

An Analysis of Transphenomenal Reality in Quantum Mechanics from Modern Perspectives

Modern Perspektiflerden Kuantum Mekanikinde Transfenomenal Gerçekliğin Analizi

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Abstract: This study explores the concept of transphenomenal reality by examining its treatment in the history of philosophy and its relevance to quantum mechanics. The question of its existence remains central in both modern and contemporary metaphysics. The study is divided into two sections: the first traces views from Aristotle, Descartes, Kant, and Locke, highlighting their distinct approaches to transphenomenal reality. The second section compares these classical perspectives with contemporary quantum theories. Aristotle's rejection of radical indeterminacy aligns with the wavefunction collapse in the Ghirardi-Rimini-Weber theory, while Descartes' mechanistic philosophy resonates with Bohmian determinism. Kant's distinction between phenomena and noumena mirrors the measurement problem in quantum mechanics, and Locke's unknown substratum reflects the concept of hidden variables. The study concludes that historical and contemporary views on transphenomenal reality are deeply interconnected.

Keywords: Transphenomenal reality, Substance, Modern metaphysics, Ontology of quantum mechanics, Epistemology of quantum mechanics.



Introduction

Transphenomenal reality denotes that which lies beyond the bounds of human knowledge. Throughout the history of philosophy, this elusive and transcendent realm has been described in various terms—substance, *prima materia*, or the unknown substratum.¹ Despite its ancient roots in metaphysical discourse, it continues to be a focal point in contemporary debates on the metaphysics and ontology of quantum mechanics (QM). Arguments for its existence, whether drawn from recent developments in QM or grounded in philosophical analysis, offer distinct advantages and face particular challenges. While Aristotle and the early moderns frequently employed *reductio* arguments, contemporary philosophers of QM explore a range of theoretical interpretations. This study contends that, despite their apparent differences, these approaches are deeply interconnected.

The study is organized into two sections, each aimed at uncovering the connections between modern and contemporary conceptions of transphenomenal reality. The first section begins by examining Aristotle's views on matter, form, and their composite, showing that his ontology indeed accommodates a transphenomenal reality. While Aristotle is not a modern thinker, his ideas shape the frameworks of many later philosophers. After outlining Aristotle's notion of potentiality as a mode of matter's existence, the discussion turns to the metaphysical views of early modern philosophers on transphenomenal reality. Descartes, drawing on Aristotle, argues for its existence by distinguishing between primary and secondary qualities and employing a *reductio ad absurdum* to infer a transphenomenal realm. Kant, with his distinction between phenomena and noumena, exerts a significant influence on contemporary debates in QM, using a *reductio* argument similar to Descartes' to posit transphenomenal reality. The final modern philosopher discussed is Locke, whose taxonomy of simple and complex ideas, along with his ontology of particular substances and unknown substratum, finds resonances in QM. Like Aristotle and Descartes, Locke also employs a *reductio* argument to advance his proposal of an unknown substratum.

¹ To make it clear that I do not align myself with the philosophical position of any particular modern or classical thinker, I deliberately use the term *transphenomenal reality*.



The second section explores the relationships between these philosophers and their continued resonance within QM. Aristotle's rejection of radical indeterminacy is examined in relation to wavefunction collapse as described in the Ghirardi-Rimini-Weber (GRW) theory. Descartes' mechanistic philosophy finds parallels in Bohmian determinism and aligns with the pilot-wave theory, while his use of a *reductio* argument is echoed in Bricmont's approach. Kant's concept of phenomena resurfaces in QM as measurements, with quantum reality itself corresponding to his notion of transcendent reality. Philosophers such as Bohr, Pringe, and Karakostas underscore Kant's ongoing relevance to quantum reality through different interpretative principles of QM. Finally, Locke's concept of the unknown substratum maps onto the hidden variables in QM, with his philosophical framework offering valuable insights into the epistemology of both macroscopic and microscopic systems.

I. On Modern Ontologies on Transphenomenal Reality

In the *Metaphysics*, Aristotle offers several examples of the unknown substratum and articulates four distinct conceptions of substance: "essence, the universal, genus, and subject or substratum, and then subdivides the fourth further into three: matter, form, and the compound of these" (Chen, 1957, 47). He introduces the matter-form distinction by asserting that "there is a way in which matter, another way in which shape-form, and a third in which the composite, is assigned this role" (Aristotle, 1998, 1029b).² Although Aristotle ultimately holds that substance is the composite of matter and form, in this context the unknown substratum corresponds specifically to matter. To clarify this triad, he uses the example of a bronze statue: "matter [is] the bronze of a statue, while by shape-form I mean the geometry of object's appearance and by the composite the statue itself as a whole entity" (Aristotle, 1998, 1029b). At first glance, the bronze seems to refer to the elemental material itself. However, within Aristotle's ontological framework, matter signifies not the element *per se* but the potentiality of what can be formed from it. He states that "the potential is matter's mode of existence" (Aristotle, 1998, 1071a), thereby emphasizing the logical nature of potentiality. This is further clarified when he explains

² To aid readers in tracking citations across editions, I use the original paginations for all authors such as Aristotle and Kant, whose works include standardized page numbers.



that “the potential indicates what is not necessarily false, in another way what is true and in another still what admits of being true” (Aristotle, 1998, 1019b). Matter, then, is understood as possessing the capacity to become something else through actualization. For instance, “Earth is not, as it is, potentially a statue. To be potentially a statue it must undergo a change and be bronze” (Aristotle, 1998, 1049a).

