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What If the Ontological Basis of Consciousness are Quantum Exclusions?

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Abstract

The aim of this paper is to advance a new hypothesis on the ontological correspondence between the quantum alternatives excluded from actualization in the quantum measurement ("collapse of the wave function") and micro-phenomenal facts. Just as Heisenberg identified quantum potentia as a new type of ontological state distinct from the actualized state, it is a matter of conceiving a third type of ontological state, distinct from both the potential state and the actualized state. While Heisenberg's quantum potentia is distinguished as a superposition of potential space-time outcomes, the third type of ontological state, the quantum exclusion state, can be defined as a state of space-time outcomes annihilation. We can also conceive of quantum exclusions as Everettian branches that, deprived of physical quantities due to the collapse of the wave function, assume only phenomenal qualities. Quantum exclusions seem to be the only entities/states involved in the quantum measurement process, which are naturally supervenient but not logically supervenient on the actualized states (space-time events). Therefore, compared with Heisenbergian quantum potentiae, quantum exclusions might have fundamental advantages as the ontological basis of consciousness, as the "place of consciousness," in terms of less vulnerability to Chalmers' conceivability arguments (e.g., zombie argument, inverted spectra argument), and most importantly because they do not exhibit the feature that makes quantum potentiae irreconcilable with our phenomenological evidence, namely superposition.

Key Words: quantum, ontology, consciousness, supervenience

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1. Taking quantum exclusions seriously as well

One of the most ontologically revolutionary implications of the advent of quantum theory was the introduction of the category of possibilities or "potentiae" among the fundamental categories of reality. Heisenberg's original suggestion that quantum entities can be understood as a form of Aristotle's "potentiae," where potentiae are not

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simply epistemic, but ontologically fundamental constituents of nature, was later recovered by several authors interested in capturing the ontologic features of reality behind the experimental success of quantum formalism. Recently, on the basis of Heisenberg's ontological framework of quantum potentia, new interpretations of quantum physics have been advanced, notably R. E. Kastner's RTI/PTI (Kastner, 2012), in which quantum states do not exist in spacetime but are nonetheless real. "This new ontological picture requires that we expand our concept of 'what is real' to include an extraspatiotemporal domain of quantum possibility," write Ruth Kastner, Stuart Kauffman and Michael Epperson in their remarkable paper "Taking Hesisenberg's Potentia Seriously" (Kastner *et al.*, 2018). In this seminal article, the three authors propose two ontological categories as the foundation of reality: *Res Extensa*, coincident with the four-dimensional spacetime of Einstein's general relativity, and *Res Potentia*, mathematically described by Hilbert space in which Heisenberg's potentiae, namely pure quantum states or superpositions of possible outcomes (i.e., rays in Hilbert space), reside in and from which four-dimensional spacetime crystallizes through actualization of outcomes (i.e., quantum measurement).

According to the authors, this ontological proposal would shed light on important as yet unsolved quantum mysteries, foremost among them the intrinsic nonlocal character of quantum reality well established experimentally by EPR tests (Aspect *et al.*, 1982). Within the context of the Res Potentia/Res Extensa ontology, the explanation of nonlocal EPR-like correlations is straightforward: new quantum measurement outcomes i.e., new spatiotemporal actualizations, *instantaneously and acausally alters what is next possible*. The ontological dualism Res Potentia/Res Extensa would also afford an account on other puzzling aspects of standard actualistic approaches to quantum theory, such as the enigma of the loss of interference in the two-slit experiment, or the conundrum of "null- measurement".

In addition to explaining the nonlocal nature of quantum mechanics, the ontological view based on Res Potentia and Res Extensa, in which Res Potentia replaces Descartes' Res Cogitans (in an alternative dualistic framework of "duality of mutually implicative concepts" as opposed to Descartes' "duality of mutually exclusive concepts"), might also shed light on the "mind-body problem", the most important problem that any dualistic theory of reality is forced to face. In fact, the mysterious interaction between mind and matter finds new explanation as *acausal interplay between actualities and possibilities*, where matter, i.e., actualizations in spacetime (Res Extensa), can instantaneously and acausally alter, via non-local EPR-like affection, what is next possible, i.e., Res Potentia, which in turn, via quantum measurement, generates what is next spatiotemporally actual, i.e., Res Extensa. Quantum measurement, being inherently indeterministic, cannot be assimilated to a causal interaction (in the sense of classical, efficient causation), nor can instantaneous possibility-

conditionalization of potential outcomes by spatiotemporal actualizations (non-local EPR-like affection) be considered a causal connection in the classical way.

While representing a possible solution to the "mind-body problem", the ontological category of Res Potentia does not seem to possess features corresponding to those we intuitively associate with consciousness, meaning by consciousness specifically the phenomenal component of subjective experience that David Chalmers defines as not logically supervenient on physical facts and therefore not reducible to physical (Chalmers, 1996). In fact, one of the main features of Res Potentia is superposition, while the *"qualia," or phenomenal components of consciousness, do not appear to be superpositions*, at least on the basis of the evidence of our subjective first-person experience (the only form of phenomenological evidence). Stuart Kauffman himself, one of the authors of "Taking Heisenberg's Potentia Seriously", pointed out in later articles, precisely based on the fact that qualia are never superpositions, that, unlike other features of "Mind," qualia do not belong to Res Potentia, but arise upon the collapse of the wave function (Kauffman and Roli, 2023).

Furthermore, although Res Potentia is linked acausally, via quantum measurement, with Rex extensa, ensuring the causal closure of Res Extensa (physical causal closure), this linkeage appears necessary: *since Res Extensa is generated from Res Potentia, by spatiotemporal actualization through quantum measurement, Res Extensa cannot exist without Res Potentia*. Indeed, Res Potentia is defined as "mutually implicative" with Res Extensa, which means that Res Potentia cannot exist independently of Res Extensa and Res Extensa cannot exist independently of Res Potentia. This mutual implication constraint seems to rule out the conceivability of a "Res Potentia zombie world", i.e., a world identical to ours in terms of the ontological category of Res Extensa (physical world) but lacking the ontological category of Res Potentia altogether (Chalmers'zombie argument) or provided with a Res Potentia with features inverted from those of our world (Chalmers'inverted spectra argument). Therefore, the ontological proposal of Kauffman, Kastner, and Epperson based on the dualism Res Potentia/Res extensa, while making strides in solving the "mind-body problem," does not seem to help in solving David Chalmers' "hard problem of consciousness," as vulnerable on the same level as physicalism to Chalmers' conceivability arguments (Chalmers, 1995).

Nevertheless, within the transition process from Res Potentia to Res Extensa, that is, within the quantum measurement process, a better candidate than Res Potentia can be discerned as a possible ontological locus of phenomenal consciousness. A third fundamental ontological category, in addition to Res Potentia and Res Extensa, with more closely related features to what we know from direct first-person evidence of the phenomenal component of consciousness.

The transition process from Res Potentia to Res Extensa, that is, the

quantum measurement process, can be distinguished into two fundamental steps.The first step, corresponding to Von Neumann's Process 1 *, concerns the transition from pure states $|\psi> = \sum_i c_i|\psi_i>$, i.e., coherent quantum states (where coefficients arecomplex number and denote the probability amplitudes relative to the basis vectors Ψi) to ensembles of mutually orthogonal (mutually exclusive and exhaustive alternative states), probability-valuated according to the Born's Rule. This first step is described in decoherence-based approaches to quantum mechanics as the transition from a larger, coherent, pure-state density matrix to a reduced density matrix, which mathematically represents the “improper mixture” of preferred states or pointer states selected in Darwinian fashion as being more robust against decoherence (or entanglement), through the cancellation of “off-diagonal” terms representing superpositions of interfering states (Żurek, 2001):

$$|\psi><\psi| = \sum_{ij}|\psi_i> c_i\, c_j^*<\psi_j| \longrightarrow \sum_j |\psi_j> |c_j|^2<\psi_j|$$

The mutually orthogonal preferred states or pointer states generated by decoherence, that can be considered quasi-actualized or quasi-classical states, will be referred to here as *Kolmogorov potentiae*, as they are associated with well-defined Kolmogorov probabilities (real numbers), as opposed to pure potentiae, which are conversely associated with probability amplitudes (complex numbers) and indicate pure coherent states, i.e., superpositions. By the term Kolmogorov potentiae I will also refer to quasi-actualized states predicted by non-decoherence-based approaches to quantum physics, such as the incipient transactions predicted by Ruth Kastner's RTI/PTI, which, however, constitute, according to Kastner, a proper mixture as opposed to the improper mixture of decoherence-based approaches (Kastner, 2014).

The second step in the quantum measurement process, on the other hand, concerns the transition from the ensemble of mutually orthogonal Kolmogorov potentiae, probability-valuated according to Born's Rule, to a single individual outcome:

$$\sum_j |\psi_j> |c_j|^2<\psi_j| \longrightarrow |\psi_{j_0}><\psi_{j_0}|$$

This second step is contemplated only by some interpretations of quantum mechanics (those that predict an effective “collapse of the wave function”) and according to some authors lies outside the very scope of quantum mechanics (Epperson, 2004). Among the interpretations that have explicitly distinguished this second step of quantum measurement from Von Neumann's Process 1, it is worth mentioning that of Henry Stapp, who named this step as Process 3 or “Dirac process” (“the choice on the part of nature”)(Stapp, 2001), and Ruth Kastner's RTI/PTI, who hypothesized a Spontaneous Symmetry

* It should be noted that in several literature the term "Von Neumann's Process 1" coincides with the entire quantum measurement process and not just its first step as in this paper

Breaking to explain the transition from the ensemble of incipient transactions to a single outcome transaction(Kastner, 2017). And it is precisely in this second step of the quantum measurement process that a better "place of consciousness" may lie hidden.

