EasyChair Preprint

№ 6848

"Noema" and "Noesis" by Information After Husserl's Phenomenology Interpreted Formally

Vasil Penchev

October 16, 2021

“Noema” and “Noesis” by Information after Husserl’s Phenomenology Interpreted Formally

Vasil Penchev, vasildinev@gmail.com
Bulgarian Academy of Sciences: Institute of Philosophy and Sociology:
Dept. of Philosophy of Science

Abstract. Along with “epoché” or his “reductions”, Husserl’s “noema” and “noesis”, being neologisms invented by him, are main concepts in phenomenology able to represent its originality. Following the trace of a recent paper (Penchev 2021 July 23), its formal and philosophical approach is extended to both correlative notions, in the present article. They are able to reveal the genesis of the world from consciousness in a transcendental method relevant to Husserl, but furthermore described formally as a process of how subjective temporality appears being isomorphic to objective temporality of the “world by itself” (an abstraction meaning it out of consciousness or transcendental consciousness): thus, it shares the same mathematical structure, which is embodied in the physical process of decoherence by the physical quantity of quantum information. The temporal world is able to appear naturally (rather as a ridiculous effect of the mythical “Big Bang”). The same process translated by formal and mathematical tools as interpreted in terms of “noema”, “noesis”, or transcendental consciousness is isomorphic to how “Self” (including in an individual and psychological sense) appears in virtue of transcendental consciousness.
Keywords: consciousness, formal phenomenology, noema, noesis, the Self, transcendental consciousness.

I INTRODUCTION: HUSSERL’S PHENOMENOLOGY INTERPRETED FORMALLY

Husserl, a mathematician by education, bequeathed the idea, rather proclaimed than implemented, for “philosophy as a rigorous science” on the relevant formal and axiomatic basis and then built deductively therefore following the paradigm of mathematics. Properly, he renewed an old intention traceable at least to Leibniz and even still to ancient Pythagoreanism when philosophy appeared linked to arithmetic (and thus, to mathematics in a contemporary sense) rather before Socrates’s “humanistic revolution” in it (particularly, which rejected and made impossible that formal and mathematical approach to philosophy and it has been enumerated among “humanities” since then).

The contemporary “classical” quantum mechanics as well as the theory of quantum information were forced to revive implicitly a new, quantum form of ancient Pythagoreanism due

to the theorems of the absence of hidden variables (or "hidden parameters"[1]) proved by Neumann (1932), by Kochen and Specker (1967) as well as a series of analogical corollaries or independent theorems, all of them based on a few properties of the separable complex Hilbert space underlying quantum mechanics as its mathematical formalism[2].

Indeed, any mismatch or difference of reality and its mathematical model, which can be revealed in the future, should be interpretable as those "hidden variables": thus, the theorems at issue can be realized philosophically as a proof for the identification of model and reality in quantum mechanics able to be universalized in virtue of the fundamentality of quantum mechanics.

One can even trace the idea of Kochen and Specker's proof (1967) of inferring the absence of hidden variables in quantum mechanics from the mutual incommensurability of quantities (not only conjugate[3]) in quantum mechanics still to the discovery of the geometrical incommensurability of quantities representable arithmetically by their geometrical length and which shocked the ancient Pythagoreans[4]. Indeed, the suggested eventual commensurability as that of natural (rational numbers) as that generalized by Kochen and Specker to relevant relations of mathematical structures[5] impies hidden variables in quantum mechanics or the "absence of

---

[1] The notions "hidden variables" and "hidden parameters" (though often used as synonyms) are not identical, especially ontologically. Both "hidden variable" and "hidden parameter" suggest for a quantity to be a variable, but from a different viewpoint in each case: the former is "observed inside", within the framework of the "local space", and the latter is changeable within the framework of the "global space" remaining the same, i.e. constant as to any certain "local space". Indeed, the identification of both as absolute synonyms correspond to the "philosophy of the Standard model". However, if one accepts the viewpoint of quantum information (especially, as a theory of quantum gravity, therefore identifying entanglement and gravity as the same, but observed accordingly from the local or global space, already generalized as "curved" in general), "hidden parameter" should be distinguished even quantitatively from "hidden variable".

[2] Thus, the conclusions tractable in a Pythagorean manner do not depend on quantum mechanics or quantum information properly, but only on a mathematical structure such as the separable complex Hilbert space though both include it.

[3] Kochen and Specker emphasized explicitly (Kochen, Specker 1967) that generalization, which is meant in their theorem in comparison with the corresponding theorem of von Neumann (1932)

[4] The Pythagorean incommensurability of geometric quantities measured by rational numbers (and thus, by pairs of natural numbers, i.e. *finite* necessarily) implies for their ratio to be an irrational number, i.e. unambiguously determinable only by an *infinite* well-ordered sequence of digits. The concept of "hidden variable" in quantum mechanics only generalizes that of rational number from the usual arithmetic (e.g. as it is axiomatized by Peano) to Hilbert arithmetic, furthermore identifiable with the separable complex Hilbert space of quantum mechanics in the final analysis. Indeed, the "hidden variable" implies for any two wave functions sharing it to be a total multiple, or respectively, a multiplier of their greatest common multiple as concepts generalized from Peano arithmetic to Hilbert arithmetic. Then. the absence of hidden variable, meaning right that total multiple to be definitively always not more than a unit, implies for all quantities in quantum mechanics to be the corresponding generalizations of "rational numbers" as to Hilbert arithmetic, therefore bridging (over millennia) the Pythagorean discovery of incommensurable geometric quantities and the absence of hidden variables in quantum mechanics as a generalization to Hilbert arithmetic.

[5] By means of Hilbert arithmetic, the "P vs NP" problem (one from the seven Millennium problems according to Clay Mathematics Institute) can be represented by the correspondence of arithmetic (meant

irrational numbers" (Penchev 2020 August 5). In other words, the availability of hidden variables is similar (or even isomorphic under a few additional conditions) to the commensurability according to the idea embedded in any rational number as a ratio of integers.

That similarity can be interpreted as an "irony of history" since the discovery granted by the ancient Pythagoreans to be a refusal of their doctrine turns out to be even isomorphic in a rigorous meaning to the contemporary restoration of a new, "quantum" Pythagoreanism in virtue of the Kochen - Specker theorem itself. One can try to exonerate the incommensurability of irrational numbers as a rejection of the original Pythagoreanism by the reverse projection of Kochen and Specker's arguments "back in time" as follows:

If one interprets the one segment (as the diagonal of a square or a rectangle in the Pythagorean proof) as the "coherent state before measurement", and the other segment (as a side of the same square or rectangular) as the "state measured by the apparatus" in the Pythagorean discovery of incommensurable segments, the same incommensurability means the absence of hidden variables able to make commensurable the two segments to each other and thus, the ontological (but not mathematical) coincidence of model (the "second segment") and reality (the "first segment").

