottle gestalt goes down in its applicability to the neutron which in the conception of Young, may have its proper timing as any other particle or system. Indeed, the Kleinbottle is the topology in the Rutherford-Animalu-Santilli compressed electron-proton model of the neutron in Hadronic Mechanics, the theory of the strong interactions due to Santilli [116]. This theory -according to its founder- succeeded by superseding Quantum Mechanics deemed to be inapplicable- to give account of the strong interactions. For its relation to torsion and Brownian motions see [95]. There is a saying by anthropologists, *refering* to self-reference: It is turtles all the way down (and up, we further comment). The pun was not accidental here but fully intensional. We are indicating the self-referential being of all languages, spoken, written, gestural, etc., which somehow we fail to identify.

completely and irrefutably. For Atahualpa, his examination of the object had not rendered him the meaning that the interpreter had demanded to comply with and thus was unable to interpret it (yet, he was in-formed previously to find improbable the truth value of the ethical aspects of the message demanding submission). [53] Notably, the shocked Spaniard narrators explicited the fact that both Spaniards and Incas were aware and spoke out in similar instances that this was the case. As we know from daily life, action, interpretation, truth value, cognition and perception, even if incomplete, are unseparable.

To resume: this psychic in-formational character of designed objects embodies a semiotic action jointly with intention, interpretation, a cognitive state, actual cognition and perception. As we have argued, it is a codification of energy through a torsion field from which multivalued logic, its transformation into quantum physics, and time waves appear.

Returning to our explanation, any artifact, device or even a social organization embodies purpose-intention through design (demanding thus to the the beholder or social actor an interpretation), a fact rarely acknowledged -but crucial to an integral approach to life-, which is the intent of control and thus of anticipation. The *identification* of a subject with the reification of this psychic in-formational character is a regressed form - fetishism- of animism, all too common and a major driver of technological inventions, as well as of all kinds of undesirable events (we have seen the purport of fetishism in the previous tragic history). To wit, this reification (not the identification of the subject with it) materializes the intention of the in-formation, and since intention is associated to the action of the time operator, this process of manifestation of the in-formation is the result of the action of TIME in Matrix Logic, and is further related to perception as we shall elaborate below. The identification of the subject with this reification of the in-formation, consistently with Hegel's conception that subjectivity is related to time [41] while for Gunther this relation with time is established in connection with the abandonment of the principle of non-contradiction [34][101], is tantamount to the assimilation of subjectivity and time to the Aristotelian universe of discourse, as transpires from direct examination of this process of fetishism. [54]

Returning to our discussion of examples of in-formation of designed objects, at a larger scale of humankind and in the antipode of largely low degrees of freedom (until nanotechnologies appeared) materials turned machines or artifacts by purpose-intention, we consider events which as A. Young rightly remarks are associated with light [139]. These are events

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[53] An utterance becomes a message only if a meaning is ascribed to it and shared at least partially by the would-be participants in the communication; an act of interpretation is essential to this transformation. An interpretation requires an intention, to cognize, and an action, the actual cognition. This is not the take of the modern theory of communication based on Shannon's work, for which messages are subject-independent objects, i.e. Cartesian objects, then they can be represented binarily as in Boolean logic. With respect to the logical valorization we pointed out to it by mentioning the irrefutability issue: Atahualpa by dropping the object questioned the truth value of the invaders' claims of Love, and their true intentions with regards to his people and himself. Here appears another element absent in the dualist mindset: A cognitive state is assigned to the utterance in becoming a message and it carries a truth value in it as we described above. Hermeneutics may precede the asignation of truth value.

[54] A particular notoriously active form of this fetishism is provided by the fact that usually criminals -as the previous tragic story shows- purport to be acting for good or some superior source, thus collapsing logical cognitive states to one value which is false while pathologically claiming true. The reification of their identification, a second-order reification (the first one being the reification of their intentions yet with certain degrees of freedom which is followed by the exhaustion of all degrees of freedom), is hell.

that may surge from the infinite potentialities of differentiation and complexization that may arise from it. It is the logo-physical-photon-primeval-distinction-torsion-field that creates events as the unfoldment of a Kleinbottle, acting as a major social and historic field creating patterns and processes, thus embodying forms and functions, physis and psyche. [55] Since control is related to purpose-intention we have a big-scale coherent anticipative field which conforms a Zeitgeist (spirit of the epoch), actions over resources and a self-action of humankind: the Kleinbottle in social and historical scales. Yet, purpose-intention is manifested through time operators, particularly, TIME. We recall that it has been found that there exist time regularities and patterns (*chronomes*) in history (revolutions, war, peace, etc.), culture and its several manifestations (design !, architecture, philosophy music, creativity on the most diverse fields of psycho-social action), ideas (memes, ideologies, religions, etc.) which have been ascribed to cosmo-psychological archetypes in the work of sophiologist-mathematician Emil Páles [82], whose work found antecedents in that of the sociologist Sorokin [118]. So, again, the psychic element 'exteriorizes' the logo-physical-torsion field as well as is the 'interiorization' of 'outer' phenomenae -cosmological chronomes-, but as we argued, it is a Kleinbottle; we shall discuss this further in the case of visual perception. The study of chronomes is a field who counted with physiologist Pavlov as one of its pioneers, was developed in the former USSR by several researchers grounding the ideas of 'cosmism' (Chizhevsky, Vernadsky, Kondratiev, Kozyrev, etc.). Presently is a growing field of knowledge (which requires persistent experimentation) which may lead us to a completely new understanding in science with amazing findings which not only indicate the existence of standing time-waves acting on all systems, but furthermore manifest nonlocal cosmological correlations; see [36] and references therein and [117, 59]. These findings give support to the ideas of Musès chronotopolgy, which in our conception is the Kleinbottle, the embodiment of the myth of the Eternal Return. We shall retake this issue on examining the self-referential Kleinbottle topographic representations of the somatosensory and auditive modes, and the self-referential gestalt given by the mammal heart. Yet we want to mention that in the mathematical representation of the process of growth of seashells it was found that their development was possible due to a retrodictive character of the action of the future on their present state of growth (the Gaitlin propagator)[49]. This non-linear character of time was examined by Heidegger [40]. In physics it appeared as branching time [92]; for a study on the politics and religious beliefs behind the linear non-operator time prevailing in physics we refer to Raju [93].