In fact, in the second step of the quantum measurement process (Stapp's Process 3/Kastner's Spontaneous Symmetry Breaking) only one of Kolmogorov's potentiae actualizes by contributing to the constitution of spacetime (Res Extensa), while it is not clear, from an ontological standpoint, where the other Kolmogorov potentiae, those excluded from actualization, should end up. According to Kolmogorov axiom of unit measure, when the actualization in space-time of a single outcome takes place, the actualization probability of the *selected* Kolmogorov potentia becomes equal to 1; concurrently, the actualization probabilities of each *unselected* Kolmogorov potentia become zero. *Once their actualization probability becomes zero, these excluded eigenstates can no longer be part of Res Potentia, because in Res Potentia each state, to the extent that it is possible/potential, must be characterized by a nonzero actualization probability*. Nor can they be part of Res Extensa since they are not fully actualized in the second step of the quantum measurement process. Kolmogorov potentiae excluded in the second step of quantum measurement process seem to remain ontologically poised between Res Potentia and Res Extensa, so much so that it is conceivable to identify a third fundamental ontological category, in addition to Res Potentia and Res Extensa, in which these entities/states may reside from an ontological point of view. I will call this third fundamental ontological category Res Exclusia, as the ontological place housing excluded Kolmogorov potentiae (excluded preferred states/pointer states/incipient transactions), which can be also called quantum exclusions for short.

Some will point out that it is not at all necessary to assume a third ontological category that accommodates quantum exclusions, since it is perfectly conceivable and natural to think that these quantum entities/states, excluded in the second step of the quantum measurement process, simply annihilate from the ontology. They certainly annihilate with respect to Res Extensa, but it does not necessarily follow from this that they annihilate with respect to any ontology. It is natural to think that quantum exclusions annihilate totally from ontology because it is natural to think that Res Extensa is all that exists. But as in the case of Res Potentia this may just be our evolutionary bias in viewing reality. It is natural to think that space-time (Res Extensa) is all there is, but, as Kauffman, Kastner and Epperson point out, "we need to think outside the space-time box."

Just as Heisenberg identified quantum potentiae as a new type of ontological state distinct from the actualized state, it is a matter of conceiving a third type of ontological state, distinct from both the potential state and the actualized state. While Heisenberg's potential ontological state is distinguished as a superposition of potential space-

time outcomes, the third type of ontological state, the quantum exclusion state, can be defined as *a state of space-time outcomes annihilation*, thus as a state of annihilation of the physical properties, adopting Stoljar's notion of t-physical property (Stoljar, 2001), involved in the quantum measurement process that give space-time outcomes. The components of Res Potentia (quantum potentiae) are ontologically distinct from the components of Res Extensa (actualized events in space-time) since they constitute possibilities for actualization of the physical quantities involved in the quantum measurement (e.g., position, momentum, spin) and of space-time itself, while the components of Res Exclusia (quantum exclusions) could be ontologically distinct since they constitute exclusions from actualization of the physical quantities involved in the quantum measurement and of space-time itself. Given that quantum exclusions, as a third distinct type of ontological state, cannot be in space-time and cannot be characterized by the physical quantities involved in the quantum measurement process (precisely because they are defined on the basis of their annihilation), the question is what kind of alternative features or properties this new ontological state of quantum exclusion may exhibit.

A first option is that these ontological states of quantum exclusions have no, effectively, features or properties at all. In fact, a world in which quantum exclusions are totally annihilated by the ontology in the second step of the quantum measurement process (Stapp's process 3 or Kastner's Spontaneous Symmetry Breaking) while not logically necessary as mentioned above, is nevertheless perfectly conceivable. And it is precisely this conceivability of a world without Res Exclusia, the conceivability of a "Res Exclusia zombie world", that makes the ontological framework presented in this paper advantaged over the ontological proposal of Kauffman, Kastner and Epperson, based solely on Res Potentia & Res Extensa, vis-à-vis Chalmers' conceivability arguments. Indeed, in analogy to Chalmers' statement about consciousness, if one can conceive of a "Res Exclusia zombie world", Res exclusia cannot be considered reducible to Res Extensa. *Res Exclusia stands as naturally supervenient on Res Extensa, but not logically supervenient on Res Extensa.* On the contrary, in the proposal of Kauffman, Kastner, Epperson, a "Res Potentia zombie world" does not seem conceivable, since Res Extensa and Res Potentia are ontologically "mutually implicative" and therefore Res Potentia results logically supervenient on Res Extensa (or Res Extensa logically supervenient on Res Potentia). And according to Chalmers to be the "place of consciousness" it is necessary to be naturally supervenient but not logically supervenient on Res Extensa.

The second option is that quantum exclusions take on physical quantities not involved in the quantum measurement process, such as eventual physical quantities undergoing "super-selection rules" (Earman, 2008). However, if quantum exclusions were characterized by such eventual physical quantities undergoing "super-selection

rules", any kind of third-person detectable (i.e., detectable by Physics) causal effect of them on Res Extensa would have already been detected, given the ubiquity of quantum exclusions, which according to the thesis proposed here would accompany the actualization of every spacetime event within every quantum measurement process. No ontological category so ubiquitous could have remained so elusive without being compatible with the conservation laws and symmetries that characterize Res Extensa, that is, the causal closure of Res Extensa, i.e., the physical causal closure. In fact, it does not seem likely that we never noticed Res Exclusia if it is capable of physical interactions, unless such interactions are so weak as to be undetectable with the current tools of Physics (Carroll, 2021).

Moreover, in the ontological proposal based on the Res Potentia/Res Extensa dualism, the quantum measurement process does not only entail, as in the standard interpretation, the actualization of physical properties such as position, momentum, spin, etc., but also, and primarily, the actualization of space-time itself. Therefore, since Res Exclusia is defined in ontological antithesis with respect to Res Extensa, space-time relations must be excluded from Res Exclusia. And given that Physics and the quantities it describes and measures reveal, according to well-established arguments in philosophy of science, essentially spatiotemporal structures or, at any rate, relational/dispositional properties from a spatiotemporal point of view, i.e., spatiotemporally extrinsic properties, it seems more plausible that Res Exclusia is characterized by spatiotemporally intrinsic properties (intrinsic with regard to spatio-temporal relations/dispositions), according to the definition of intrinsic properties already given by Leibniz and more recently, for example, by David Lewis (Lewis, 2001)., on which the entire metaphysical framework of Russellian monism/panpsychism rests (Alter and Nagasawa, 2012). And according to the argument introduced already by Leibniz himself (and, of course, consolidated by several exponents of Russellian panpsychism), the only intrinsic property of which we have evidence, even if only through subjective first-person experience, are the phenomenal features of consciousness (qualia) (Seager, 2006).

Therefore, if we assume that quantum measurement entails the realization, from Res Potentia, not only of Res Extensa (space-time) but also of a third fundamental ontological category called Res Exclusia, it seems reasonable to conclude that Res Exclusia;

- has no features/properties at all, or

- has phenomenal/qualitative properties (qualia).

Such a conclusion opens the door to the suggestion that the mysterious "place of consciousness" so much pursued by scientists and philosophers may be hiding in Res Exclusia itself.

In comparison with Res Potentia, Res Exclusia would have key advantages as ontological "place of consciousness": in addition to less

vulnerability to Chalmers' conceivability arguments, quantum exclusions seem to avoid the feature that makes quantum potentiae, understood as pure states (pure density matrix), irreconcilable with our phenomenological evidence, namely, superposition. In fact, quantum exclusions are derived from the same set of mutually orthogonal quasi-actualized states that are Kolmogorov's potentiae, from which spacetime events are derived (the former by exclusion, the latter by selection), through the same transition process (second step of the quantum measurement process). The quantum exclusions, as well as the spacetime events actualized in Res Extensa, are derived subsets of a set of mutually orthogonal non-superposed states (Kolmogorov potentiae). Therefore, it seems reasonable to consider them to be non-superposed states themselves, given also that the stochastic process of derivation from the set of mutually orthogonal potentiae (es. Stapp 3/Spontaneous Kastner symmetry breaking process) does not seem to affect their non-superposed state in any way, just as it does not affect the non-superposed state of the components of Res Extensa in the transition from Kolmogorov potentiae to actualizations in spacetime. In other words, since both Res Exclusia and Res Extensa are subsets derived from the same set through the same process, it seems reasonable to assume that *the components of Res Exclusia as well as those of Res Extensa are never superpositions*.

At this point, some might ask whether, instead of adding new ontological entities such as quantum exclusions, it is not possible, in an Occam's Razor perspective, to more simply identify the “place of consciousness” in the Kolmogorov potentiae, since they, too, like quantum exclusions, avoid superposition. Still, Kolmogorov potentiae, while never superpositions, are a necessary step in actualizing the components of Res Extensa, so they are logically supervenient on Res Extensa (or rather Res Extensa is logically supervenient on Kolmogorov potentiae). In other words, a “Kolmogorov potentiae zombie world”, unlike a “Res Exclusia zombie world”, is not conceivable. To make a trivial analogy, the Kolmogorov potentiae stand to Res Extensa as the mechanism of action of a drug stands to the effect of the drug, while Res Exclusia stands to Res Extensa as a side effect of the drug stands to its therapeutic effect. Out of billions of possible universes, while the mechanism of action, i.e., Kolmogorov potentiae, is necessarily present in all possible universes, conversely the side effect, i.e., Res Exclusia could be present only in ours: it may be that only in ours did it happen that the process of realization of Res Extensa was associated with the realization of a Res Exclusia with phenomenal qualities. Kolmogorov potentiae are necessary for Res Extensa, while quantum exclusions are collateral, contingent. And according to Chalmers' conceivability arguments, the “place of consciousness” must be contingent and not necessary to that of Physics: naturally supervenient but not logically supervenient. *Quantum exclusions seem to be the only entities/states implicated in the quantum measurement process, that are naturally supervenient but not logically supervenient on Res Extensa.*

The introduction of Res Exclusia, as a third fundamental ontological category, in addition to the two fundamental ontological categories Res Potentia and Res Extensa already proposed by Kauffman, Kastner and Epperson, and its identification as a "place of consciousness," while presenting advantages in terms of less vulnerability to Chalmers' conceivability arguments and with respect to the problem of the apparent irreconcilability between our first-person phenomenological experience and the superposition of Res Potentia, it could, however, be seen as a setback to what is the main innovation contributed by the proposal of Kauffman, Kastner and Epperson, namely the resolution of the mind-body problem through the identification of the consciousness-matter interaction with the interplay "quantum measurement - non-local EPR-like acausal affection". Specifically, in the proposal of Kauffman, Kastner and Epperson, the action of consciousness on matter (consciousness causation), corresponds to quantum measurement process, while the action of matter on consciousness corresponds to the non-local EPR-like acausal affection. With the removal of the phenomenal component of consciousness from Res Potentia and its placement in Res Exclusia, the risk of a Descartes-style dualistic scenario, in which consciousness causation (the basis of human free-will) would remain mysterious, could be reintroduced, since Res Exclusia, unlike Res Potentia, is not directly linked to Res Extensa through the quantum measurement process, as illustrated in Fig.1.1.