A philosophical comparison and reflection on why an isomorphic mathematical argument is interpreted oppositely by the ancient Pythagoreans and quantum mechanics reveals the following formal and logical structure. The ancient Pythagoreanism directly or naively had identified mathematical reality and ontology and discovered that they were incommensurable. Thus, it concluded that its fundamental postulate that reality is arithmetical (mathematical) should be false.

The contemporary argument in favour of a "quantum" Pythagoreanism can be interpreted in the above philosophical terms: OK, let one admit that mathematical reality and otological are different; this immediately implies that they are the same, but on the next metalevel, as the incommensurability from the viewpoint of quantum mechanics means the absence of hidden variables in it.

Thus, one can coin a metaphor that the Pythagorean viewpoint (already in a quantum interpretation) is God's one as far as the theology of Christianity grants rather for God to be situated on both level and metalevel simultaneously unlike human being engaged empirically only with the "level" (and the "metalevel" is accessible only religiously, but not empirically for the human beings).

The analogical "scholia" can be involved in a "quantum phenomenology" (Penchev 2021 July 26) called to embody literally Husserl's "philosophy as a rigorous science"; that is: formal phenomenology (accomplished as "quantum phenomenology"), in particular, is to be realized

---

by a Turing machine) and Hilbert arithmetic (meant by a quantum computer). So, one elementary example of a "P vs NP" problem can be that: to calculate the state of Schrodinger's cat. Ii is a non-P problem, since if it was a P problem, this would imply "hidden variables" in quantum mechanics. Nonetheless, it is a NP problem since it needs the choice between a finite set of alternatives (two in the case: either a "dead cat" or an "alive cat").

only on the next "metalevel", as if philosophy observed from "God's viewpoint" and here is how if the case is just "quantum phenomenology":

Only an abstract qubit consisting in turn of two dual qubits (and those three qubits constituting a bit of classical information at the next metalevel, furthermore called the "philosophical bit of information") is sufficient to be added to the usual qubit Hilbert space of quantum information. That complementing philosophically bit consisting of three qubits is absolutely consistent with the qubit Hilbert space being even equivalent to the latter in virtue of the axiom of choice.

Properly, it adds only the external, metaphorically called above "God's viewpoint to the world" formally and mathematically represented by the investigated qubit Hilbert space. Then, Husserl's basic concepts such as epoché, eidetic, phenomenological (psychological), transcendental reductions, etc. can be defined as relevant interpretations of that "philosophical bit of information" (Penchev 2021 July 26) due to the absolutely formal representation of the main idea of scientific transcendentalism by it (Penchev 2020 October 20).

One can notice that Husserl's "noema" and "noesis" (1913) appeared later than his (cited above) notions share the same formal structure of the "philosophical bit of information", but being "directed oppositely" to the previous ones in a sense (Kersten, Zaner 1973). For example, "epoché" means to identify the world and consciousness therefore introducing Husserl's "phenomenon", but "noema" and "noesis" appear in the process of splitting the initial phenomenon between "noema" (intentional content identifiable with the "things of the world' in the final analysis, i.e. at the end of splitting the transcendental unity) and "noesis" (intentional act turning out to be finally situated into the "Self" ultimately opposed to the world). That "splitting" represented formally by the "philosophical bit of information" is isomorphic to the process of "decoherence" in the theory of quantum information; respectively, the correlation of "noema" and "noesis" permanently emphasized by Husserl corresponds to "quantum correlations"[6] (or the "entanglement" of "noema" and "noesis" once they are translated in terms of "quantum phenomenology").

The mathematical formalism involved by quantum mechanics and information for a specific objective can be generalized further as a universal tool for investigating temporality wherever it to appear, and much more powerful than Newton's (or Leibniz's) infinitesimal calculus supplied classical physics with the first relevant mean to research processes in time formally and mathematically (Penchev 2021 February 25), So, the separable complex (or qubit) Hilbert space though applied in quantum mechanics (and information) first (as Newton's infinitesimal calculus, in his theory of gravitation or the elements of mechanics) is a universal tool applicable to describe at all how time appears anywhere (Penchev 2021 April 12) rather than processes in time supposed in advance to be a necessary condition postulated and thus out of the scope of the problem and its investigation.

Just following the same paradigm of an extended understanding of that Hilbert space as a formal and mathematical mean to research the genesis of time everywhere, quantum

[6] The paper of Bulnes (2013) contains similar ideas.

phenomenology as a formal doctrine allows for philosophical temporality to be discussed the genesis of the Self furthermore investigating in addition the gradual process (not being temporal in a narrow sense since it calls time to appear at its end) of splitting the Self and the world by assistance of “noesis” and “noema”correspondingly.

The same approach allows for paralleling the well-known (at least from Freud’s age) “non-Self psychology” concentrated on the “unconscious” (but now understood as the way for consciousness to appear from it rather than only opposed to the latter) and “dark matter” and “dark energy” not as a strange “curio”, or accidentally, but by virtue of the same underlying mathematical structure conditioned by involving time in both cases.

Classical physics (and not less the “classical” quantum mechanics) postulates time (and thus space) to be a universal and absolute condition of all claiming to be physical. On the contrary, quantum information due to all phenomena of entanglement admits not only to exist physical reality out of time (and space), but even it to be crucially prevailing in the universe (for example, establishable by experiments as “dark matter” or “dark energy”). Particularly, the “Big Bang” meaning the occurrence of the universe (after which space-time as well as energy conservation are necessary conditions) as a real event seems to be rather a myth.

However, the present paper after utilizing of “noema” and “noesis” as formal and mathematical notions considers another interpretation, situated even at the other pole of Cartesian dualism: consciousness also postulated to be temporal as the universe of classical science, therefore being like the “surface part of the iceberg of the psyche”, the huge “hollow part” of which is the non-temporal unconscious (Mills 2015). So, the process of splitting “noema” from “noesis” means the gradual emergence of consciousness permanently as a constant result after the ultimate distinction (“decoherence”) of “noema” and “noesis” in any moment of physical time rather than as a mythical initiation in a certain moment in one’s “childhood” (after Freud).

There exists a tendency for all non-temporal phenomena (if the emergence of consciousness is enumerated among them) to be concentrated in a mythical beginning when “time starts” being universally valid since then. That propensity is to be reflected and prevented: so, the split of “noema” and “noesis” though a process is rather paradoxically not a process in time. Alas, all human experience is temporal and thus any process is thought to develop in time, but not otherwise. For that reason, splitting “noema” and “noesis” is to be represented formally and mathematically rather than by the depiction of common sense or rather than as similar to all usual processes.