When analyzed as matter, earth has the potential to be actualized into bronze. Once earth is processed and actualized into bronze, bronze then plays the role of matter for the form of the bronze statue, as it possesses the potential to be shaped or actualized into that form. Aristotle offers textual support for this interpretation in the *Metaphysics*, where he defines potentiality as “a principle of change in something else or in the same thing qua something else” (1998, 1020a). This is why it is bronze, not earth, that “is potentially a statue” (1998, 1065b). Aristotle’s hylomorphism conceives of substance as a composite of matter and form; through substance, one can apprehend the form and one of the potentials of the matter, since it is the form that “grounds the necessary features characteristic of the compound and its matter” (Peramatzis, 2015, 197). I emphasize ‘one of the potentials’ because, for Aristotle, matter in itself cannot be fully known. No matter can be assumed to reveal the entirety of its potential. Such an assumption would imply that the entire logical domain of possibility for a given material—say, bronze—has been actualized: that all possible forms of bronze have been realized and everything that could be made from it has been made. But this is not the case. Matter never discloses the full range of its possibilities through its actual substances, rendering it epistemically transphenomenal, whereas only the composite substances are accessible to us—i.e., phenomenal. The crux of Aristotle’s account is that reality, in its material aspect, remains veiled and epistemically transphenomenal. We can attain knowledge of substances because it is through phenomenal substances that transphenomenal reality partially reveals itself—yet this is always an aspectual unveiling, never a complete one.

In Descartes’ metaphysics, matter appears as extended substance—a conceptual inheritance from Aristotle’s framework. Indeed, as Scarrow observes, when Descartes “discusses substance and substances, he is presenting a version of Aristotelian ontology” (1972, 18). Like Aristotle, Descartes



maintains that extended substance is veiled and cannot be known *per se*. According to him, it is possible to strip material substance of all sensible properties—“weight, color, and all the other properties of this kind which are experienced in material substance” (1982, 41)—while leaving the “substance intact” (1982, 41). This view can be translated into Aristotelian terms: just as matter can be conceptually separated from all forms, Descartes envisions material substance as something that can be conceptually stripped of all attributes, leaving behind a pure, extended substratum. It is crucial to note, however, that extension is not an informative form or property, but rather a tautological and analytic feature of material substance. Descartes reinforces this point by equating extension with material substance: “the idea of that extension which we conceive in any space whatever, is exactly the same as the idea of material substance” (1982, 49). Hence, the assertion that ‘material substance is extended’ does not reveal the essence of material substance; it merely reiterates a definitional identity. In this sense, extension functions not as a predicate that informs us about the substance’s nature—just as, for Kant, existence is not a real predicate—but rather as a formal marker. Material substance thus remains intact, concealed, and inaccessible in terms of its essence; our epistemic access through properties fails to disclose its true nature.

Descartes introduces a significant development to the debate—namely, that the existence of veiled corporeal substance is accessed not through direct perception but through inference. This constitutes the second major point in his account of material substance. While the properties of material substance are accessible through perception, the substance itself remains epistemically veiled. Descartes explains that “substance cannot be initially perceived solely by means of the fact that it is an existing thing, for this fact alone does not *per se* affect us; but we easily recognize substance from any attribute of it” (1982, 23). In other words, our knowledge of material substance is mediated through its attributes, which serve as the phenomenal traces of something essentially transphenomenal. It is on this basis that Descartes formulates his inference regarding the existence of material substance. He argues, for example, that “it would be as contradictory of us to conceive of a mountain without a valley, as to conceive of this concavity without the extension contained in it, or of this



extension without an extended substance” (Descartes, 1982, 48). This form of reasoning is essentially *reductio ad absurdum*: denying the existence of extended substance would entail a contradiction, given that extension itself presupposes a substrate.