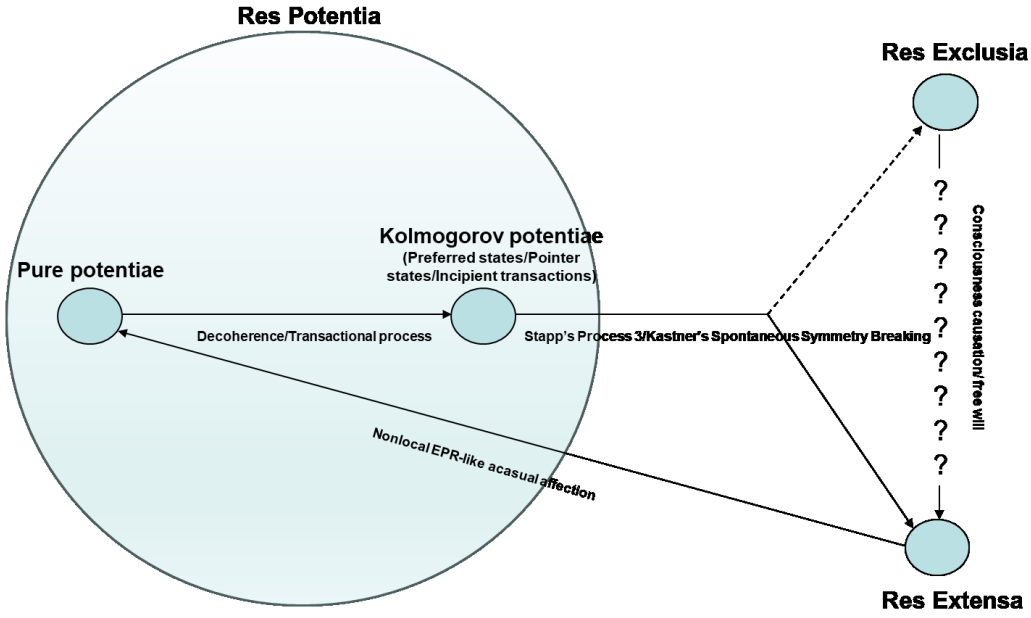

Figure1.1. Diagram illustrating the tripartition of the fundamental ontological realms of Res Potentia, Res Extensa, and Res Exclusia, in which, however, the connection between Res Exclusia and Res Extensa remains mysterious in a Descartes-style dualistic scenario.

However, if we conceive of quantum exclusions as Everettian branches that, deprived of physical quantities due to the collapse of the wave function (which conversely in the many-worlds/many-minds interpretation is not predicted), assume only phenomenal qualities, each outcome in one of these "ghostly" Everettian branches instantaneously affects what is possible to implement next in this given branch, by non-locally and globally altering the superpositions of alternative possibilities for all entangled degrees of freedom relative to this given branch, in the same way that each actualized event in space-time (Res Extensa) instantaneously affects what is possible to actualize next in space-time, by non-locally and globally altering the superpositions of alternative possibilities for all entangled degrees of freedom relative to space-time. For each pure potentia that undergoes "collapse," N+1 nonlocal EPR-like affections are generated, where N denotes the number of Kolmogorov potentiae excluded from spacetime actualization for each quantum measurement (more precisely for each second quantum measurement step). Of these new N+1 nonlocal EPR-like affections, only one instantaneously conditions the alternative possibilities of actualization in spacetime, while the other N nonlocal EPR-type affections instantaneously condition the alternative possibilities each in the respective Everettian "ghostly" branch.

Therefore, it is plausible to assume that there is an instantaneous alteration of Res Potentia by Res Exclusia in *N-to-1 parallelism* with that exerted by Res Extensa. Just as Res Extensa affect Res Potentia non-locally and acausally through the instantaneous conditionalization of the possibilities for *what is next actual in space-time*, so Res Exclusia affects Res Potentia nonlocally and acausally through N instantaneous conditionalizations of the possibilities of *what is next in each of the N "ghostly" Everettian branch* that composes Res Exclusia. If we admit that Res Exclusia is really the "place of consciousness," then the N nonlocal EPR-like acasual affections from Res Exclusia toward Res Potentia indeed take the form of N instantaneous conditionalizations of the possibilities for what is next phenomenal, just as the nonlocal EPR-type acasual affections from Res Extensa toward Res Potentia take the form of instantaneous conditionalization of the possibilities for what is next physical, i.e., actual. So, to distinguish non-local acausal EPR-like affections connecting Res Exclusia to Res Potentia from those connecting Res Extensa to Res Potentia, I will refer to the former as phenomenal and the latter as physical.

N non-local EPR-like phenomenal affections do not alter what is next actual, just as the 1 non-local EPR-like physical affection does not alter what is next phenomenal. Therefore, N non-local EPR-like phenomenal affections have no experimentally detectable effect on Res Extensa, which maintains its causal closure at least at the microphysical level. The N-to-1 phenomenal-physical parallelism scenario illustrated in

Fig. 1.2 is unable to restore at the microphysical level the solution provided by Kauffman, Kastner and Epperson to the mind-body problem, since there are no interactions between the N "ghostly" Everettian branches (quantum exclusions) and the actualized events in space-time, (in the same way that there are no interactions between one branch and another in the "many worlds/many minds" interpretations).

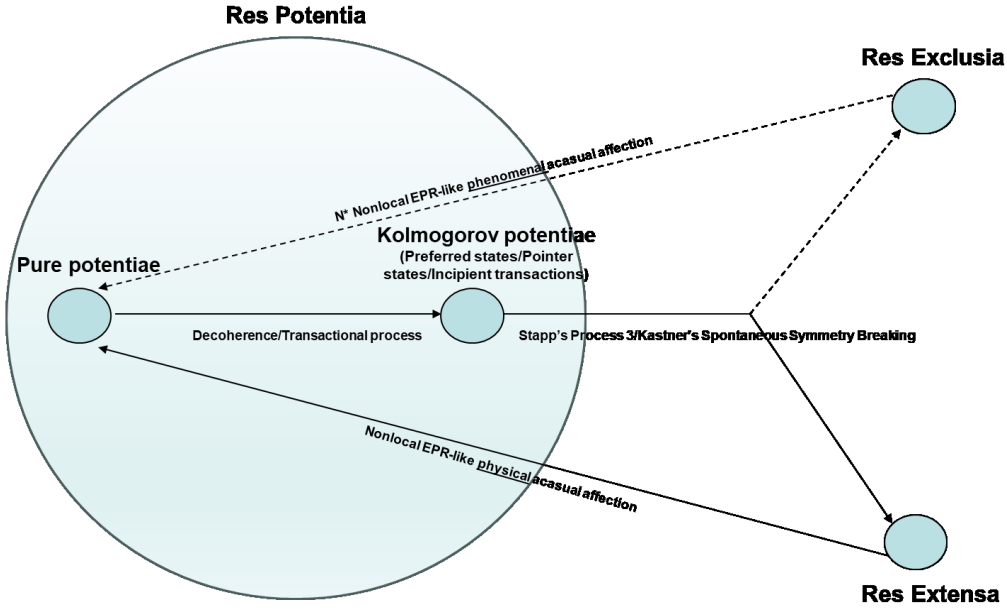

Figure 1.2. Scenario of N-to-1 phenomenal-physical parallelism arising from conceiving quantum exclusions as "ghostly" Everettian branches with only phenomenal qualities.

Nevertheless, the "ghostly" Everettian branches that converge in Res Exclusia are united by being made up of outcomes that are part of the same ontological category, namely quantum exclusions. Within Res Exclusia nothing prevents the occurrence of *highly integrated historical constructs* generated by elementary units coming from N different branches, but belonging to the same ontological category. It is even plausible to argue that at the level of specific highly integrated spatiotemporal constructs, such as the human brain, specific highly integrated historical macrophenomenal constructs within Res Exclusia may find their way to interconnection with Res Extensa, *via nonlocal EPR-like affections additional to those depicted in Fig.1.2.* I will expound on this topic in the next section.

Moreover, the solution to the mind-body problem provided by the ontological view proposed by Kastner, Epperson and Kauffman, in which mind, i.e., Res Potentia, interacts with matter, i.e., Res Extensa, through quantum measurement, seems to be at least incomplete. In fact, from the article "Taking Heisenberg' potentia seriously," it does

not seem clear how the interaction between Res Potentia and Res Extensa, which inevitably passes through the inherently indeterministic second stage of the quantum measurement process, can be reconciled with our phenomenological evidence for consciousness causation and free will. Conversely, the ontological framework based on the introduction of Res Exclusia, while not retaining the solution to the mind-body problem proposed by Kauffman, Kastner and Epperson at the microphysical level, provides for its restoration at the level of specific highly integrated macrophysical systems such as the human brain, at the level of which it is even plausible to explain the causality of the interconnection between the phenomenal world and the material world (as I will argue further in the next section), through a re-proposition of the quantum Zeno effect, however not applied to quantum measurement as in Henry Stapp's conjecture but to the aforementioned additional nonlocal EPR-like affections.

So, while it is certainly a good idea to take Heisenberg's quantum potentiae seriously, it might be reasonable to take quantum exclusions seriously as well.