II “NOEMA” AND “NOESIS” AFTER HUSSERL

There is a huge literature starting from Husserl himself about his “noema” and “noesis”. Only a few aspects of them will be discussed as relevant to the intended way for them to be introduced absolutely formally and mathematically, namely:

“Noema” and “noesis” correlate immediately with each other by virtue of the fundamental property (postulated by Husserl as well) of intentionality, and only in relation to it, they can be defined. Intentionality is crucial also for his conception of internal (or subjective) time as the

interrelation of “retention” (directed to the past) and “protention” (directed to the future) by their permanently changing synthesis in the present. As a corollary, “noema” and “noesis” by mediation of “intentionality” (Rinofner-Kreidl 2002) can be related to Husserl’s “time” (2008) , then, to the standard physical quantity and to temporality (at all) for as a necessary condition for all claiming to be physical (even according to the “classical” quantum mechanics). Finally, a parallel in essence relied on the same shared formal and mathematical structure can be revealed in both correlating “noema” and “noesis” and the non-temporal (and thus, non-spatial as well) phenomena of entanglement in physics[7]. The synopsis in the present paragraph can be decomposed in more detail and one by one:

Intentionality (a fundamental and definitive property of consciousness shared by Brentano’s conception) means the direction of consciousness to its content and even the identification with it, after which consciousness is available as its opposite, the “world”. When Hussserl interpreted its doctrine as a form of Kant’s transcendentalism (1924), he tended to understand intentionality as the constitutive property of consciousness to be directed out of itself, to the transcendent[8] in relation to it to be determined and defined within itself transcendentally.

Thus, intentionality can be seen formally as still one interpretation of the totality when consciousness exemplifies the totality according to Western philosophy after Descartes’s “mind - body” innovation and transcendentalism is meant in its framework as a solution of that dualism; furthermore, transcendentalism itself is defined absolutely formally as “scientific transcendentalism”, i.e. as that formal doubling forced definitively by consciousness once one means its wholoness and thus, sharing the formal structure of the totality.

Particularly, intentionality is summoned to explain the fundamental dominance of “natural attitude” as well as the way veiling what all phenomena are, and which Husserl’s phenomenology studies. Once one’s attention is concentrated on intentionality (rather than on the world being self-exhaustive in “natural attitude”), the approach to the proper phenomenological research of consciousness is open.

On the contrary, the naturalizing psychology (postulating an objective investigation of psyche just as in natural attitude, in fact, hiding it) is self-contradictory since its method veils its object (or they are complementary to each other in an extended sense of complementarity suggested also by Bohr).

Once intentionality is postulated to be universal to any possible research of consciousness (as properly psychological as philosophical), it is to be applied to itself in the framework of consciousness therefore generating “noema” and “noesis” again *as a distinction within intentionality*, but at the next metalevel, or said otherwise, as the “intentionality of intentionality”.

---

[7] One is to mean the correlation of time and spatial models after Husserl’s temporality (Larrabee 1989).

[8] For example, interpreted intentionality *implicitly* and ontologically as transcendence embodied by time (Heidegger 1929).

Thus and particularly, “noema” and “noesis” should be defined both “intentionally”[9]: correspondingly as “intentional content” (as what consciousness itself is identified as realized in the standard “natural attitude”) and “intentional act” (hidden in that natural attitude now directed to consciousness itself). In other words, consciousness represents for us usually as noema(s), and the mechanism of that representation identifiable as consciousness remains “irrepresentable” again: consciousness “works” by itself just in this way.

If one means the absolutely formal approach of the “philosophical bit of information” (sketched above), the distinction of “noesis” and “noema” is to be related to the choice itself of choice rather than to one (“consciousness”) or another (the “world”) alternative of the already chosen and meant by “epoché”. If one bit of information is determined by two binary oppositions, from which the one distinguishes “before choice” and “after choice”, and the other is: the one or the other of equally probable choosable alternatives, the former is meant by “noema” and “noesis” , and the laller, by “consciousness” versus the “world”. Thus, “phenomenon” achievable by “epoché” to the latter distinction, anyway, can be decomposed by the former one. Consequently, the conception of “noema” and “noesis” supplies a kind of meta-phenomenology, or phenomenological means and research of phenomenology itself.

Analogically (or even isomorphically, if one means the underlying formal and mathematical structure), entanglement would relate to the metalevel of quantum information unlike the “classical” quantum mechanics referring to the single qubit Hilbert space by itself (and isomorphic to the usual separable complex Hilbert space of quantum mechanics under a few elementary conditions).

The same analogy (or isomorphism) supplies furthermore the searched key to a formal investigations of Husserl conception of internal (or subjective) time, being definitively opposed to the external (or physical) time, and relied on “noema” and “noesis”: that internal time is to be situated on a metalevel to time meant by physics (including, the “classical” quantum mechanics) therefore definable by a relation analogical (or isomorphic) to the correlation of “noema” and “noesis”: and named by Husserl “retention” (directed backwards as to physical time, from the present to the past) and “protention” (directed forwards as to physical time).

Though the relation of “protention” and “retention” is similar to that of “noema” and “noesis”[10], the identification of either of them as the “time of noema” (or respectively, the “time of noesis”) is incorrect and absolutely misleading as far as the similarity is valid only to the *relation* without implying the identification of those which are related.

“Protention” means rather a kind of *reversible* time able to synthesize all moments of the future as available in the present, and “retention”, also reversible time, but as to the past, and also available in the present. So, the present is able to be related simultaneously, but independently, to the past and to the future both meant as a whole, but as two whole entities absolutely distinguishable from each other (Alves 2008).

---

[9] One is to mean the “history of intentionality”, at least from Brentano to Husserl ((Hickerson 2007).

[10] The relation of time and intentionality (and thus, to noema and noesis) are discussed in detail in the paper of Doyon and Breyer (2020) from a contemporary viewpoint.

Their unification in the present can be represented by Heidegger's latter concept of "ontological hermeneutic circle" (or respectively, that of Gadamer) consisting of "time forwards", that of happening, and "time backwards", that of interpretation. Thus, "noema" and "noesis" are able to share the same structure of the hermeneutical circle, however without any correspondence of either semicircles between the two cases. Hermeneutical circle is related to the quantity of entanglement (what quantum information is), but without binding with what is entangled. In other words, entanglement in physics, by the mediation of quantum information, and hermeneutical circle in ontology or the abstract theory of interpretation should be fundamental and not reducible to their components, which are absolutely different in each case.