To conclude these disgressions on the physic in-formational character of designed objects imbued in the design itself, by sheer consistence we are now ready to postulate a psychic in-formational character of Nature at large, of which teleology is one of its expressions, in consonance with Spinoza and several traditions standing in sharp contrast with the alienation of the Cartesian mindset. We have encountered this already on discussing the phase variable introduced by Eddington and further examined by Young. There is a time operator

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[55]In the phenomenological *radical recursion* philosophy of S. Rosen, a logo-physical-psychological field hierarchy and associated Musès hypernumbers are ascribed to the Kleinbottle; we have shown already that logical operators are representable by hypernumbers, which are related to Pauli operators, i.e. to spin, and ultimately to torsion. Rosen further ascribes this hierarchy and the different topological and knot operations on the Kleinbottle to the mineral, vegetal, animal and human realms.

acting on all scale dependent systems. Furthermore, these scales are not arbitrary, but may be determined by a fractal structure discovered by H. Muller, and which now conforms the central core of the theory of Global Scaling [77].

7.5 LIGHT, TORSION FIELDS, QUANTUM AND TOPOLOGICAL NON-LOCALITY, CHRONOMES, VISUAL PERCEPTION, DEPTH AND ANTICIPATION

Torsion as the primitive distinction introduced in the undifferentiated plenum and thus establishing a locus and phenomenology, is the fusion of subject-with-object, as well as that of form and function, which biology and most notably, some medical practices tend to separate. This unfolds in several ways, one of which is its association to spin which is a field not only notable in physics, but as well as all pervasive in biology [25]. Thus, as much as the primevally undifferentiated plenum has the potentiality of all forms and functions, it is by torsion cleaving this plenum that these come to manifestation. The Cartesian Cut attempts precisely to dissociate between form and function, being the case that their gestaltic fusion is due to the simple fact that function -physis- is established due to inhomogeneities that give rise to processes, which produce themselves forms and structures through symmetry, which due to the impossibility of being isolated from the environment of other forms-functions produced by other cleavages, tend to loose their symmetry and thus become processes, i.e. physis. This is the essential dynamics in semiosis [123]. Torsion thus is associated with action, and thus it gives rise to quantization of the plenum, and thus the corresponding physical parameter is Planck's constant, which is not singular but multivalued as shown by Pitkanen [85] and Nottale's Scale Relativity [81]; the latter be derived from torsion without recourse to forward and backward derivatives which are basic to Nottale's work [97][99]. Thus, the Kleinbottle stands for quantized *re-entering* limited domains (QRLD), with different quantization magnitudes which correspond to different scales. We shall later return to this through stereoscopic vision and the Kozyrev phenomenae.

If thus time is subjective as in Hegelian dialectics, in the concrete realization of this stands the process of photon absortion by the subject. But the photon is no 'external' particle to the subject, as the classical formula would like us believe but is the physical particle' which is the core of the self-referential process of fusion of object with subject (inasmuch as the geometrical fusion is the torsion). Indeed, when we visualize a photon, we are actually visualizing our seeing of the photon, the absorption process by which we complete the objectification of the photon as an independent emmiter, object-in-space-before-subject which now when absorbed becomes the fusion of object-with-subject. Self-referentially, the photon (as a lifeworld) is the observation of the link between the photon (as an element of objective reality) and the perception of the photon (i.e. the Fibonacci type reentrance of a form into itself in the calculus of indications; the 'atom of thought' as in Johansen's conception [52]); see [101]. [56]

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[56] This process is a lifeworld in which the body in its integrity is compromised. A photon in a meditative state may come to settle in the forefront, in the locus of the so-called third eye. It appears as an extended radiating (and per se, not in complete equilibrium) two-dimensional flat structure, which is then perceived

In this context, quantum jumps play an essential role since they represent what is present to cognition and perception, i.e. differences which produce differences (as in Bateson), as we also know well from physics and visual perception; these differences are crucial to the neurocortex organization and physiology under the complex logarithmic map topographic representation of vision, as explicited in the pioneering works of Schwartz [114]. We have characterized quantum jumps in terms of singularities of the torsion potential described by the differential of the logarithm of these scalar fields produced by the node set of them so that concerning spacetime fields, it is in the two-dimensional Riemann sphere representing the complex plane -and thus a real $2D$ manifold- as also is the cognitive plane of matrix logic and the plenum on which the primeval distinction creates the holonomic structure-process which fuses 'outer' and 'inner' realms, that quantum jumps, cognition, visual perception and logic are grounded on a plane from which through holography the full structure can be retrieved [113]. This is linked to the nondual character of interior and exterior as is the topology of the Kleinbottle.