2. Inside the N-to-1 phenomenal-physical parallelism

In the "Potentia Beyond Quantum Mechanics" section of "Taking Heisenberg's potentia seriously," the three authors highlight the difficulty of moving, within Res Potentia, from the fundamental and quantifiable level of quantum potentiae to the more indefinite "macroscopic possibilities" realm. Of course, the same difficulties are imaginable within Res Exclusia. However, if one believes that Res Exclusia is the "place of consciousness," it is essential to understand how the transition from the fundamental units represented by quantum exclusions to more complex macro-phenomenal facts (which presumably could correspond to the phenomenal experiences with which we are familiar as human beings) might occur within it. The problem of how to move from microphenomenal facts to macrophenomenal facts is well known in philosophy of mind as the "combination problem" (Roelofs, 2019). It is one of the greatest problems facing any panpsychist theory that predicts the existence of fundamental microphenomenal facts associated with even the most basic particles or physical fields, from which it is possible to generate the macrophenomenal facts with which we are familiar in our conscious life as human beings (Chalmers, 2013).

The problem of moving from microphenomenal to macrophenomenal is first to figure out what kind of links between the microphenomenal elementary units can hold them together allowing their combination into complex macrophenomenal facts. Phenomenological evidence from our direct subjective experience does not make intelligible any type of link or microstructural relationship between phenomenal facts,

which appear to us inextricably unitary and intrinsic.

In the case of the tripartite ontological view presented in this paper, the kind of links that hold together microphenomenal facts within Res Exclusia evidently cannot correspond with spatiotemporal links, because spatiotemporal links are actualized together with spatiotemporal events in Res Extensa through quantum measurement. Space-time links and events themselves constitute Res Extensa (one of the interpretations based on the dualism Res Potentia/Res Extensa in which the conception of space-time events/links generation through quantum measurement is most explicit is Ruth Kastner's RTI/PTI) (Kastner, 2016). Since Res Exclusia is realized in quantum measurement in ontological antithesis to Res Extensa, space-time links and events clearly cannot be part of Res Exclusia. Nor can the linking geometry through which to hypothesize a combination between the elementary units of Res Exclusia (quantum exclusions), be mathematically represented by Hilbert space, which instead represents the space of possibilities from which both spacetime (Res Extensa) and Res Exclusia itself are crystallized through quantum measurement. Once again it is necessary to think outside the space-time box, but also outside the Hilbert space box.

In an ontological framework such as the one outlined in this paper, not even the description of a macroscopic object placed in Res Extensa exclusively in terms of its space-time events/links structure is to be considered adequate, rather it is to be considered ontologically partial. In fact, just as every individual spatiotemporal event is the outcome of pathways of "nonlocal EPR-like affections + quantum measurements", similarly a macroscopic spatiotemporal object, rather than simply being a collection/history of spatiotemporal events, can more appropriately be described as *a collection or history of pathways of "nonlocal EPR-like affections + quantum measurements*", according to an approach similar to that provided by interpretations based on decoherent histories (Griffiths, 1984). In a perspective no longer limited to the single ontological category but based on the tripartite ontological framework of Res Potentia/Res Exclusia/Res Extensa, even macro-phenomenal facts as well as macroscopic space-time objects are conceivable as collections or histories of pathways of "nonlocal EPR-like affections + quantum measurements." These will be different histories, since the N "ghostly" Everettian branches that make up Res Exclusia run in parallel with respect to the space-time history (Res Extensa) without any interaction at least at the microphysical level. However, they are histories composed of basically the same kind of pathways, i.e., "nonlocal EPR-like affections + quantum measurements" pathways. Different combinations and different outcomes, but the same type of links between one outcome and the other.

The description of the components of Res Extensa in terms of geometrical spatiotemporal structures, in accordance with Einstein's

general relativity, is an ontologically partial, category-specific description, just as the description of macrophenomenal facts as unitary and intrinsic, on the basis of the phenomenological evidence with which we are familiar in our subjective experience, is ontologically partial and category-specific. The geometrical spatiotemporal description of physics and the phenomenological description of consciousness appear mutually incompatible precisely because they are both ontologically partial and category-specific descriptions, one, that of physics, Res Extensa-specific, and the other, that of phenomenology, Res Exclusia-specific. In fact, we should not be surprised if, on the one hand, phenomenal consciousness, i.e., the first-person epistemic view, appears to be a mystery when investigated with the tools of Physics or third-person science (hard problem of consciousness) and, on the other hand, the mathematical and geometrical space-time description of science, i.e., the third-person epistemic view, proves to be "unreasonably effective"(Wigner,1960) when it is considered a mere abstraction and modeling derived solely from direct human experience and activity. Shifting from an ontologically single-category description to a description based instead on all three ontological categories Res Potentia/Res Extensa/Res Exclusia allows us to overcome the incompatibility between the geometrical spatiotemporal description of Physics and the phenomenological description of experience, bringing both the spatiotemporal links between outcomes within Res Extensa and the mysterious phenomenal links between outcomes within Res Exclusia back to a joined description, grounded on the pathways of ""nonlocal EPR-like affections + quantum measurements", within a metaphysical view evoking Whitehead's theory of process (Whitehead,1929), where "the process", however, unfold in the tripartite ontological realm of Res Potentia/Res Extensa/Res Exclusia.

Therefore, it is feasible to grasp a possible solution to the "combination problem" by conceiving the combination of microphenomenal facts into macrophenomenal facts as a combination history of pathways of "nonlocal EPR-like affections + quantum measurements", as a history that starts from an individual pathway of "nonlocal EPR-like affection + quantum measurement" and arrives at a collection of pathways of "nonlocal EPR-like affections + quantum measurements." The combination history of the pathways of "nonlocal EPR-type affections + quantum measures" in Res Extensa runs parallel to the corresponding combination histories of the pathways of "nonlocal EPR-type affections + quantum measures" in Res Exclusia.

For each outcome in Res Extensa there are N outcomes in Res Exclusia. Put in more metaphorical terms, each event in space-time carries with it N spectra of exclusion in Res Exclusia, "vestiges" of a shared past in quantum superposition (or more correctly vestiges of a shared past as ensemble of Kolmogorov potentiae). Within this scenario of phenomenal-physical N-to-1 parallelism there seems to be no room for any kind of interconnection between the physical space-

time history and the phenomenal histories that take place in the "ghostly" Everettian N-branches in Res Exclusia, while between one phenomenal history and another within Res Exclusia integration is conceivable as between parts of the same fundamental ontological category.

In fact, although the instantiation of the fundamental units constituting Res Exclusia (quantum exclusions) occurs independently according to N "ghostly" Everettian branches, *within Res Exclusia it is conceivable that individual quantum exclusions can integrate into unitary historical constructs.* Unlike the many worlds/minds of the "many-worlds/minds" interpretations, the separation between the N "ghostly" branches is assumed exclusively at the stage of entering, through the process of quantum measurement, of new degrees of freedom (quantum exclusions) into Res Exclusia, while it vanishes once the new degrees of freedom are instantiated within the same ontological category. In other words, quantum exclusions, even if they come from N different branches, once instantiated within the same fundamental ontological category, can contribute to the historical combination of pathways of "nonlocal EPR-like affections + quantum measures," in the same way that within Res Extensa space-time events contribute to the historical combination of pathways of "nonlocal EPR-like affections + quantum measures," up to the eventual combination of highly integrated historical constructs in both Res Extensa and Res Exclusia.

Conversely, the interconnection between spatiotemporal history and the N phenomenal histories is difficult to conceive not only because for each actualized event in Res Extensa, the nonlocal EPR-like physical affection exerted by Res Extensa on Res Potentia entails the cancellation of all N excluded alternatives (N quantum exclusions) from what is next actual, just as the N nonlocal EPR-like phenomenal affections by Res Exclusia on Res Potentia entail the cancellation of spatiotemporal outcomes from what is next phenomenal, but also because Res Extensa and Res Exclusia are composed of ontologically different outcomes, on the one hand spatiotemporal outomes and on the other hand phenomenal outcomes. Furthermore, if the interconnection between spatiotemporal history and N phenomenal histories were ubiquitous in nature, it would conflict with Res Extensa causal closure (physical causal closure).

Therefore, the proposal brought forward in this paper is to conjecture the interconnection between the spatiotemporal history and the N phenomenal histories exclusively at the level of specific highly integrated macrophysical systems, such as the human brain, consistent with our phenomenological evidence of consciousness causation and free will, but also, on the other hand, for loss of consciousness in correspondence with specific physical events that presumably occur at the level of the central nervous system. Spatiotemporal-phenomenal interconnection, then, as an evolutionary

advantage limited to specific highly integrated systems such as the human brain, in the face of non-interacting N-to-1 parallelism instead ubiquitous in nature. In this view, microphysical causal closure (and that of much of Physics) would be preserved and, moreover, the basis for the explanation of consciousness causation and free will at the level of such complex and integrated systems would be laid. However, it remains necessary to figure out how, albeit limited to such complex and integrated systems, the interconnection between spatiotemporal and phenomenal can take place within an ontological framework such as the one outlined in this paper.