III THE "QUANTUM DECOHERENCE" OF NOEMA AND NOESIS

A previous paper (Penchev 2016) discusses a model of metaphor based on quantum information. If one represents the correlation of noema and noesis as similar to that brought by metaphor to words linked by it, the same quantitative model based on wave functions in the separable complex Hilbert space can be extended also to the present topic. Restricting the topic to the idea described only qualitatively, one can utilize Derrida's "white metaphor" (1972) as its gradual deletion during the course of use and destroying the metaphorical link "entangling" their meaning being an equivalent of what is known as "decoherence" in quantum mechanics.

Following the same model, the permanent use of of the same noetic-noematic unity[11] (about a certain thing. or in other words, about its "phenomenon" in Husserl's sense) distinguishes it from being separated within the world, on the one hand, and the way of observing it by the Self to "melt" into "transparency". So, the methodological paradigm of classical physics and science can be inferred as the ultimate, extreme degree of decoherence of the same noetic-noematic unity to the investigated object absolutely independent of the observer studied it, after which measurement can be postulated as "transparent".

Meaning that last generalization of epistemic postulates by means of Husserl's phenomenology, a bridge of transferring quantum mechanics (both quantitative and experimentally testable theory) to the doctrine of noema and noesis so that a formal and mathematical model of their correlation can be built in analogy or in isomorphism. Then, quantum mechanics[12] describes the fundamental rules following which, speaking loosely, "time can appear as a side effect" from the ultimate decoherence and applicable by virtue of the same model to the "decoherence" of the Self and the world: a welded fact in Descartes's dualism postulated in its basis:

In other words, quantum mechanics forced by its narrow scientific problem (how to unify consistently the discrete change for the Planck constant with the smooth continuous change as classical physics describes the "apparatus") has managed to resolve much, much wider and fundamental philosophical puzzle bequeathed by Descartes and penetrating Western philosophy

[11] The noetic-noematic unity is discussed in detail in the paper of Moran (2015) or in that of Wojciech (2020).

[12] And especially quantum information created, particularly, to explain the way in which the epistemic constellation of classical physics becomes possible once quantum mechanics is fundamental.

since then. Moreover, the same quantum solution is formal and rigorous therefore allowing for the goal pursued in the present paper: a formal, "quantum" model describing the correlation of noema and noesis.

So, the situation meant in classical physics, science, and epistemology as both self-understanding and universal is not more than an extreme ("borderline") and thus particular case, to which quantum mechanics puts a paradigm of how one can restore the complete pathway only finally resulted in the usual "object" independent of "subject" by virtue of the transparent observation and measurement postulated in advance.

What is granted to be "self-evident" in "natural attitude" is already problematic in Husserl's phenomenology once "epoché" has involved the opposite ultimate pole of "phenomenon", in which noema and noesis are merged rather than only any entity in natural attitude and its mental image. Then, "noema" and "noesis" being inherently related to the intentionality of consciousness are furthermore relevant tools for consciousness to be described as the room where the world can appear as opposed to the Self, but only as an ultimate final, after which consciousness can hide itself being postulated as an absolute and transparent "stage", on which the "Self" constituted correlatively in the same process can watch as independent the world already complete and thoroughly "ready for observation" by classical science.

Parallely, isomorphically, but absolutely independently, the decoherence of time occurs permanently: the "coherent state" of hermeneutical circle is decomposed to the past and the future thoroughly distinguishable from each other, after which the present is reduced to a point (otherwise the intersection of the past and the future would be nonzero). If one considers any moment in both past and future (as far as any moment "has been" a present moment, and any moment in the future "will be" a present moment), this generates the quality of time in classical physics representable mathematically by the concept of "well-ordering"[13]. That is the "temporal screen" conserved also in the "classical" quantum mechanics, only on which energy conservation is absolutely valid:

On the contrary, Huserl's conception of "internal time" divides only "protention" from "retention" by the mediation of the present moment. However, both retention and protection are reversible as the "quantum time" of coherent state is: they are well-ordered only to each other rather than within either of them[14]. A step further is made by Heidegger or Gadamer's "hermeneutical circle" admitting for the present moment the same reversibility of time as to Husserl's "retention" or "protention".

IV NOEMA, NOESIS, AND TIME, OR WHY THE SELF NEEDS TIME

Noema and noesis are correlative, but their correlation decreases by itself, or in virtue of the welded "world" and the welded "Self", which join them correspondingly, ultimately when (or rather "where") the process of their division has ended. Properly, one can speak of "time" or

[13] Epistemic ordering is linked to intentionality as a universal entailment in the paper of Swenson (1999).

[14] Particularly, the following illustration is possible. The internal time as both protection and retention does not imply energy conservation though whether the concept of energy at all makes sense to consciousness seems to be too problematic.

"internal time" only when (or rather "where") the process at issue has ended: so, that process cannot happen as a process usually meant by classical science, i.e. as a process running in the usual, empirical and physical time.

The process of decoherence, an analogue of the division of noema and noesis, shares the same mathematical description and can serve as a paradigm for articulating the logical, methodological, and philosophical problems about the nontemporal genesis of internal time. Those obstacles are significant as far as physical time (respectively, internal time) is not rejected as a necessary condition for all physical (respectively, all psychical).

Even Freud and the other researchers of the unconscious, though opposed to consciousness, consider it as an entity developing in the course of time rather than as a nontemporal entity (Aaron 1990). As to physics, the same incapability for generalizing physics in a way to comprise nontemporal phenomena as entanglement and decoherence results into the ridiculous idea of the mythical "Big Bang", a temporal beginning of the universe contradicting all physical laws, for example that of energy conservation, on a unique and unimaginable scale.

So, the "classical" quantum mechanics tends to describe decoherence only in relation to the apparatus (respectively, to all the welded world). However, this implies a fundamental contradiction being extrapolated to the alleged zero moment of the "Big Bang" because "then" no world existed yet (to which the "classical" quantum mechanics might define time). Furthermore, the "classical" quantum mechanics, following Pauli, has often been disposed to proclaim time irrelevant to any quantum entity by itself, but relevant only to the eventual apparatus able to measure it. However, that approach prohibits decoherence to be investigated in terms of the quantum entity itself (i.e. in quantum superposition of all possible states) as a temporal process (therefore rejecting the conjecture of the Big Bang, particularly).

Instead of time, the variable of that gradual process of decoherence should be the degree of entanglement of all possible states decreasing very fast in the macro-time of the measuring apparatus. Particularly, quantum calculation makes sense only if that degree of entanglement is high enough, a very short period as to the time of the apparatus and being the main obstacle for the practical implementation of quantum computers.