Several cues are used for the formation of the perception of depth, such as occlusion, rotation of objects (so a perceptual spin is relevant to the formation of depth perception which has already appeared as SPIN), the most important is believed possibly to be stereo-scopic vision, i.e. the image formed by the joint use of two eyes. It appears that stereoscopic vision only leads to the formation of three-dimensional images if the two eyes actually sense asymmetric images for each of them, in the contrary there is no distinctive image but a blank homogeneous state [48]. This indicates that the actual concrete perception of a geometry requires an inhomogeneity at its basis, i.e. torsion, self-reference. [57] This is most remarkable since stereoscopic vision is the basis for the conceptual emergence of symmetry with which physics is constructed, and this findings points out that this is only possible from actual asymmetries (which conceptually are based on the manifestation of differences) which if lacking only an homogeneous perception is formed, i.e. no structured perception of inhomogenities, only the triviality of sameness.

This perceptual homogeneous plane where no distinctions are present is the one that is associated with the physical symmetrical vacuum, the plenum which we have already presented. So here we have the appearance that depth to be perceived as an original dimension, a difference that makes a differences is necessary as in the conception of G. Bateson, and this is the basic asymmetry between the images of each eye [48]. We shall discuss later the complex logarithmic map that appears in the expression of the quantum jumps that originates in

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inside the brain, as a very quickly fluctuating plasma structure with philaments of great complexity and beauty, by the extended watching Self living this awesome experience with and through intensity, self-extension and detachment. Thus, there is an actual seeing of the seeing; second order. The full body of subjectivity has in the photon a first stage of self-reference which is not the last one. Finally, it exits the body in a silvery shortly perceived helicoidal motion. We have found no account of this lifeworld in the discussions of light in the Tibetan Buddhist tradition [33] nor elsewhere.

[57]Further below we shall elaborate further on introducing the complex logarithm representation of the retinotopic visual and somatosensory perceptions which transform the photons impinging either in the retina or the skin in a mapping at the plane two-dimensional neurocortex. We shall see that this logarithmic map that appears explicitly in the formula for the quantum jumps, plays a essential role in providing these maps, both locally and globally, and that this map provides also for the basis of the stereoscopic vision formation in terms of differences as we have already repeatedly alluded in this work, and in terms of the vortical structures that appear in the neurocortex' hypercolumns.

the differential of the complex logarithm of the photon wave function, is also the key to the multisensorial representation of the body on the neurocortex and is further related to the codification both of depth and of stereocospic vision in the neurocortex. [58] Furthermore, time dilation and space contraction are related to the baud rate of in-formation processing (which we shall elaborate in terms of ATP's metabolism) Hence, there is no 'pure objective' cognition of an object: Visual perception and cognition depend also on contextual *interpretations* by the subject. (As we said before, perception, cognition, truth values, action and interpretations are unseparable.) Furthermore and most surprisingly, they depend on cultural and theoretical constructs, to some extent [107]. Thus, the classical Cartesian formula is untenable and perception is not secondary to cognition, the subject is a full participant in the construction of the proper visual model. This 'interiorization' of the geometry by the subject with its dual operation of projection for the construction of the 'exterior' geometry of space and time can be still be linked with the metabolic rate of the production of ATP (adenosine triphosphate) in the brain's visual area which is still linked with the quantity of light absorbed in the retina (which is related to quantum jumps and torsion, and thus to the quantization of 'outer' spacetime).

When general human metabolism (and the V5 area of the neurocortex which is believed to be associated with motion detection) is fast, time runs slow; conversely, when the metabolic rate is relatively slow, time runs relatively faster; see Harms [38] and references therein. This has support as we said already in the fact that there is a related 'inner' geometry of vision in which there is a limiting velocity of percepts processing. This is widely known to occur in extraordinary situations of stress such as high velocity drivers perceiving the 'outer' world through a time dilation and space contraction, which may be accompanied with their relative visual V5 metabolic states speed-up, compared to observers in other frames at lower speeds relative to this visual limiting perception velocity. In the Kleinbottle function-form of the neurocortex, quantized 'outer' spacetime is thus transformed into 'inner' quantized perception and thus a minimal instant is associated to it, through which motion and all differences come to be. Then, at that minimal instant there is no motion. Motion must be then the perceptual differences that exist from one instant to the next. Thus, motion may only take place between the instants in time. Here the instants are given to us by the processing speed of these instants by the V5 area, which might be related -though we are in a state of ignorance with respect to this issue- by the frequency of light entering the eye [38]. We would like to propose that it is that at the limiting velocity of ATP production and visual geometry hyperbolic space [50], in which cognition appears due to the quantization of time, with associated limiting values of acceleration and control, in which TIME, Cognition Operator M and SPIN operate. This should establish the Lorentz-Fitzgerald perceptual phenomenon in which the previous fundamental operators manifest. We recall that ATP production and destruction is a fundamental organizing process for the cell's operations, and is further related to the zipping and unzipping of the microtubules, in terms of which Penrose proposed his quantum non-computability source for will. So again, it is the action of time that has to do with will, and this may have a biophysical

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[58]It is in the field of mathematical psychology in which it has been theoretically and experimentally verified, that visual perception follows the organization of visual 'internal' geometrical representations [63, 50] that they are described by a psychometric function dependent on the observer.

operational substrate in the creation and destruction of ATP, which may actually create at their limiting velocity, the quantum action of TIME, as the difference between creation and destruction as suggested by its very definition; see eq. (66). The background media which is essential to the ATP production and destruction is water, which itself has the remarkable property of having memory [136]. We recall that anholonomity, and particularly torsion, allows to encode memory as argued by Pattee [83]. It is important at this point to remark that the Aharonov-Bohm effect we found associated to the logarithmic torsion potential in our discussion of quantum jumps in Section 3.1 plays a central role producing non-local correlations in biological systems [130], especially those that are sustained by water.