One possible hypothesis, which is highly speculative and needs further investigation, is based on the prediction of *additional* nonlocal EPR-like affections between Res Potentia and Res Extensa/Res Exclusia beyond the ones outlined in Fig.1.1 and 1.2. We have already described in the previous section that for each new spatiotemporal event in Res Extensa, as well as for each new N-corresponding phenomenal outcome in Res Exclusia, non-local EPR-like affections are instantiated between the spatiotemporal event (or between the N-phenomenal outcomes) and entangled systems of quantum potentiae in Res Potentia. It is a matter of conjecture that, specularly, for each new quantum potentia (pure quantum state) in Res Potentia, *inverse* non-local EPR-like affections may occur between a new quantum potentia and highly integrated systems (mirroring the entangled systems in Res Potentia) that are part of Res Extensa or Res Exclusia. *The idea is that the more these systems (or rather historical constructs) are integrated and thus resemble, though never be superpositions, entangled quantum systems as the degree of integration of subsystems within the system, the more significant are the inverse nonlocal EPR-like influences affecting these systems in Res Extensa and Res Exclusia (see. Fig.2.1).*

It is presumable that at the level of the human brain these inverse nonlocal EPR-like affections are highly significant. More generally, a way to identify the collections/histories at the level of which the integration of historical constructs in Res Extensa and Res Exclusia is so relevant as to resemble entangled quantum systems and, therefore, to make significant inverse non-local EPR-like affections that would allow interconnecting Res Extensa and Res Exclusia via Res Potentia, might be to extend the concept of integrated information Φ (Tononi, 2016), introduced by Giulio Tononi at the level of spatiotemporal geometric structures, that is, only at the ontological level of Res Extensa, to the Res Exclusia level as well. Similar to Tononi's Φ, the ontologically extended version of Φ could be measured by how much the historical constructs embedded in Res Extensa and Res Exclusia change if they are partitioned (cut or reduced) along its minimum partition (the one that makes the least difference). Other possible criteria for measuring the level of integration of historical constructs within Res Extensa and Res Exclusia could be derived as non-quantum analogs of the quantum concept of entanglement entropy, which is used to quantify the level of integration of quantum

subsystems within many-body entangled quantum systems (Nishioka *et al.*, 2009)

In any case, the inverse nonlocal EPR-like affections would be the fingerprints of the interconnection between the phenomenal world (Res Exclusia) and the material world (Res Extensa). Only where there is a trace of inverse nonlocal EPR-like affections can there be interconnection between consciousness and matter. Specifically at the human brain level, the inverse nonlocal EPR-like affections would provide the interconnection between neural correlates and phenomenal states of consciousness.

In his theory of mind-brain quantum interaction (Stapp, 1993), Henry Stapp distinguishes two actions exerted by consciousness on the quantum brain state, namely a quantum brain state preparation action and a quantum brain state probing action. In the ontological framework proposed in this paper, what Stapp calls the preparation action would coincide with the physical isolation of new quantum potentiae and their consequent interaction through the inverse non-local EPR-like affections with the highly integrated systems that are part of both Res Extensa and Res Exclusia. Unlike Stapp's conjecture, the preparatory action is not exerted by consciousness on the brain, but is instead a physical action (i.e., occurring within Res Extensa) exerted by brain structures that, through the creation of physical barriers deputed to isolation, generate the conditions for the instantiation of new quantum potentiae, of new degrees of freedom in Res Potentia.

The preparation of new quantum potentiae, and thus new histories unfolding in the triapartite ontology of Res Potentia/Res Extensa/Res Exclusia, could take place in the human brain in analogy to the experimental preparation of quantum states in laboratories, through isolation from the surrounding environment within dedicated brain structures, yet to be identified. The preparation of new quantum potentiae, that is, the creation of new degrees of freedom in Res Potentia, could be the key to the interconnection between Res Extensa and Res Exclusia, between the material world and the phenomenal world, through Res Potentia. The basis of this interconnection could be instantiated primarily by the inverse nonlocal EPR affections resulting from the preparation action of new quantum potentia, as illustrated in Fig.2.1 below.

The N-to-1 parallelism between phenomenal and material worlds, ubiquitous in nature, turns into 1-1 relationship at the level of co-presence of highly integrated historical constructs in both Res Extensa and Res Exclusia, via new pure potentiae. New pure potentiae are the gateways through which these pathways of interconnection between phenomenal and material (space-time) can develop. They can develop, however, exclusively where both on one side (Res Extensa/e.g., neural correlate) and on the other (Res Exclusia/e.g., phenomenal state) of the gateway are historical constructs so highly integrated that they

resemble entangled quantum systems.

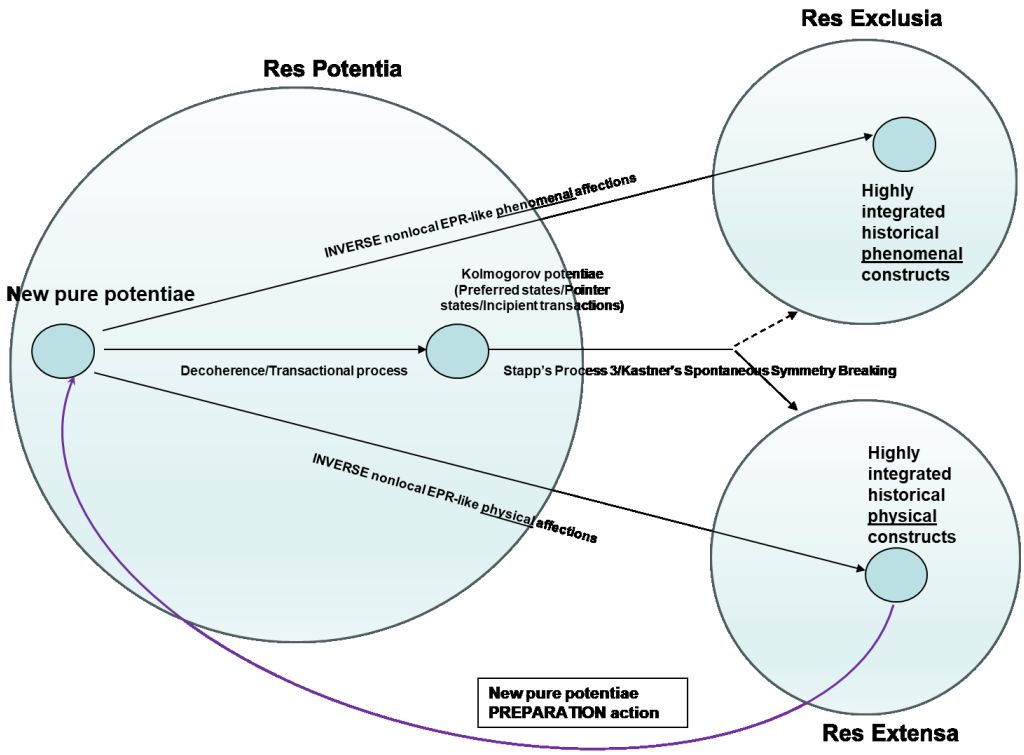

Figure 2.1. Diagram illustrating the instantiation of inverse nonlocal EPR-like affections in co-presence of new pure potentiae in Res Potentia (isolated through physical preparation action) and highly integrated historical constructs in both Res Extensa and Res Exclusia.

Nevertheless, the inverse nonlocal EPR-like affections, exhibiting both outgoing verses from Res Potentia, cannot mediate on their own the interconnection between highly integrated historical constructs in Res Extensa and highly integrated historical constructs in Res Exclusia. For such bidirectional "mind-body" interconnection to be instantiated, a kind of feedback nonlocal EPR-like affection, from the highly integrated historical constructs of Res Extensa/Res Exclusia toward the new pure potentiae, is required. If we consider the highly integrated historical constructs as new integrated units, as new unitary objects (the more integrated, the higher their ontologically extended version of Φ or their non-quantum analog of entanglement entropy) it is plausible to identify them as new unitary degrees of freedom at both the level of Res Exstensa and Res Exclusia, in conjunction with which the feedback nonlocal EPR-type affections, which we might call *re-inverted* nonlocal EPR affections, could be instantiated.

In fact, each type of nonlocal EPR-like affection instantiates in conjunction with the occurrence of new outcomes or degrees of

freedom in at least one of the three fundamental ontological categories and with the arising of highly integrated (entangled-like) systems in the remaining categories. Standard nonlocal EPR-like physical affections instantiates in conjuction with the occurence of new outcomes/degree of freedom in Res Extensa and the arising of quantum entangled systems in Res Potentia (in N-to-1 parallelism with the N nonlocal EPR-like phenomenal affections that instantiates in conjuction with the occurence of N new outcomes/degree of freedom in Res Exclusia). Inverse nonlocal EPR-like physical affections instantiates in conjuction with the occurence of new degree of freedom in Res Potentia (new pure potentiae) and the arising of highly integrated (entangled-like) historical constructs both in Res Exclusia and Res Extensa. The re-inverted nonlocal EPR-like physical affections might instantiate in conjuction with the occurence of a new kind of unitary object both in Res Exclusia e in Res Extensa, namely the highly integrated historical construct (so integrated as to resemble a quantum entangled many-body system and to constitute a new integrated unit or a new unitary degree of freedom), and the arising of new entangled many-body quantum systems evolved from the new quantum potentia in Res Potentia. The re-inverted nonlocal EPR affections will be more significant the more highly historical constructs in both Res Extensa and Res Exclusia are integrated to the point of forming a new integrated unit.

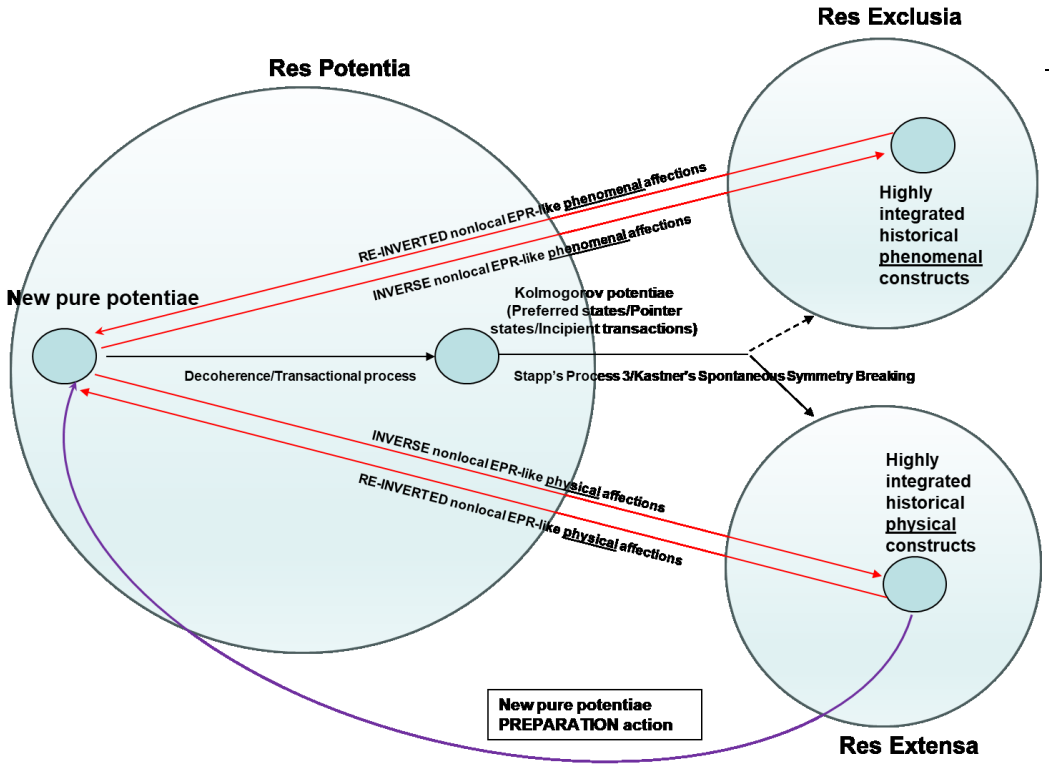

Figure 2.2. Two-way "mind-body" interconnection scenario between highly integrated historical constructs in Res Exclusia and highly integrated historical constructs in Res Extensa through inverse and re-inverted nonlocal EPR-like affections.