That consideration suggests naturally that the degree of entanglement is to be the correlative quantity of the time of the apparatus as to the quantum entity. The degree of entanglement (as the superposition of all possible states) as correlative to time can be interpreted as the frequency of the de Broglie wave associated with that entity in virtue of wave-particle duality. However, the same frequency is proportional to a certain value of energy by the mediation of the Planck constant and should decrease (as the degree of entanglement and the corresponding frequency decrease). Thus, one might observe how the energy of the investigated entity appears gradually (but in an extremely short period if it is measured in the units of time of the measuring apparatus) as if *ex nihilo*[15]: in fact, the fundamentally unobservable (being situated under the threshold of

[15] If one integrates that energy "appearing *ex nihilo*" all over the space-time of the universe and concentrates on a single point in the past, it would be an equivalent of the "Big Bang".

the Planck constant) becomes observable only passing over the threshold at issue[16]. Consequently, the Planck constant is simultaneously that threshold of absolute decoherence, after which physical time makes sense: then, the phenomena of entanglement and gradual decoherence should be roomed into the sub-Planckian scale, which seems to be a nonsense (in fact, only at first glance) because their effects are observable therefore relevant to quantities of action exceeding the Planck constant.

The ostensible contradiction is easily resolvable if one interprets wave-particle duality as the duality of the sub-Planckian and super-Planckian scale (or as a still more generalized principle of relativity allowing for the physical laws to be invariant to observers whether "within" or "out of" the universe; and being equivalent to the invariance of discrete and smooth reference frames[17]). Then, effects due to sub-Planckian phenomena as those of entanglement or gradual decoherence are interpretable and can be studied by their observable physical effects exceeding the Planck constant (as well as vice versa).

Those considerations drawn from philosophy of quantum information, but articulated and exemplified in terms of quantum mechanics, can be repeated in relation to the noetic-noematic unity of consciousness in virtue of the formal and mathematical structure of the qubit Hilbert space able to underlie both. Internal time can appear in an isomorphically describable process running out of it, but resulting in its appearance. The relevant variable of that process generating internal time is the gradual separation (or emancipation) of noema and noesis from each other (therefore justifying the introduction of their concepts in a theory relevant not only to consciousness, but even rather to the genesis of consciousness and thus to the genesis of internal time itself).

So, the "mind-body problem" inherited by Cartesian dualism, but fundamental for psychology to make clear its place in the modern "episteme" (utilizing Michel Foucault's term), acquires new additional dimensions of its genesis, right in which it is resolvable. The ultimate result consists in a "doubled noema", the one copy of which is situated in one's mind and the other one, in the "world by itself". Their identity and even only correspondence is not guaranteed, therefore being the permanent trouble of human cognition building bridges over the gapped copies, eventually by "God's help" (in Descartes's conjecture).

Husserl's doctrine of "noema" and "noesis" (and here interpreted by a formal and mathematical "quantum phenomenology") depicts a quite different sketch for the appearance of the "world by itself": only in the framework of consciousness and only in virtue of mathematical necessity rather than due to any reasons able to "cause" the emergence of consciousness naturally (what means it as processes in time, the causes of which are in the world by itself and the effects, in the consciousness; as well as and not less, vice versa), thus more or less by

[16] The same process of visualizing energy once it has exceeded the quantity of action of the Planck constant can be thought still in two equivalent ways: (1) as transforming dark energy into visible energy, and (2) as transcending the boundary of the universe, equivalently and hypothetically.

[17] Those ideas are represented in detail in other publications (Penchev 2021 June 8).

accident and therefore needing in turn their explanation in a relevant "next metalevel" and leading to Hegel's "bad infinity" in the final analysis.

What can be seen only as the "mind-body dualism" of "doubled noema" under the universal condition of time underlying uniformly consciousness and the world can be made problematic once the internal, subjective and external, physical times are distinguished from each other as Husserl did to avoid and push away from the "natural attitude" of common sense to consciousness (i.e. as still one kind of entities in the world). If time of physics interprets any moment in time whether in the future or in the past as another "now" mathematically isomorphic to the "true, present now", Husserl's "retention" and "protention" (respectively, "noema"\and "noesis" though in a quite different sense) means "now" as an absolute reference frame (though analogically restorable in any moment of physical time, but needing the mediation of the latter to move on, since internal time is immovable or "eternal" in a sense).

Then, one can observe how the present moment of "now" is being "wedged" in the absolutely homogenous "body of time" therefore causing its division of two asymmetric halves, both past and future, gradually and "immediately" repeated as if "spatially", wedging into "noema" and "noesis": consciousness has managed to hide absolutely sibstituting its noetic nature and essence by (and as) a second copy of noema definitively of the same quality as the original one and identical to it in that sense.

So, the emergence of consciousness runs in Husserl's "internal time" as both gradual differentiation of noema from noesis and transformation of the noesis into the noema. The two sides of that twolateral process causes two noemas of the same quality or a single noema doubled into two copies in the final analisis: the one, never mind which one, in consciousness though its origin can be anyway distinguished as "noetic", and its correlative counterpart, the other copy, in the world, keeping, however, its noematic origin though already invisible in the ultimate result.

Then, physical time can be exhaustively defined anyway in terms of internal time, i.e as a particular case or aspect of it: where (or "when") the noema turns out to be the same as the noesis qualitatively and even quantitatively. That is the welded world of our experience and which is postulated by common sense (or "realism") to be the "world by itself".

On the contrary, internal ("subjective") time cannot be identified at all with external ("physical") time even only for the former is able to describe the emergence of the latter by dividing noema from noesis, by which the future can differentiate from the past as well. Moreover, the course of physical time can be described not worse in the same terms of internal time by substituting the noesis by a second noema and thus, the future moment by a second "past moment" as classical physics and science need.

If one wish to investigate the emergence of consciousness as a process in physical time (as psychology is forced to do if it is legitimated to be an objective, natural, empirical, and even experimental science in the modern episteme), it occurs very fast, but not "instantaneously" (i.e. not for a zero interval of physical time[18]).

---

[18] For example, the emergence of consciousness needs physical (electro-magnetic and chemical) processes in nerves running in physical time. One can distinguish, furthermore, the internal viewpoint, within one's

If one researches the emergence of consciousness psychoanalytically, as a process realizing the unconsciousness as after Freud, Jung, etc., it passes successive stages of semi-realization. in which Husserl's noema and noesis are not yet thoroughly divided from each other as in the ultimately established consciousness and absolutely temporal already and fit to reflect adequately the world sharing the same physical or purely "noematics time", in which the noema is only doubled and any length of physical time can be notated by the one noema as its beginning, and the other noema, as its end, therefore implying for all intermediate moments of physical time to be also noemas, at least potentially. On the contrary, any jumplike, quantum leap between two moments of physical time needs the proper phenomenological, noetic-noematic research of the corresponding consciousness.