Let us return to the problem of depth, its identification with the operation of time as can be perceived in the Necker cube [79], and following the phenomenological philosophies of Merleau Ponty and S. Rosen. Stereoscopic vision which establishes depth perception brings to the fore the problem that in order to obtain a synchronous visual flow in both left and right brain hemispheres, which is needed to account for its coherence, the temporally delayed signals of both eyes' left and right visual fields (which are processed in different hemispheres), should be integrated with anticipated versions of their complements in order to close the time gap existing with the firing of neurons in the separated hemispheres and recurrent visual control [58]. As we have repeatedly elaborated in this article, control is linked to purpose and thus to anticipation and to TIME Operator. Remarkably, Kampf's proposal for a solution of this problem (which we recall that is fundamental to the establishment of a physiological process which sustains multivalued logic as the perception of the two possible instances of the Necker cube requires as both instances unfold in time through depth perception) is to invoke anticipation, as conceived by Dubois [21]. Kampf: "representational simultaneity, as a brain process spread over spatially distant loci, is achieved by temporally bidirectional interactions of neuronal processing on a quantum scale. Absorber effects between the presumed 'advanced' and 'retarded' signal components are proposed to generate standing time-waves pattern which might be speculatively assigned to the carrier process of an internal psychophysics of the representation of visual space." Furthermore "...absorber effects appear, on the operational side, as anticipations of future states of the system". Kampf's proposal then stems from the transactional interpretation of quantum mechanics (TIQM) due to Cramer [18]. In fact, the absorber theory which was the basis for TIQM, attempted to explain the EPR paradox in a straightforward way. It rests on the idea that a 'handshake' -we prefer the logical term 'identity transparency', or still the physical interpretation as a 'resonance'- between the ordinarily transmitted signal and an anticipative effect deeply rooted in the quantum world is *fedback* from the 'absorber' to the 'emitter'; so, in our terms, this requires control, or still, the action of the TIME Operator. [59] Coupled in-between the 'retarded' and 'advanced' components in the collapsing wave function of the quantum event under measurement, this process appears to an external observer as a seemingly time-reversed transaction. In our account, this is the action of the TIME Operator. Kampf presents arguments for the significance of advanced signals as an anticipative feedback for the synchronization of spatially distant retarded processes which

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[59]Further elaborations of the causality operators that trascend the mere physical causation were applied to the Kozyrev phenomenae in terms of his epistemology by Johansen [52].

he derives from an analogy between the synchronization of neuronal activity and that of chains of coupled oscillators on different scales (including a cosmological one). Thus Kampf argues for the existence of a time-loop that accounts for this synchronization and control, proposal which fits well with our previous disgressions. He further notices that the mathematical roots of this lies in the standard quantum-mechanical procedure for calculating the 'collapse' of the wave function, by computing the square of the probability amplitude which is done by multiplying a complex number $\cos t + i\text{sen} t$ by its conjugate $\cos t - i\text{sen} t$, where t stands for the time angular variable i.e. by phase (as in Eddington-Young space) conjugation, which is the basis of holography as elaborated by P. Marcer and W.Schempp [113] and which we note that in matrix logic is the transformation of a cognitive state of the form $< q| =< (\cos^2 t \quad \text{sen}^2 t)|$ into $< q| =< (\cos^2 t \quad -\text{sen}^2 t)|$. In the case of $t = \frac{\pi}{4}$ this is the TIME Operator transformation between the superposed state $< S_+|$ into $< S_-|$. These topological entangled states form an orthogonal basis which is the transform by the Kleinbottle in-formation matrix H of the Boolean orthogonal vectors $< 0|$ and $< 1|$ and conversely, $\frac{1}{2}\mathcal{H}$ transforms $< 0|$ and $< 1|$ into $< S_+|$ and $< S_-|$ and these four states generate all matrix logic [95]. Thus, for these states, we can 'interiorize' the transaction as an action of TIME which generates the laws of thought. [60], or conversely. [61] We already argued that the neurocortex cell visual representation is both supported by holography and the Kleinbottle [101], and that the latter is a classical-quantum-classical transformer which sustains multistate logic which is related to quantum fields, transforming the average of the cognitive operator M on cognitive states to the average of the logic spin operator SPIN (related to the perception of depth) on two-state wave functions; furthermore, we can substitute M by SPIN acting on cognitive states and M (cognition operator) acting on quantum states and this identity is still valid, so we can both have $< q|M|q >=< \psi|\text{SPIN}|\psi >$ and $< q|\text{SPIN}|q >=< \psi|M|\psi >$ where $< \psi =< (\psi(\uparrow) \quad \psi(\downarrow)|$ is the spin-up spin-down quantum state; this identity stems from the decomposition $M = \text{TIME} + \text{SPIN}$, and the fact that TIME is a distinction *cognitive* operator, i.e. $< q|\text{TIME}|p >= p - q$, so that the average $< q|\text{TIME}|p >= p - p = 0$; TIME appears to be unchanged for unaltered states of consciousness.. So indeed, quantum effects, time loops as in the Kleinbottle lift of the calculus of distinctions giving thus the periodic reentering of a limited space domain through time waves, the action of TIME Operator and anticipation which are the very embodiment of the holographic structure of the Kleinbottle are present in the mind-brain (we use this term because of the exchangeability of cognition -mindlike- and SPIN -brainlike- observables described above). Entanglement is due to the action of the non-orientable topology of the Moebius surface, or still by the torsion introduced by the cognition operator, which also

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[60]We have argued elsewhere that following the phenomenological philosophy due to Merleau Ponty, depth which is precisely related to stereocospic vision is a primitive dimension associated to time and paradox. We shall later discuss the relation of this with respect to the retinotopic and somatosensory complex logarithm representation on the neurocortex and its relation with oppositely oriented vortical structures associated to the hypercolumns in the neurocortex.