With the instantiation of re-inverted nonlocal EPR-like affections, an ontological scenario of vast bidirectional interconnection between "mind and body", between phenomenal states and neural correlates of consciousness, between highly integrated historical constructs in Res Exclusia (i.e. Gestalt wholes) and highly integrated historical constructs in Res Extensa, opens up, as depicted in Fig.2.2.

However, all these pathways of interconnection between Res Exclusia and Res Extensa, via Res Potentia, seem to remain acasual. Missing in the scenario of interconnection between the three ontological categories Res Potentia/Res Extensa/Res Exclusia, depicted in Fig.2.2, is a causal action of consciousness on matter that can explain our phenomenal evidence of free will. What Henry Stapp calls the probing action is missing.

The means of moving from acausal to causal identified by Henry Stapp is the quantum Zeno effect (Stapp, 2005). The "holding" effect called the quantum Zeno effect (a nickname chosen by physicists E.C.G. Sudarshan and R. Misra), due to the repetition of quantum measurements so rapidly that they "freeze" the measurement process on a specific outcome, was conjectured by Henry Stapp to be the basis of the top-down action of consciousness on the brain that is, the so-called probing action of consciousness on the brain. In other words, in the ontological scenario proposed by Stapp, it is the rapid repetition of quantum measurements and outcomes in the material world that underlies the causality of consciousness and, consequently, human free will.

Within the scenario of interconnection between the phenomenal and material worlds proposed in this article, the quantum Zeno effect, that is, the rapid repetition of quantum measurements and space-time events/outcomes in Res Extensa, cannot explain how Res Exclusia can act in causal and controlled way on Res Extensa, cannot explain consciousness causation. In fact, given the pattern of interconnections shown in Fig.2.2, the quantum Zeno effect could explain the consciousness causation only if it occurred, instead of at the level of quantum measurements and outcomes in Res Extensa, at the level of new quantum potentiae and conjugate inverse nonlocal EPR-like affections, and at the level of highly integrated historical constructs (in both Res Extensa and Res Exclusia) and conjugate re-inverted nonlocal EPR-like affections. Within the ontological scenario outlined in this paper, unlike the one conjectured by Stapp and by the three authors of "Taking Heisenberg's potentia seriously", *the causal interconnection between phenomenal and material does not unfold through quantum measurement, but through inverse and re-inverted nonlocal EPR-like affections*.

By means of inverse and re-inverted nonlocal EPR-like affections, the quantum Zeno effect could explain not only consciousness causation, but specularly, also the causal action of the brain on consciousness. Among the plausible causal actions of the brain on consciousness

could also be included the first-person access we experience to the world of phenomenal facts, whether through our sensory perception system or through our introspective awareness cognitive system. In other words, a bidirectional quantum Zeno effect could shed light not only on consciousness causation but also on the question of epistemic asymmetry, that is, why phenomenal experiences are accessible exclusively from the inside, first-person epistemological perspective, as opposed to the geometric-spatiotemporal descriptions of Physics accessible from the third-person epistemological perspective.

Still within this epistemic view, the direct subjective experience (access to Res Exclusia), rather than constituting a “desktop interface”, or a “controlled hallucination” or a neuroidealist a priori veil (Britten-Neish, 2024), would be inextricably conjugated with the brain's cognitive (algorithmic) access to the spatiotemporal reality of Res Extensa, in what might be called a mixed dual access: in which the cognitive access through the sensory organs that takes place all within Res Extensa (in a sort of Kantian acquaintance all within material or spatiotemporal reality) is inextricably mixed with the phenomenal access that instead concerns the action by highly integrated historical constructs within Res Extensa (neural correlates of consciousness) toward highly integrated historical constructs within Res Exclusia (Gestalts), via Res Potentia. In the mixed dual access framework, both first-person subjective knowledge and third-person objective knowledge have both a cognitive access component (all within Res Extensa) and a phenomenal access component (between Res Extensa and Res Exclusia, via Res Potentia).

In fact, mixed dual access occurs as much in the human activities that underlie first-person knowledge, from vision to bodily sensations to introspection, as it does in the human activities that underlie third-person knowledge, that is, the activity of logical-mathematical/hypothetical-deductive abstraction and experimental verification in the laboratory, that is, the scientific method. All conscious human activities (from perception to action) would provide a mixed dual access, as opposed to unconscious human activities that would occur exclusively through the material cognitive structures of the human body and brain, all within Res Extensa. This would open up a possible reformulation of the very concept of science, in which the two fundamental forms of human knowledge are placed on the same plane, without hierarchies or sharp divisions between third-person knowledge through logical-mathematical abstraction, currently considered the only relevant form of knowledge by the scientific community, and the first-person knowledge of direct experience, the primacy of which is instead claimed by proponents of phenomenology since Husserl and Merlau-Ponty.

Some might ask what is the evolutionary advantage of having an ontologically inter-categorical (between Res Extensa and Res Exclusia, via Res Potentia) phenomenal access component of knowledge in

addition to the cognitive access component (zombie access knowledge) that would instead all occur within the same ontological category (Res Extensa). The evolutionary advantage could be the one conjectured by proponents of the predictive processing/coding framework (Millidge *et al.,* 2021) in both cognitive science and neuroscience, namely the minimization of prediction error, or information-theoretic surprise (measured in terms of minimization of free energy) (Friston, 2010) through the exploitation of the "counterfactual richness". However, in contrast to the predictive processing/coding theories, in the ontological and epistemological framework set forth here, the "counterfactual richness" is not to be conceived as a model generated in some unknown way by the neural networks of the human or animal brain, but as an highly integrated historical construct (i.e. Gestalt) within an extraspatiotemporal ontological realm (quantum exclusions could in fact be regarded as the fundamental quantum building blocks of counterfactuals) to which highly integrated neural networks are able to gain access via Res Potentia through inverse and re-inverted nonlocal EPR-like affections.

In any case, the very definition of causal pathways, or more generally the very definition of causality, the nature of which from Hume onward continues to appear mysterious, could be based on the implication (causality) or non-implication (acausality) of the quantum Zeno effect. Of the quantum Zeno effect, which, however, concerns the rapid repetition of new pure potentiae + inverse nonlocal EPR-like affections and highly integrated historical constructs + re-inverted nonlocal EPR-like affections, and not, as Stapp conjectured, the rapid repetition of quantum measurement outcomes.

3. Quantum computing vs qualia societies

The picture that emerges by introducing Res Exclusia as a fundamental ontological category consists of the partitioning of reality into a triad of worlds, in an ontological scenario very close to dual-aspect/neutral monism of a compositional type (Atmanspacher, 2012) in which:

- the *neutral basis* is represented by Res Potentia, mathematically described by Hilbert space.

from which comes the realization in N-to-1 parallelism, via quantum measurement, of:

- Res Extensa, or the material world, that is, the four-dimensional space-time of Einstein's general relativity.

- Res Exclusia, or the phenomenal world of consciousness

Within this tripartite ontological arena, most of the histories that make up the universe are inherently indeterministic, since they pass through the second step of quantum measurement, and do not involve

interconnection between spatiotemporal events and phenomenal facts that confluence in Res Exclusia in N-to-1 parallelism. However, it is plausible to argue that in the course of the universe's evolution, historical constructs may have arisen in both Res Extensa and Res Exclusia that are so integrated (e.g., high Tononi's ontologically extended Φ) that they resemble enantangled many-body quantum systems, while being neither quantum nor superposition, and constitute new integrated units/degrees of freedom in both Res Extensa and Res Exclusia. Such specific properties make possible the instantiation of inverse and re-inverted nonlocal EPR-like affections among these highly integrated historical constructs and new quantum potentiae injected into Res Potentia through a preparatory action mediated by as yet unidentified physical (brain) structures.

The ubiquitous in nature N-to-1 parallelism between the phenomenal and material worlds never provides for contact between the two ontological categories, except in the case of the co-presence of highly integrated physical (e.g., human neural/bodily correlates of consciousness) and phenomenal (e.g., phenomenal components of consciousness, Gestalts) historical constructs, linked together through inverse and re-inverted nonlocal EPR-like affections. At the level of this co-presence mediated by nonlocal EPR-like affections additional to the standard ones, the contact between phenomenal and material world can even become causal through the quantum Zeno effect instantiated at the level of new quantum potentiae and highly integrated historical constructs.

The inverse and re-inverted nonlocal EPR-like affections underlying the interconnection between the phenomenal and material worlds are thus a new possible solution to the centuries-old “mind-body” problem. According to the hypothesis presented here, this type of nonlocal EPR-like affections could be detected experimentally only at the level of the human (or other higher animal) brain or body. Therefore, whether or not inverse and re-inverse nonlocal EPR-like affections can be experimentally detected makes the ontological thesis of Res Exclusia presented in this paper falsifiable.