Mamardashvili (1984) tended to investigate consciousness in that dual, philosophical and psychological viewpoint introducing the term of centaur-like entities, being specific or even definitive about how consciousness appears registered by itself rather than by bodily reaction as experimental psychology does. The "omnipresent metaphor" suggests a linguistic tool for those centaur-like entities to be represented more or less relevantly in terms of words about the world, thus stuatable in the final noematic poles being permanently established in discourse. Indeed, Heidegger's philosophical apology of poetry (e.g. as in the "Hölderlin" cycle) can be easily explained by its inherently metaphorical essence not less relevant to describe the emergence of consciousness by dividing from the world, however appearing in the same noetic and noematic act: a subject too important or at least curious for philosophy as well. Another paper (Penchev 2016) bridges "metaphor" and "entanglement" and thus further, via metaphor to the emergence of consciousness and Husserl's description by noema and noesis.

In fact, Husserl created a noetic-noematic theory of Descartes's "Self" in way to explain how the "Self" appears *ex nihilo* and to bridge over the insurmountable abyss of the mind-body dualism where the world is not more than copied full of mistakes in the "Self" however postulated by Descartes to be "doubtless" unlike the correlative and opposed, "doubtful" world. So, "the subject is doubtless", on the one hand, therefore able to generate all sciences and arts of humanity, but on the other hand, the image of the world within the "Self's mind is "full of mistakes" therefore optionalizing natural sciences (and even mathematics interpreted accordingly) obeying the conception of truth as adequation (of the mind and the world):

So, one can trace ontogenetically or phylogenetically the pathway, on which contemporary cognition is being had divided into two arguing, rival, inconsistent and incommensurable branches of cognition, but both admissible and available in the episteme established after Descartes with own dual poles: humanity (or even the previous religion of Christianity, once God is obvious just for and by the "Self") believing and originating from the "Self" versus natural science appearing by the world itself and only imperfectly reflected in the Self's mind. That observation allows for one to estimate the revolutionarity of Husserl's doctrine transcending the

---

consciousness and its internal time, from the external viewpoint of the apparatus measuring e.g. the time of reaction of the same one's body and the corresponding to the external physical time.

principles in which, modern cognition is being had become gradually posible, century by century:

Husserl's noetic-noematic theory of the Self allows the modern episteme of humanity versus science to be realized and reflected as a subject of investigation rather than as welded, hidden, and thus pre-predicative and absolutely inaccessible condition for any cognition to be possible in our age. A series of fundamental, revolutionary, scientific (or art and humanity's) discoveries outlined the boundary of all possible modern cognition going more or less out of it in one or other aspect since the beginning of the twentieth century[19]. Thus, the noetic-noematic analysis is not less relevant to the cognitive episteme itself therefore allowing for its reflecting investigation (begun e.g by Heidegger's destruction "to the origin", or Derrida's deconstruction of "Logos as writing", or by Husserl's "The krisis …", but not less by the building of his phenomenology itself): even rather elementary just substituting humanities for the Self, and natural science for the world. Nonetheless, that last observation can easily explain why the structure of contemporary cognition itself does not admit for phenomenology to be universalized and thus radicalized (particularly, as a formal and mathematical "quantum phenomenology" meant here: though it strictly follows Husserl's legacy or inherited direction, it mets the same kind of pre-predicative resistance and non-acceptance).

Anyway, the present article is concentrated on the noetic-noematic Self properly, rather than on a possible analysis of the modern episteme being not only analogical, but even isomorphic formally and mathematically.

Though the Self results ultimately as another copy of the world (whether the doubtless one, after humanities and religion, or full of mistakes and needing a basic repair after natural sciences), the investigation of the corresponding noetic evolution of the Self by itself (or better, "by oneself") rather than the also corresponding noematic, often phylogenetic evolution of more and more perfect representations of the world is what one is to mean in the present context. That evolution happens not in the external, physical time (however taking a real, nonzero interval of it), but in the internal, subjective, rather "unconscious time" and after which both consciousness and the Self (both unifiable as self-consciousness as well) appear (or appears), at least can appear as a correlative result.

Neuroscience, anyway, suggests an experimental way to "noetic syntheses" (since the intentionality of consciousness fundamentally closes their accessibility by reflection, which transforms them into noemas of noetic acts absolutely different from their proper correlative noemas) interpreting them as successive innervations of neuron networks (NN) in the course of a thought reflectable only as noematic changes and implying a relevant physical time, in which they happen or can happen. Then, those NN states are mathematically isomorphic to classes of

[19] After which the wave of historical countermovement has risen as Postmodernity therefore interfering with that previous wave for transcending Modernity: an "interference", the "standing wave" of which has been continuing until now. Thus, Postmodernity continues and extends Modernity partly neutralizing and weakening the jump-like revolution against Modernity started in the beginning of the twentieth century. Postmodernity can and should be interpreted partly (or half as in "halfly") as the restoration or renovation of Modernity not less than as a smooth evolution from Modernity further, to the future.

quantum states repepsentanle in turn as wave functions as far as any NN state can be meant as a finite approximation within the infinitely-dimensional qubit Hilbert space.

Thus, that Hilbert space is able to unify the formal and mathematical rather equivalents than models of noema and (respectively its change as a corresponding noematic synthesis, but not less as a metaphor interpreted both poetically and ontologically after Heidegger and many others after him) for any state of the world meant by a noema is some quantum state representable by a certain wave function in the final analysis, and any state of mind (interpreted as a NN state of brain) is able to be represented in its dual state. Meaning that, the so mysterious link of body and mind (thought by means of "noema" and "noesis", and then interpreted formally and mathematically as wave functions in the qubit Hilbert space being inherently complete) that Descartes involved "God's power" as able to accomplish it is to be understood or identified as isomorphic to entanglement therefore building a universal approach for transferring over the extremes of the dualistic abyss.

The noetic interpretation of the dual qubit Hibert space (once noema has been engaged with its twin, being idempotently dual to the former) can immediately explain the legitimacy of its substitution with another world of noemas (whether the "real one" after humanities or full of mistakes to the "indeed real" one after natural sciences) for both noetic interpretation and the usual second noematic interpretation are isomorphic and thus indistinguishable from each other as any two interpretations of the same mathematical structure. In fact, both determine the same shift of the world, by which it is observable by binocular vision just as that shift (and equivalent to entanglement).

So, though the Self is interpretable in two incommensurable even ostensibly inconsistent ways, whether as one's brain consisting of noetic NN states or as the same one's mind consisting of noematic doublings of the world (supposedly, "by itself"), the Self is necessary only to double the world with the one or other state of entanglement of the Self and of the world rather paradoxically (at first glance) identifiable as the Self "by itself" as the the world "by itself". In other words, the interpretation of the Self as noetic or secondarily (respectively, primarily) noematic is not essential once the essence itself consists in the doubling only in which the world can appear.