[61]For the benefit of the reader who skipped the previous parts of this chapter, we recall that cognitive states are real valued vectors which we write as Dirac bras and kets formalism of quantum mechanics $< q| = (\bar{q} \quad q)|$, where $\bar{q}$ is the negation of q (the *real*-valued logical variable), i.e. $1 - q$ so that they are *linearly* normalized, related to the wave-state of two state quantum mechanics by the relation that the former are the complex square root of the latter, i.e. $q = \psi\bar{\psi}$.

represents the non-duality of TRUE and FALSE. To resume: entanglement is topo-logical-physical. One can enquire still if this quantum entanglement is related to the 'interiorization' of quantum entanglement at a cosmological level, a question which Kampf does not raise (perhaps due to the lack of a Kleinbottle logic), restricting the arguments to the possible parallels of both cosmological (as in the Kozyrev phenomenae [62]) and microscopical entanglements. The natural answer is represented through the Kleinbottle which has no inside nor outside, but a form-function which transforms a local interior to a local exterior holographically. Thus, absorption at one hemisphere of the cortex of a photon is entangled with the anticipative emission of a photon of the other hemisphere producing synchronization , and this transaction is 'interiorized' in the laws of thought of multivalued logic matrix or still in the calculus of distinctions in which we incorporate paradox through reentrance of a Kleinbottle limited domain defined by a quantized distinction, a QRLD as we called them. Yet, this is the rotational action of TIME Operator; we shall later see that analytically it is embodied in the complex logarithmic map of sensorial modes (in particular, retinotopic) on the neurocortex. So, as we said before, it all (perception, cognition, interpretation, physics) boils down to the projection on a two-dimensional plane, be that a neurocortex slice, the phase space of Eddington-Young, the plane of cognitive states in Matrix Logic, or the projection of the Riemann sphere as the complex plane which can be generated by three primeval distinctions as pointed out by James [51] or still for characterizing quatum jumps as primeval differences. In this transaction the torsion geometry of cognitive space is essential [63], since itself produces a superposition state, $< S_+|$ which stems from the non-orientable character of the Moebius band and shows up defining the cognition operator; from $< S_+|$ the other superposed state $< S_-|$ is produced through the TIME transform, and together they form the cognition operator (and the Kleinbottle in-formation matrix $\mathcal{H}$) which encodes the transformation of cognition to spin observables and conversely. This 'interiorization' process, in the Kleinbottle logic is identical to a cosmological entanglement, of which the Kozyrev astronomical observation which we have already pointed out that it is a cosmological example of a chronome, a time-structure-function which also can be interpreted through the TIQM and also which has been verified that exists not only in cosmological scales but also as quantum entanglement between solar and geophysical phenomenae as proposed and experimentally verified by Korotaev [59]. Remarkably, the Kozyrev phenomenae can be explained also through the same geometries that the mind-brain operations associated with Matrix Logic and a QRLD, i.e. in terms of torsion through spacetime (Brownian motions) fluctuations [97] -which we observe that thought unless programmed is a random motion-

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[62]Kozyrev and Nasonov discovered on observing through a telescope with a device, that there exists a radiative field associated with, say a star or galaxy, that cannot be shielded but with polietylene. In pointing the telescope to the future and current position of the star this radiation was also registered [60]. These experiments were repeated decades later by Lavrentyev with the same results and the theory is currently used to compute current positions of astronomical bodies [27]. So time-loops exist at astronomical scales.

[63]In fact, already the geometro-stochastic form of the Schroedinger equation for ψ (where the torsion field $d\ln\psi$ describes the average motion of the universal Brownian motion generated by the torsion geometry together with the diffusion tensor associated with a metric)[99], incorporates *both* boundary conditions on the past *and* the future that allow to consider the probability distribution $\psi\bar{\psi}$ which we interiorize as the logical variable q depending on the universal time variable of Stuckelberg, Horwitz [45]. This variable is the variable that parametrizes quantum jumps as we characterized in the initial sections to this chapter.

and spin-torsion fields [120]. This leads to enquire on how QRLDs, say a cosmological one (with a corresponding cosmological Planck constant) [81] may be entangled with a meso or microscopic domain (with an appropiate Planck constant)- as already the human 'homunculus' representation already achieves- with a neurological domain so that the entanglement that synchronizes stereoscopic vision through logical torsion entanglement or through an emission-absorption transaction, forming a self-referential loop in which one is transformed into the other. A natural solution perhaps can be found in the fractal structure provided by nested QRLDs in which 'interior' domains reenter through 'exterior' ones and viceversa. It would be interesting to consider this in regards of the fractal structure of time [133].

8 THE COMPLEX LOGARITHM MAPPING OF VISUAL AND SOMATOSENSORY PERCEPTION AND THE KLEINBOTTLE

Up to this point we have presented a theory of the joint constitution of the physical, logical, cognitive and perceptual realms, yet for the latter we have mainly discussed the study of stereocospic vision and synchronization. We shall retake this issue in a wider conception which evolves from the relation between the sensorial realms and its mathematical representation in the neurocortex, and further the physical phenomenae that appear in the neurocortex. This is of course related to one of the longest standing philosophical problems raised by several philosophers and the core problem of what we contemporarily know as cognitive sciences, and any attempt of dealing with it in the needed extension is unfortunately severed by length constraints. We have already presented our conception in [101] and above, yet rather than continuing with the philosophical discussions we shall restrict our disquisitions to the mathematical representations already alluded and its relations with neurology.