The question then arises as to whether, in this kind of ontological scenario, the construction of machines endowed with artificial human-like phenomenal consciousness is possible in the albeit distant future. According to the hypothesis presented in this paper, even if in the distant future we come to build a machine that is a spatiotemporally identical copy of the human brain (or human brain + body), this copy while being identical from a geometric-spatiotemporal point of view, will not be identical in terms of the tripartite ontological history of combinations of pathways from which it will be composed, it will not be identical in terms of the history that gave rise to it both from the evolutionary and the developmental (EVO-DEVO) point of view.

The inverse and re-inverted nonlocal EPR-like affections, together with the new quantum potentiae instantiated in Res Potentia and the highly

integrated historical constructs in both Res Extensa and Res Exclusia, are to be considered, according to the thesis presented here, as the fingerprints of consciousness causation. Where there are inverse and re-inverted nonlocal EPR-like affections there is consciousness causation and thus free will. Therefore, the occurrence of inverse and re-inverted nonlocal EPR-like affections could constitute the hallmark of the presence of a higher macro-phenomenal consciousness of human type.

However, robots of the future that will be identical to us humans not only from a geometric-spatiotemporal point of view, but also in terms of number of inverse and re-inverted nonlocal EPR-like affections, while certainly having consciousness causation and free-will, might have a different macro-phenomenal experience from what we are familiar with. A different macro-phenomenal component that is difficult for us humans to even conceive of, just as it is difficult for us to even imagine the subjective experience (what is like to be) of a bat (Nagel, 1974). Robots of the future, to be endowed with phenomenal consciousness similar to ours, will have to be similar to us not only from a geometric-spatiotemporal or by number of inverse/re-inverted nonlocal EPR-like affections, but also in terms of the whole history of pathways that unfolds within the tripartite ontology of Res Potentia/Res Extensa/Res Exclusia. Since the history of combining pathways that gives rise to human mind and brain goes back a long way, from Australopithecus and still back, it seems difficult to imagine even in the most remote future an artificial reconstruction of such a big history.

It will probably be challenging to experimentally verify our technological prediction regarding the phenomenal experience of robots identical to us humans spatiotemporally and by number of inverse/re-inverted nonlocal EPR-like affections but not in terms of the whole history, given the difficulty of experimentally measuring the phenomenal component of consciousness in third person. However, other technological predictions that are more likely to be tested experimentally in the future can also be derived from the ontological hypothesis presented in this paper. For example, certain predictions concerning quantum computing and the future of societies based on quantum computing.

In recent years we have witnessed the rise of quantum brain theories and a growing emphasis and expectation of quantum computing, based on the belief that through the use of quantum computers it will be possible in the near future to build machines that are not only intelligent but also conscious like us. The prediction of the ontological thesis presented here is that the quantum superposition, in the absence of co-instantiation of highly integrated historical constructs in both Res Extensa and Res Exclusia (e.g., co-instantiation of highly integrated neural correlates in Res Extensa and highly integrated phenomenal components/Gestalts in Res Exclusia), and thus in the

absence of inverse/re-inverted nonlocal EPR-like affections, will not only fail to lead to the creation of artificial consciousness, but will lead to a progressive neutralization of the phenomenal component from our lives and societies.

In fact, if by "quantum computing" or "quantum intelligence" we mean the ability to perform functions or calculations through components belonging to Res Potentia, according to the dual-aspect/neutral monist view presented here, quantum computing /quantum intelligence, operating at the level of the neutral constituent of the universe, in performing its functions and calculations would induce a reduction in the generation of qualia compared to the same classically conducted functions or calculations. In other words, according to herein ontological proposal, *macroscopic quantum superpositions, without the co-istantiation of highly integrated historical constructs in both Res Extensa and Res Exclusia, have a neutralizing effect on the generation of phenomenal qualities (qualia).* The more the histories of pathway combinations that develop in the tripartite ontology of Res Potentia/Res Extensa/Res Exclusia go through quantum measurement ("wave function collapse"), the more they generate outcomes in Res Exclusia, that is, phenomenal qualities. Conversely, it can be expected that the more functions (e.g., at the level of the human brain) are assisted by devices based on quantum computing, the less phenomenal components will be generated in association with those functions.

By imagining a future in which quantum computing-based technologies will be able to perform functions or computations that in our subjective experience are closely associated with phenomenal components, such as visual perception or introspective awareness, experimental tests to challenge the hypothesis of the neutral nature of quantum computing are conceivable. Although it will not be possible to challenge this thesis through third-person experimental trials, there may be room in the future for first-person experimental trials comparing the impact on subjective experiences (reported through verbal reports) of devices based on quantum artificial intelligence/quantum computing. For example, it is possible to conceive of future experiments in which neuro-optic chips based on quantum computation and not co-instantiated with highly integrated historical constructs in Res Extensa/Res Exclusia vs. neuro-optic chips based on quantum computation co-instantiated with highly integrated historical constructs in Res Extensa/Res Exclusia are compared. The prediction is that the *non-co-instantiated* chip will result, as long as it is able to maintain its quantum superposition, in an amplification of the visual functional performance of the subject under study without any alteration in the experience of the associated phenomenal component. Whereas an alteration in the phenomenal visual experience would be experienced by the subject under study as soon as the quantum neuro-optic chip is *co-instantiated*, through inverse/reinverted nonlocal EPR-like affections, to highly integrated

historical constructs in Res Extensa/Res Exclusia.

In brief, the greater the penetration of not co-instantiated quantum computing into our brains and societies, the lower the generation of qualitative phenomenal components associated with the functioning of our brains and societies.

Our human history is pervaded by phenomenal qualitative components being that each of us is immersed in a phenomenal inner life. We live in qualia societies. However, the likely coming, in the more or less near future, of quantum computers and devices based on macroscopic quantum superpositions could change the face of our qualia societies, neutralizing the phenomenal components associated with more and more functions of our brains. The domain of Res Potentia will extend more and more at the expense of that of Res Extensa and Res Exclusia. One day, perhaps, our qualia societies will end up becoming neutral societies.

4. Discussion

There are three main quantum ontologies: Heisenberg's ontology, in which quantum measurement generates the events that constitute space-time reality from a more extended reality consisting of quantum potentiae, mathematically represented by Hilbert space. Everett's ontology, which, by not predicting the collapse of the state vector, entails the actualization of all the alternative possibilities that make up the quantum state, which branch into parallel worlds/minds with each interaction with the environment, within a universal quantum wave that unfolds from the very origin of the universe. Bohm's ontology, also without any prediction of state vector collapse, which entails the existence of particles or fields actualized since the initial conditions of the universe (particles/fields initial positions constitute the hidden variables of the theory), guided by a pilot wave coincident with the quantum state, i.e., an ontology inclusive of both quantum pilot wave and material particles/fields since the origin of the universe.

The ontological view presented in this article inherits something from all three of these main visions. In fact, it’s based first on the Heisenbergian categorization of reality into quantum potentiae and actualized events, in the metaphysics of Res Potentia/Res Extensa as further implemented by authors like Stuart Kauffman, Micheal Epperson and, particularly, in Ruth Kastners's RTI/PTI ontology. With respect to Heisenberg's ontology, the herein proposal involves the addition of a third fundamental ontological category consisting of quantum exclusions, i.e., the eigenstates excluded in the second step of the quantum measurement process (Stapp's Process 3 or Kastner' Spontaneous Symmetry Breaking). Such quantum exclusions can be conceived as Everettian branches that, deprived of observable physical quantities due to the collapse of the wave function, assume only phenomenal qualities, so that the proposal presented here can be

described as a “many minds with collapse” or “many ghostly worlds but one” interpretation. Bohm's ontology also predicts the existence of inert or ghostly branches, but these are part of the pilot wave, i.e., Res Potentia, and not of a third ontological category (Res Exclusia) resulting from the collapse of the wave function, which is not predicted by Bohm's theory. Nevertheless, at the level of highly integrated historical constructs such as the human brain, the scenario presented here ends up resembling Bohm's view, predicting a causal interaction of the phenomenal mind on the material brain through the instantiation of nonlocal (inverse and re-inverted) EPR-like affections that might be reminiscent of the interaction between pilot wave and matter particles in Bohm's theory.

The proposal presented in this paper also fits into the line of approaches to solving the mind-body problem based on dual-aspect/neutral monism. Specifically, the proposed ontological scenario identifies the common neutral basis in the state of quantum superposition, i.e., in the world of possibilities or Res Potentia, mathematically described by the Hilbert space. From this common neutral basis comes the realization through quantum measurement of both the material world of Res Extensa coinciding with Einstein's four-dimensional space-time and the phenomenal world of Res Exclusia.

Already Alfred Norbert Whitehead believed that every event in the universe should have both a material objective aspect, measurable with the tools of Physics, and a phenomenal aspect of subjective experience (Whitehead, 1961). The philosopher Thomas Nagel arrived at similar conclusions, proposing that every constituent of matter, beginning with elementary particles (or fields), should exhibit proto-mental properties that, organized into particular complex structures corresponding to equally complex material objects (such as the human brain), could give rise to the phenomenon of consciousness (Nagel, 1979).Consciousness would be a natural phenomenon that originates from a fundamental and ubiquitous proto-phenomenal property, which under particular conditions of configuration and complexity would give rise to the unitary subjective experience that we can access through introspection. Consciousness then as a macroscopic phenomenon, explainable only from a specific ubiquitous microscopic property. For Thomas Nagel both the properties of the material world and the properties of the conscious world must have a common origin. According to hereby proposal this common origin is the quantum measurement. There are similarities also with Chalmers' dual-aspect theory of information, which predicts a dual realization of information, one physical and one phenomenal, from a common information space. Other forms of dual-aspect thinking can be identified in the Pauli-Jung conjecture (Atmanspacher and Primas, 2009) and, more recently, in the work of Primas, who proposes a dual-aspect approach where the symmetry breaking of the timeless and psychophysically neutral level of reality originates through the decomposition of an experiential time associated with the phenomenal component and a physical time

associated with the material component (Primas, 2003).