However, the noetic (by NN) and noematic interpretations of the Self seem to suggest accordingly different interpretations of "internal time" thus possibly differently applicable to Husserl's initial concept of it: as both "protention" and "retention" in the present. Indeed, if "noesis" as an intentional act is identified with a certain NN state, this time should be the physical one: on the contrary, if noema is attributed to consciousness right for its intentionality, Husserl's "internal time" should be the relevant one. Therefore, an ostensible contradiction appears between "noema" and "noesis" once they have been so interpreted in virtue of their different kinds of time: external and physical versus internal and conscious.

Fortunately, quantum mechanics has already been forced to resolve the analogical mismatch of the *irreversible* time of the apparatus and the *reversible* time of the measured quantum quantity in coherent state (as if "brain" can be likened to be the apparatus in relation to "mind").

Meaning the same problem in proper quantum terms, Pauli established that no operator (unlike all other physical quantities in quantum mechanics) corresponds to the time of the apparatus (here interpreted as the noetic time, ot the physical time of brain processes) once energy conservation should be conserved in quantum mechanics in virtue of its unitarity (inherently embedded in its mathematical formalism of the separable complex Hilbert space).

Following the above parallel, one is to question: what should correspond to energy conservation (particularly allowing for the identifying the system at issue as the same) in the case of the "brain - mind" Self?

The natural conjecture seems to be: just the "Self" definitively remaining the same, but therefore needing the physical (noetic) time of brain processes to conserve permanently, respectively vanishing after the Self's termination[20]. If the case is postulated to be that, one can admit *consciousness by itself*, i.e independently in general of the "apparatus of the brain" (just as one admits "quantum entities by itself", independent of any eventual apparatus).

That "consciousness by itself" in the context of Husserl's noetic-noematic conception should be interpreted as "proper or purely noematic consciousness" without any noetic intentional acts as necessary for it to exist. If one prefers the model of doubled noematic consciousness for a noetic-noematic one, physical time is anyway restored since the different noematic states of consciousness suggest (or at least allow for) a real and nonzero interval of physical time between them. Then, the purely noematic "consciousness by itself" implies the identification of both noematic copies to each other and thus, a zero physical time of transition between consciousness and the world.

The proper Huserl "retention - protention" conception of internal time does not correspond unambiguously to the pair of the irreversible physical time of the apparatus versus to the reversible time of coherent quantum state. Anyway, it can be complemented by the consideration that retention refers to an actual single sequence in the past, and thus should be identifiable as the also well-ordered physical time of the apparatus and unlike protention relating to the uncertain future and probably relevant to the superposition of coherent state. Then, the correspondence of the past and the future (really accomplished by the mediation of the present) fits exactly to that of the apparatus and the quantum entity.

One is to discuss what corresponds to Pauli's statement about the absence of any operator of time: the Self makes sense only to physical temporality due to natural attitude to the world (as far as it shares the same physical temporality only in the framework of classical science, but crucially disputed by quantum mechanics and especially by the theory of quantum information). Then, there is no correspondence of the Self in consciousness by itself (for example "transcendental consciousness") following the parallel to Pauli.

Anyway, one can conserve the Self even to "transcendental consciousness" if the unitarity of quantum mechanics is relevantly interpreted, though (as it allows for the "conservation of of energy conservation" even after missing the "operator of time" in quantum mechanics): it should

[20] However, the physical time implied by brain processes is rather necessary than sufficient condition of the Self, if that the Self does not exist during sleep is granted.

identify transcendental consciousness being non-temporal and the world being temporal, postulatively[21]. On the contrary, the theory of quantum information, accepting all phenomena of entanglement and being transferred to a Huserlian description of consciousness by both "noema" and "noesis" (furthermore, correlative to each other) admits the fundamentally attemporal availability of transcendental consciousness[22].

V INSTEAD OF CONCLUSION: BEYOND TIME AND BEYOND THE SELF?

Following the last consideration in the previous paragraph, one can define the "Self" as the only temporal form of consciousness and thus thoroughly exemplified by the human being's consciousness being temporal even definitively due to the inherent link to "body" ("brain"). However, a mismatch, respectively, distinction of the "Self" and consciousness (or psyche) even in human beings and eventually ascribed to the unconscious psyche: for example, the Self (being rather only philosophically interpreted) versus consciousness (being both philosophically and psychologically interpreted).

The conjecture of non-temporal consciousness correlating with the human being's consciousness (or the Self[23]) is ancient and essential for religion in many of its historical and cultural forms, however no known way (and still more, a method) of how one can reconcile that eventual correlation with empirical experience seeming to be definitively temporal and thus, only relevant to the Self, but not to any nontemporal form of consciousness (if any).

The discussion (as here) in a Huserrlian manner by "noema" and "noesis" (but unlike it tending to a formal and explicitly mathematical description) makes sense, first of all, if one suggests a certain relevant way linking human empirical experience (standardly engaged with the Self) with "God" (or respectively, with any form of nontemporal or universal consciousness) reliably rather than only repeating the banalizing opposition.

The restricting conclusion should be that "God" (i.e. that hypothetical universal and non-temporal consciousness) can appear only *fundamentally randomly* within the framework and under the necessary condition of the Self (being definitively temporal). So, the corresponding phenomena are inaccessible for classical science needing the absolute repetitiveness of any natural phenomena claiming to be studiable or even researchable. Only quantum mechanics changes that postulate being forced for that radical step by the fundamentally random single measurement, however remaining permanent in the more general framework of an extended enough statistical ensemble of measurements therefore determining unambiguously a relevant (eventually, density) distribution and a certain wave function.

---

[21] Pantheism in theology can be considered as analogical to that statement.

[22] Respectively, the corresponding doctrine would state that "God is beyond time" (eventually creates it or has created it) and rejects pantheism only if nature is restricted to be "within time" (as classical science did). However, if nature is generalized in a way to include all phenomena of entanglement (as the theory of quantum information does), pantheism is again admissible though in a generalized way furthermore identifying "consciousness" and the "world" still at the most fundamental level of the origin of anything, non-temporal at all.

[23] The opposition of the "egoistic Self" and God (or cosmic, universal consciousness) preventing their merging is often met in religion, particularly in Christianity.

Analogically, any “divine” phenomena accessible to human empirical or experimental (i.e. scientific) experience should be describable by that model borrowed from quantum mechanics: though the investigated “divine participation” in human deeds is fundamentally random, anyway a probabilistic profile should be discernible: and then a probability (density) distribution and a relevant wave function allow even for the exhaustive formal and mathematical representation of that “divine participation”.