In the introduction to the deep work on the topology of the body representation by Werner, it is pointed out there is a wealth of clinical and experimental studies that established the existence of a fixed relation between regions of a body and areas on both the sensory and motor cortex achieved in the decades 1930-1969, which lead to the notion of the existence of orderly systematic mappings of the body's peripheral events in the brain. The evidence in this regards was that the cortical and subcortical projections of the visual system are topographically organized such that the fiber tracts and neurons preserve the spatial arrangements in the retina; also, the spatial orderliness of representations of the body at the cortical and subcortical relay stations follows the segmental (i.e. dermatomal) innervation pattern of the body periphery.

Prior to these discoveries, there were several theories postulating that perceived space is correlated with spatial patterns established in the nervous system [64]. Thus the notion of a

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[64]In the Gestalt conception, "all experienced order in space is a *true* representation of a corresponding order in the underlying dynamical context of physiological processes". Remarkable to this conception, is that there is a logical value ascribed to perception, which can still be relative to the choice of particular cues. This is the basic phenomenae which we encounter when dealing with a geometry alike the Necker cube

mapping from the peripherical sensory bodies to the central nervous system was proposed. In particular, the mapping of the body surface, and the auditory and visual receptors.

We quote E. L. Schwartz [114]. "A universal feature of the anatomical organization of the vertebrate sensory system is that the visual [125] [2], auditory [64], somatosensory [137][134][135] and olfactory systems are organized in terms of orderly spatial projections of a peripheric receptor mosaic to more central processing sites. Embedded within this 'receptotopic structure' is the detailed local neurophysiological processing that results in the existence of well-defined neuronal 'trigger features'. At the striate cortex in primates, cells respond optimally to oriented, elongated stimuli with well-defined velocity, direction of movement, *binocular disparity*, ocular dominance and colour. Cortical cells that are sensitive to the *orientation* of a stimulus are grouped into columns, or slabs, of common orientation [48]. These columns are themselves arranged into a highly structured geometric pattern termed 'sequence regularity' by Hubel and Wiesel, who introduced the term 'functional architecture' (we note here the blending of function and form -our comment) to describe the anatomical arrangement of the physiological significant cortical structure." In the work by E.L. Schwartz the term 'functional architecture' was generalized to include the global, retinotopic organization of the cortical spatial map as well as the local columnar structure described by Hubel and Wiesel, and the somatosensory representation and still the relation with stereocospic vision. From the work by Schwartz appeared that all these maps act transforming input from two-dimensional sensorial surfaces to the two-dimensional cortex (albeit with a columnar structure representing each point of the cortex) are all given by the complex logarithmic map, which in the retinotopic representation nearby to the centre of the eye where the tangent space can be identified locally with the retina gives an excellent agreement which matches with experimental data and furthermore, has allowed for predictions which have later been verified, in particular, for binocular disparity tuning (which is a subject we have already raised above). Schwartz's discoveries lead him to pledge that the term functional architecture was to be taken in a literal sense: the spatial structure of neural activity in the primary sensory system turned to be of direct significance to visual perception. To resume, the problem arises as how the neural system accomplishes the task of mapping both the surface of the body and the interior of the periphery of the three-dimensional body into a *single two*-dimensional cortex surface.

The experimental findings by Werner lead to the conclusion that the "geometrical representations of the cortical body appear quite different from those of the body itself for several reasons. First, unlike the relation in the body periphery, the projection of the skin does not form a continuous boundary in the cortical map, enclosing the projection from the 'deep sensors'. A second reason for the difference between the body and its map is that the relations of proximity and distance between points on the body do not consistently remain preserved in the cortical map. The meaning of this is that receptors fields which are closed in the periphery in the two-dimensional cortex space in which the topographical map takes

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[79], in which there are two possible choices of cues and perceived cubes, which are related to the invalidity of the principle of non-contradiction of Aristotelian logic. Any of the possible perceptions are 'true' and thus the Necker cube embodies paradox very much in its design, as we discussed above. The extension of this to non-orientable surfaces, namely the Moebius surface and still more notably the Kleinbottle, lead to the foundation of multivalued logics as shown above.

their image, may not be close any longer". Remarkably also is that what is codified by the map in the neurocortex is *not* the actual points of the skin as a sensorium, but 'dermatomal trajectories' [134] [135], alike, say, Roman soldier's shoes helicoidal footlaces strappings or still the helicoidal Hebrew phylacteries [65]

Werner's conclusion is that the topographic map was not related to a metric as in General Relativity but to an homeomorphism, a continuous bijective invertible map whose inverse is also continuous which further transforms open sets in the domain into open sets in the image [134]. The solution compatible with the experimental findings is that the global somatosensory map is given by the Kleinbottle [134]. Furthermore, what in the periphery may appear as broken dermatomal trajectories, in the Kleinbottle map they are represented by continuous trajectories. Werner further suggested the implications for the haptic sense (i.e. the integration of sensory modes, such as tactile and kinesthetic) are represented by one single map, thus the Kleinbottle plays the role of integrative sensory somatosensory mode. Yet there is something more striking on this and especially important to the very essence of the possible existence of the Kantian apriori schemata. This is the fact that "the sensory representation in the cerebral cortex can possess properties that are not inherent in the raw data originating from the peripheral sense can organs themselves, and that the nature of new properties can be a consequence of the characteristics of the neural mapping process which links body periphery and central sensory representation". That is a very strong statement that somehow inverts completely in the Cartesian mindset the ideas of where the complexity stems from: As is usually stated in the dictum "the map is not the territory", meaning that there is more to the actual complexity of what is the 'objective world' than there is in the representation. This points out to the possible fact that the complexity lies on the map, and not in the skin and efferent neuronal pathways that sustain the map itself, which here is topological and is the Kleinbottle. Since the map plays the role of the subjective-objective fusion of the periphery and kinestesic recordings with the actual percepts, this becomes a self-referential -to the map!- linkage which is absolutely irreducible to the Cartesian Cut mindset. It clearly establishes the prominence of a Platonic realm, which is essentially semiotic- mathematical-logo-physical in which by the joint constitution of the lifeworld of both subject and the physical realm does not allow for discernment of where the complexity actually resides. Through the map we map the territory i.e. self-referentially, the map is both operator and operand, and thus we cannot get 'out' [66] of it to cognize it. In fact as we have seen in the constitution of logic, the Kleinbottle is the basic operator-operand from which the joint constitution of time and thought comes to be arising from paradox [101]. If we still take in account the self-referential being of language as pointed out in a torsioned way by psychoanalyst J. Lacan, it turns out that the Kleinbottle is the actual integral solution to this conundrum that philosophers, mystics, scientists and common folk have been trying to search for. Of course, what we are saying about the complexity of the human and primate bodies, apply as well to the Universe at large and its lifeworld. The last pending problem concerning this is on the *reality* of these schemata. There is no