Compared with other approaches based on dual-aspect or Russellian neutral panpsychism, the N-to-1 phenomenal-physical parallelism proposed here might better explain why the macrophysical structure of the human neural correlates of consciousness results, from the third-person neuroscientific analysis, completely different from the macrophenomenal structure we experience, that is, it could be a solution to the "structural mismatch problem": *the structural mismatch may depend on the fact that the correspondence between microphenomenal and microphysical is N- to-1 and not 1-to-1, and that at the level of highly integrated historical constructs the N-to-1 phenomenal-physical parallelism turns into a 1-to-1 causal relationship between phenomenal mind and material brain*. Russellian panpsychism (or pan-proto-psychism) entails a strict isomorphism between microphysical and microphenomenal structure, since in the Russellian view the microphenomenal realizes 1-to-1 the microphysical. Such isomorphism at the microscopic level ill accords with the evidence of the structural mismatch at the macroscopic level that we have between our first-person phenomenal experience (macrophenomenal facts) and the third-person spatiotemporal description of the brain by neuroscience (macrophysical facts). The same isomorphism between microphysical and microphenomenal entailed by Russellian pan(proto)psychist approaches makes it difficult to explain how the richness of qualitative nuances that distinguish our phenomenal experience can derive from a number of microphenomenal qualities that, having to be in 1-to-1 correspondence with microphysical properties, should be extremely limited (on a par with fundamental microphysical properties), in what is called the "pailette problem". The ontological view presented in this paper, by replacing the 1-to-1 isomorphism between phenomenal and physical entailed by Russellian pan(proto)psychic approaches with an N-to-1 phenomenal-physical isomorphism that turns into 1-to-1 causal relationship only at the level of highly integrated historical constructs, may offer a more feasible explanation for both the "structural mismatch problem" and the "pailette problem" (Chalmers, 2017).

Lastly, the proposal presented in this paper can be included in the strand of hypotheses that consider the creation of quantum states within the human brain essential for the development of the macro-phenomenal consciousness with which we are familiar, such as Penrose-Hameroff's Orch-OR hypothesis (Hameroff and Penrose, 2014) or Henry Stapp's quantum mind hypothesis. With respect to these theories, in which the idea basically carried forward is that an extended macroscopic quantum superposition is necessary for the instantiation of human-like consciousness, that is, that human-like consciousness is the outcome of a macroscopic quantum superposition (for example, in the Orch-OR theory through quantum orchestration within specific nonpolar regions of the brain: microtubules of the soma and dendrites of pyramidal neurons in layer

V of the human cerebral cortex), the thesis presented in this paper does not consider the creation of macroscopic quantum superpositions in the human brain to be necessary for the development of the macro-phenomenal consciousness with which we are familiar. What is considered necessary instead is the creation of new primarily microscopic quantum states (new quantum potentiae isolated from their surroundings or new degrees of freedom/histories in Res Potentia), capable of evolving into entangled quantum systems, in conjunction with the co-instantiation of highly integrated historical constructs in both Res Extensa and Res Exclusia. According to the hypothesis presented in this paper, quantum superpositions in the human brain, however macroscopic and orchestrated, in the absence of conjunction with the other necessary ontological elements (highly integrated historical constructs, inverse and re-inverted nonlocal EPR-like affections) would not only fail to create the macrophenomenal consciousness we are familiar, but on the contrary would cause its neutralization.

The next step in the development of the thesis advanced here will be to define more thoroughly and possibly quantitatively the newly introduced ontological elements, namely quantum exclusions (Res Exclusia), highly integrated historical constructs, new quantum potentiae and inverse and re-inverted nonlocal EPR-like affections, in order to make the proposed hypotheses experimentally testable prospectively in both the field of neuro-cognitive science and computer science.

5. Conclusion

Although the hypothesis advanced in this paper are highly speculative and preliminary, specific new experimental and technological predictions can be made to support the ontological framework proposed. In particular, from the dual-aspect/neutral monist compositional view flows the prediction that technologies based on quantum computing, operating ontologically within the neutral component of the universe, if not implemented in conjugation with highly integrated historical constructs in both Res Extensa and Res Exclusia through the instantiation of inverse and re-inverted nonlocal EPR-like affections, they will not only fail to form the pathway by which to build consciousness-equipped machines in the future, but in perspective could lead to a progressive neutralization of the currently dominant phenomenal component in our minds and societies.

Moreover, the proposal made here is intended to testify to the importance of combining scenarios arising from research into the foundations of quantum physics, particularly the ontological implications underlying the experimental successes of quantum formalism as recently explored, for example, by authors such as R. E. Kastner, M. Epperson and S. Kauffman, with the findings of

investigation in the field of philosophy of mind, with particular focus on dual-aspect monism and Russellian panpsychism based approaches, and in the field of neuroscience of consciousness, with specific reference to Giulio Tononi's IIT, in order to advance new solutions to centuries-old problems such as the mind-body problem.

References

Alter T, Nagasawa Y. What is Russellian Monism? J Conscious Stud. 2012;19(9-10):67-95.

Aspect A, Dalibard J, Roger G. Experimental test of Bell's inequalities using time-varying analyzers. Phys Rev Lett. 1982;49(25):1804-1807.

Atmanspacher H. Dual-aspect monism à la Pauli and Jung. J Conscious Stud. 2012;19(9-10):96-120.

Atmanspacher H, Primas H. Recasting Reality. Wolfgang Pauli's Philosophical Ideas and Contemporary Science. Berlin: Springer; 2009.

Britten-Neish G. Neuroidealism, perceptual acquaintance and the Kantian roots of predictive processing. Synthese. 2024;204(4).

Carroll S. Consciousness and the laws of physics. J Conscious Stud. 2021;28(9-10):16-31.

Chalmers DJ. The Conscious Mind: In Search of a Fundamental Theory. Oxford, UK: Oxford University Press; 1996.

Chalmers DJ. Facing up to the problem of consciousness. J Conscious Stud. 1995;2(3):200-219.

Chalmers DJ. Panpsychism and panprotopsychism. Amherst Lecture in Philosophy. 2015;8:246-276.

Chalmers DJ. The combination problem for panpsychism. In: Brüntrup G, Jaskolla L, eds. Panpsychism. Oxford, UK: Oxford University Press; 2017.

Earman J. Superselection rules for philosophers. Erkenntnis. 2008;69(3):377-414.

Epperson MG. Quantum Mechanics and the Philosophy of Alfred North Whitehead. New York, NY: Fordham University Press; 2004.

Friston K. The free-energy principle: a unified brain theory? Nat Rev Neurosci. 2010;11:127-138.

Griffiths RB. Consistent histories and the interpretation of quantum mechanics. J Stat Phys. 1984;36(1-2):219-272.

Hameroff S, Penrose R. Consciousness in the universe. Phys Life Rev. 2014;11(1):39-78.

Kastner RE. The transactional interpretation of quantum mechanics: the reality of possibility. Cambridge, UK: Cambridge University Press; 2012.

Kastner RE, Kauffman SA, Epperson MG. Taking Heisenberg's potentia seriously. Int J Quantum Found. 2018;4(2):158-172.

Kastner RE. 'Einselection' of pointer observables: the new H-theorem? Stud Hist Philos Sci B. 2014;48(1):56-58.

Kastner RE. On quantum collapse as a basis for the second law of thermodynamics. Entropy. 2017;19:106.

Kastner RE. The emergence of space-time: transactions and causal sets. In: Licata I, ed. Beyond Peaceful Coexistence: The Emergence of Space, Time and Quantum. London, UK: Imperial College Press; 2016.

Kauffman SA, Roli A. What is consciousness? Artificial intelligence, real intelligence, quantum mind and qualia. Biol J Linn Soc. 2023;139(4):530-538.

Lewis D. Redefining 'intrinsic'. Philos Phenomenol Res. 2001;63(2):381-398.

Millidge B, Seth A, Buckley C. Predictive coding: a theoretical and experimental review. arXiv preprint arXiv:2107.12979. 2021.

Nagel T. What is it like to be a bat? Philos Rev. 1974;83(4):435-450.

Nagel T. Panpsychism. In: Nagel T. Mortal Questions. Cambridge, UK: Cambridge University Press; 1979:181-195.

Nishioka T, Ryu S, Takayanagi T. Holographic entanglement entropy: an overview. J Phys A. 2009;42:504008.
Primas H. Time-entanglement between mind and matter. Mind Matter. 2003;1:81-119.
Roelofs L. Combining Minds: How to Think About Composite Subjectivity. New York, NY: Oxford University Press; 2019.
Seager W. The "intrinsic nature" argument for panpsychism. J Conscious Stud. 2006;13(10-11):129-145.
Stapp HP. Quantum theory and the role of mind in nature. Found Phys. 2001;31(10):1465-1499.
Stapp HP. Mind, Matter and Quantum Mechanics. Berlin, Germany: Springer; 1993.
Stapp HP. Quantum interactive dualism—an alternative to materialism. J Conscious Stud. 2005;12(11):43-58.
Stoljar D. Two conceptions of the physical. Philos Phenomenol Res. 2001;62(2):253-281.
Tononi G, Boly M, Massimini M, Koch C. Integrated information theory: from consciousness to its physical substrate. Nat Rev Neurosci. 2016;17(7):450-461.
Whitehead AN. Process and Reality: An Essay in Cosmology. Edited by Griffin DR, Sherburne DW. New York, NY: Free Press; 1929.
Whitehead AN. Adventures of Ideas. New York, NY: Macmillan; 1961.
Wigner EP. The unreasonable effectiveness of mathematics in the natural sciences. Richard Courant lecture in mathematical sciences delivered at New York University, May 11, 1959. Commun Pure Appl Math. 1960;13:1-14.
Żurek W. Decoherence, einselection, and the quantum origins of the classical. Rev Mod Phys. 2001;75:715.