Particularly, a sufficient, but not necessary, empirical or experimental confirmation would the direct, immediately interaction of probabilities of simultaneously phenomena without any causal link between them (over a certain threshold analogical to that meant by the “violation of Bell’s inequalities”), or an entanglement of the phenomena at issue. Indeed, its necessary condition is the phenomena to be described by corresponding probability distribution since only they are able to interact directly and to exceed the threshold maximally admissible for any permanently repetitive phenomena as all those studied by classical science.

As a conclusion, the noematic-noetic research of consciousness unified by the formal and mathematical approach of quantum mechanics allows for an innovative investigation to fundamentally random macro-phenomena, among which is consistently admissible to be enumerated “miracles” (as a common synonym of fundamentally random phenomena) and rejected by the “scientific common sense” (but rather by the usual scope of classical science).

References:

Aaron, L. M. (1990) “Husserl and Freud: Time, memory and the unconscious,” *Husserl Studies* **7** (1): 29—58.

Alves, P. M. S. (2008) “Objective Time and the Experience of Time: Husserl’s Theory of Time in Light of Some Theses of A. Einstein’s Special Theory of Relativity,” *Husserl Studies* **24** (3): 205—229.

Bulnes, F. (2013) “Quantum Intentionality and Determination of Realities in the Space-Time Through Path Integrals and Their Integral Transforms,” in: (P. Bracken, ed.) *Advances in Quantum Mechanics*. Rijeka: INTECH, pp. 213- 244

Derrida, J. (1972) *Margins of Philosophy* (transl. by A. Bass). Chicago: University of Chicago Press.

Doyon, M., T. **Breyer** (2020) “Time and intentionality,” *Phenomenology and the Cognitive Sciences* **19** (3): 405–411.

Heidegger, M. (1929) “On the Essence of Ground,” in: (the same author) *Pathmarks* (W. McNeill, ed. and transl.) Cambridge: University Press, 1998, pp. 97-135.

Husserl, E. (2008) *On the Phenomenology of the Consciousness of Internal Time (1893–1917).* Husserliana: Edmund Husserl - Collected Works, Vol. 4. Dordrecht - Boston - London: Kluwer Academic Publishers (Springer).

Husserl, E. (1924) “Kant and the Idea of Transcendental Philosophy,” *Southwestern Journal of Philosophy* (1974) **5** (3): 9-56.

Husserl, E. (1913) “Noesis and Noema” in: (the same author) *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy*. Dordrecht, Springer, 1982, pp. 211-235.

Kersten, F., R. **Zaner** (1973) “Husserl’s Doctrine of Noesis-Noema,” in: (the same authors) *Phenomenology: Continuation and Criticism* (Volume 50). Dordrecht: Springer, pp. 114-144.

Kochen, S., E. **Specker** (1967) “The problem of hidden variables in quantum mechanics,” *Physical Review A* **17** (2): 59 - 87.

Larrabee, M. J. (1989) "Time and Spatial Models: Temporality in Husserl," *Philosophy and Phenomenological Research* **49** (3): 373—392.

Hickerson, R. (2007) *The History of Intentionality: Theories of Consciousness from Brentano to Husserl*. London: Continuum.

Mamardashvili, M. (1984) *Classic and Non-classic Ideals of Rationality*. Tbilisi: Mecniereba (in Russian: **Мамардашвили**, М. *Классические и неклассические идеалы рациональности*. Первое издание: Тбилиси: Мецниереба).

Mills, J. (2015) "On Meant Objects, Unconscious Intentionality, and Time," *Jung Journal Culture and Psyche* **9** (4): 92-97.

Moran, D. (2015) "Noetic moments, noematic correlates, and the stratified whole that is the *Erlebnis* (Section III, chapter 3, Noesis and noema),"in: (A. S. Staiti, ed.) *Commentary on Husserl's Ideas I*. Berlin - Boston: De Gruyter, pp. 195-224.

von **Neumann**, J. (1932) *Mathematische Grundlagen der Quantenmechanik*. Berlin: Springer, pp. 167 - 173

Penchev, V. (2021 July 26) "Quantum phenomenology as a "rigorous science": the triad of epoché and the symmetries of information," *SSRN*, https://dx.doi.org/10.2139/ssrn.3892039 or https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3892039 .

Penchev, V. (2021 June 8) "The Symmetries of Quantum and Classical Information. The Resurrected 'Ether' of Quantum Information," SSRN, https://dx.doi.org/10.2139/ssrn.3861105 or https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3861105 .

Penchev, V. (2021 April 12) "Both Classical & Quantum Information; Both Bit & Qubit: Transcendental Time. Both Physical & Transcendental Time," SSRN, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3823665 or https://dx.doi.org/10.2139/ssrn.3823665 .

Penchev, V. (2021 February 25) "Natural Cybernetics of Time, or about the Half of any Whole," *SSRN*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3750608 or https://dx.doi.org/10.2139/ssrn.3750608 .

Penchev, V. (2020 October 20) "Two deductions: (1) from the totality to quantum information conservation; (2) from the latter to dark matter and dark energy," *SSRN*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3683658 or https://dx.doi.org/10.2139/ssrn.3683658 .

Penchev, V. (2020 August 5) "A Class of Examples Demonstrating that 'P ≠ NP' in the 'P vs NP' Problem," *SSRN*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3647038 or https://dx.doi.org/10.2139/ssrn.3647038 .

Penchev, V. (2016) "A Formal Model of Metaphor in Frame Semantics," in *Proceedings of the 41st Annual Convention of the Society for the Study of Artificial Intelligence and the Simulation of Behaviour*. New York: Curran Associates, Inc.. pp. 187-194: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3647013 or https://dx.doi.org/10.2139/ssrn.3647013 .

Rinofner-Kreidl, S. (2002) "Fathoming the Abyss of Time: Temporality and Intentionality in Husserl's Phenomenology," in: (Bello, A. A. et al) *Phenomenology World-Wide*. Dordrecht: Springer, pp. 134-146.

Swenson, R. (1999) "Epistemic ordering and the development of space-time: Intentionality as a universal entailment," *Semiotica* **127** (1-4): 567-597.

Wojciech, K. (2020) "Noema and Noesis. Part I: Functions of Noetic Synthesis. Part II: Functions of Noematic Synthesis," *Axiomathes* **30** (6): 251-287 (published: 1-2 August 2019) https://link.springer.com/content/pdf/10.1007/s10516-019-09452-z.pdf (Part I), https://link.springer.com/content/pdf/10.1007/s10516-019-09453-y.pdf (Part II).