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[65]These phylacteries are strapped as helicoidal trajectories on the arm with further loops producing semiotic codifications (one of the 'names of God') and additionally have self-referential sentences vinculating the subject to God, written inside the boxes that initiate them as well as the one placed in the forefront.

[66]Identically, we cannot *speak* about the world in its manifold realms without language.

other consistent answer to this historically longstanding interrogation that the one we have just explained with respect to perception. Semiosis is not established independently of the subject but lies in the joint constitution of the lifeworld that constructs jointly the subject with the physical realm embodied in the subject's lifeworld. This is the *enaction* that can sustain Varela's view without pledging the Great Doubt [107].

Returning to the dermatomal helicoidal trajectories on the primate and human skin, these are transformed into straight lines in the planar neurocortex space. As observed by E. Schwartz, this transformation is inherent to the complex logarithmic map. Furthermore, this is not exclusive to the representation of the lymbic system but also of the retinotopic representation discovered by Schwartz consistently with experimentations [114][115][124]. The representation of the retinotopic stimuli, which as we mentioned above amounts to the stimuli provided by the class of monochromatic functions in terms of which we constructed the theory of quantum jumps and the photon in which the complex logarithm appeared to give the different surfaces of the Riemann surface on which each quantized states lies, also appears to provide the mapping for the retinotopic stimuli. In fact, as discussed exhaustingly by Schwartz in the case of the retinotopic mapping into the neurocortex, both the complex logarithmic map as an analytical topographic representation and the Kleinbottle as the topological representation are cocreated [114]. This has very important consequences to the physiology of perception. Let us briefly discuss this issue. To start with anatomical cortical development, the complex logarithmic map being analytic (in the sense of complex functions), represent a potential flow which is -as usual in complex functions theory- subjected to *boundary* conditions imposed by the shape of the boundaries. Moreover, the dendritic summation of the afferent input to the neurocortex is also locally complex logarithmic, so the anatomical structure stands in correlation with the topographic representation by the analytic map which further is related to developmental functioning, which we shall later associate with the diffusion of morphogens. Thus we find in the retinotopic topographic map and the underlying anatomy, a perfect gestaltic superposition of function and form [67] which is further related to intra-cortical inhibition and the hypercolumnar organization. The boundaries in the neurocortex of ocular (vis-à-vis binocular) domain organize the complex logarithmic map through the fact that intra-cortical inhibition and sequence regularity run parallel to these borders while binocular summation runs perpendicular to them. The ocular dominance columns provide the link between the axis of the global and the local mappings of the cortex. Now, for the actual cell density that provide for the functional architecture, their density is described by the same inverse square law of general potential theory, thus provide a two-dimensional functional-computational-architecture for electrostics, Newtonian potential, etc. The mathematical representation for both is the complex logarithmic map which also plays a central role in Karman vortex street model in fluid-dynamics described by the Navier-Stokes equations (which we proved to be a most basic example of a torsion geometry

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[67]Further below, on discussing the somatotopic mapping, it will appear that the complexity appears to be encoded not in the body as anatomical differences per-se but on the map, while in the retinotopic visual encoding we have in the -foveal- domain of validity of the mapping, a perfect gestalt. So, for light as the most unconstrained field, the encoding is embodied as anatomical-computational-architecture while in the somatotopic case seems that the computational mapping carries the complexity as we evolve to lesser degrees of freedom. We shall not enter here, due to space limitations, the relation of this with Kant's philosophy.

related to Brownian motions [97]). So, we do have vortical structures in the neurocortex which are related to the analytical retinotopic mapping. Now, how does the Kleinbottle structure appear in relation with the complex logarithmic map in this mapping? To start with, the topology of the complex logarithm map is that of the torus, which thus is the Riemann orientable surface for it. Anatomically the hemispheric representation of the cortex are joined by the corpus callosum yet on such a way that it supports the orientable torus topology [115]. Yet, the representation in cortical domains when this orientable topology is applied is asymmetric, the image by the map of the center of the local receptive field (the foveal) is on the boundary of the map, not the central vertical axis. To reinstate symmetry with respect to this organizing center, the non-orientable topology of the Moebius band is needed, which thus becomes a non-orientable Riemann surface for the complex logarithmic map. In principle, both topologies are possible inasmuch both the Boolean and superposed basis in Matrix Logic exist and are transformed by the Kleinbottle Hadamard operator; see eq. (86). Simply, for the non-orientable topology, the field's receptive center is transformed into a symmetric organizing axis in the neurocortex, while in the Boolean orientable case it is represented in such a way that the center's field retinotopic representation in the cortex has been shifted to the boundary. Therefore, non-orientability is closely related to the preservation under the analytic map of an organizing center; again, non-orientability is related to Self and appears to be related to the integration of both hemispheres.

Returning to the issue of binocular vision and disparity that provides for a cue to depth perception which we recall that in Merleau-Ponty's phenomenological philosophy [68] is the primeval dimension of perception that as we presented already leads to multivalued logics and the generation of time waves of synchronization, lies in the understanding of Schwartz in the fact that the complex logarithm links a cortical shift to a visual plane size change. Thus the slightly different projections of the two eyes are normalized by the complex logarithm to the identical cortical pattern, with the shift proportional to the size difference, and ultimately, the disparity of the stimulus [114].[69] Returning to the case of haptic perception, i.e. to the integration of several sensorial modes, we have a complex logarithmic map that is the representation map of both somatosensory and visual modes [114]. Now as much as topologically the global representation for the somatosensory mode is the Kleinbottle, it is most remarkable that the Kleinbottle appears to be the solution of representation of visual topographic maps on the neurocortex. As for the topological representation of the retinotopic mode, symmetry properties of simple cell receptive properties lead naturally to the construction of the Kleinbottle [122] coinciding with the conclusions by Schwartz. So the geometry of visual (and furthermore, of auditory and somatosensory -limbs, skin surface, etc.-) space has a representation at the visual cortex, and furthermore, at the fundamental level of cells, the topology of the Kleinbottle is naturally present. Furthermore, there is experimental evidence that supports that these maps can be represented by the Kleinbottle [122][126][134]. Interesting enough, the starting point is the 2-dimensional Gabor function (of importance in holography [61]) commonly used to model the receptive-field profiles of

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[68]Depth appears also as a possible spatial interpretation of the recursion of the Kleinbottle into itself alternatively to the time-waves interpretation [101].

[69]Thus, stereoscopic vision appears as the process of a difference producing difference; the integration of both hemispheres which we also interpreted as a time-loop through a torsion field.

simple cells [66], which make up a substantial percentage of visual cortical neurons. This function yields a topological representation which is the Kleinbottle which is already present as an holographic representation of vision on the neurocortex.

9 Epilogue

To resume [70], the primary sensory projection of each limb, the kynesthesic and the visual modes are all described by the complex logarithmic map, and they all share the same topology, the Kleinbottle. So the integrated haptic modes available at the cortex are provided by a single map and a self-referential topology, which is further related to the constitution of the fusion of participatory universe on which the subject and the object are fused through the self-referential gestalt of the photon and torsion fields. So we here find more than an integration of the psychology and the neurophysiology of the spatial senses. It is further integrated with the generation of a participatory universe in which the thinking, perceptual, cognitive, sensory and physical realms are all one. Topologically, it is the Kleinbottle. This establishes a Universe of resonances integrated by torsion fields, in which the quantization of these resonances are provided by sheets of the complex logarithmic map. These resonances give rise to the synchronization that leads to binocular vision, as being integrated through the complex logarithmic map.

Now, the body afferents which are the mediators between the body and its topographical map, independently that this is the analytical or the topological one, have a clear fractal recursive structure, and thus itself is eminently self-referential. This is common also to the actual development patterns of plants, and has been studied extensively in the mathematical work of Lindenmayer. As Schwartz with profound insight points out, the actual analytical map at each step of the recursion for the map of the sensorium be compatible with the end image in the neurocortex be the complex logarithmic map, is that this is the map that constructs the fractal at each and all stages of the recursion [71] What about the topological map? Is this iteration of the analytical map related to non-orientability, i.e. the Kleinbottle and Moebius band, at all stages of the recursion? For the retinotopic representation, this would imply at each stage of the recursion the preservation of the stimuli local centre field, concatenated by the complex logarithmic map. More generally, we suggest that the answer may be affirmative and furthermore, there is anatomical evidence that this is the case. The evidence is the mammal and specifically human heart, but not seen in the usual Cartesian sense, a space occupying object, or defined by its boundaries (would not be that it has valves connecting it with the rest of the body) by it. The actual structure of the human heart (dissected with previous extraction of the valves) is that of an iterated Moebius band, as was discovered in the work of his lifetime by F. Torrent-Guasp, in which each band folds another identical band. [72] Furthermore, this development is crucial to the physiology of

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[70]Reaching this stage of ending this chapter, and due to a conjuction of fortituous and premeditated conjuction of the lack of space and the wish of the author not to spell out conclusions but allow the reader to ponder on the text by him (her)self, we shall only write an epilogue to resume the last section.

[71]We recall the anthropologists tale: It is turtles all the way down (or up).

[72]We can actually ponder together with many loving people that there is a connection of the heart with Intelligence.

the heart, which thus functions as a torsioned geometry through vortex motions produced by the cyclical turns of the recursive Moebius bands [128]. Including the valves, is the heart a Kleinbottle?

The next question that this elicits is: What is the relation between this recursive structure-process and the growth of organs in the human body? According to the findings of Lindenmayer the case for plants is that they are unified [62]. Plants grow following the recursive patterns. Let us return to the complex logarithmic map. If we decompose it into its real and imaginary parts, they both satisfy the diffusion equation [16]. So at each stage of development of the recurrence, we have a diffusion process that we can think of morphogens. But now the topology is non-orientable at each stage, and thus the growth also follows the same topology , at each stage, explaining thus the Myocardial Band Model due to Torrent-Guasp.[73]

10 Acknowledgements:

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[73]Pioneering work in the recurrent growth algorithms that lead to the formation of human or animal organs and structures, we refer to the important, but unfortunately not translated to English, work by Bazanov [9], inspired in the work by Edwards [25]. It is important to remark that this is a very remarkable example of the fusion of form and function, alike the one that the Kleinbottle embodies.

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