This inference appears repeatedly in Descartes’ writings—for instance, in his claim that “nothingness has no attributes and no properties or qualities” (1982, 23) and “nothingness cannot possess any extension” (1982, 48). He concludes that material substance must exist, for if it were nothing, it would possess no attributes whatsoever. The presence of extension, even if analytically tied to matter, is sufficient to refute the possibility of its nonexistence. This interpretation accords with commentators who maintain that properties “can be understood as properties that inhere in substrata” (Sowaal, 2004, 227). In this framework, properties are both perceptually accessible and conceptually tied to something that cannot itself be perceived. It is precisely this interplay that allows for an inferential, rather than perceptual, apprehension of material substance. As Sowaal notes, properties “can be understood as different ways that a substance can be regarded” (2004, 227), explaining Descartes’ reasoning that if it were nothing, then it would not have any property that makes it something.

Ultimately, Descartes’ position is that the properties of material substance are perceivable, while the substance itself is only conceivable (Zepeda, 2014, 28). The essential properties are not identical with the substance but serve as inferential signs of its existence. This line of reasoning culminates in an ontological commitment to the existence of material substance, despite its transphenomenal character.

Kant, much like Aristotle and through a *reductio ad absurdum* argument, affirms the existence—yet solely the existence—of a transphenomenal reality which he terms noumena or things in themselves. As Baldner explains, “the existence of such objects is presupposed by any account of the nature of our experiences of them ... [which does not imply] there is any empirical relation between things in themselves and experiences” (1988, 355). In other words, Kant maintains that the very intelligibility of experience presupposes a non-empirical ground, even though no empirical access to this ground is possible. Before getting into the details of Kant’s



argument for the existence of transphenomenal reality, it is necessary to clarify his distinction between phenomena and noumena.

Kant's distinction between phenomena and noumena rests on the criterion of whether something can be an object of sensible intuition. Accordingly, beings that are given to us through the senses are phenomena and belong to the domain of the phenomenal world, while those that can be conceived but not perceived—noumena—belong to the domain of transphenomenal reality, as understood in the current discussion. Kant explains this distinction as follows: “Nevertheless we call some objects, as appearances, beings of sense (phenomena), [the objects] which are not objects of our senses at all, ... call these beings of understanding (noumena)” (Kant, 1998, A248/B306). In this framework, we have direct epistemic access to appearances because they affect our faculty of sensibility and thus become possible objects of experience. In contrast, noumena, as beings of understanding, lie entirely beyond the reach of sensible intuition, rendering direct epistemic access impossible.

This distinction further implies an ontological asymmetry: whereas noumena possess existence in themselves, independently of our perception (Kant, 1998, A396), appearances exist only conditionally, dependent on being given through sensibility (Kant, 1998, A104). For this reason, Kant affirms that “The sensible world is nothing but a chain of appearances connected in accordance with universal laws, which therefore has no existence for itself; it truly is not the thing in itself” (Kant, 2004, 4:354). At this juncture, two central questions emerge: first, why does Kant posit the mind-independent existence of noumena despite their epistemic inaccessibility? And second, how does he justify this position? Let me begin by addressing the first question, followed by a discussion of the second.

In Kant's framework, there is a metaphysical relation between noumena and phenomena. Kant firmly holds that all appearances are appearances of something, namely, of things that lie beyond the scope of our epistemic access. His reasoning does not proceed from the existence of appearances to the postulation of noumena; rather, the reverse holds: it is because noumena exist that appearances become possible. As he states, “the perception of this persistent thing is possible only through a thing outside me and not through the mere representation of a thing outside me”



(Kant, 1998, B275). In other words, if there were no noumena—no things in themselves or underlying substances—there could be no appearances at all.

This argument contains the core of Kant's response to the second question and reveals that it is, structurally, a *reductio ad absurdum* argument, akin to Aristotle's. Kant asserts, "even if we cannot cognize these same objects as things in themselves, we at least must be able to think them as things in themselves. For otherwise, there would follow the absurd proposition that there is an appearance without anything that appears" (Kant, 1998, Bxxvi). What Kant deems absurd is precisely the claim that there could be appearances without something that appears. The verb 'to appear' logically implies the existence of some thing(s) that appear(s). Yet aside from their existence—which, as Kant famously argues, is not a real predicate—we can know nothing about the nature of noumena: "The non-sensible cause of these representations is entirely unknown to us" (Kant, 1998, A494/B522).

Thus understood, Kant's framework offers crucial insights into the problem of transphenomenal reality. Noumena are conceived as veiled realities—"unknown in themselves, given under no description and caught by no [positive] name" (Loughlin, 1987, 498). That is, much like in the philosophies of Aristotle and Descartes, the transphenomenal reality remains unknowable in itself. What we do access is limited to appearances, which do not yield knowledge of things as they are in themselves, but only of how they appear to us. This view is corroborated by Adams, who emphasizes that "it is clearly Kant's view that we cannot even have (synthetic) beliefs that are theoretically justified about any sort of objects as they may be in themselves" (1997, 805), let alone possess any positive knowledge of them. Consequently, our knowledge of reality is inherently confined to the phenomenal, while the transphenomenal remains fundamentally veiled:

In fact, if we view the objects of the senses as mere appearances, as is fitting, then we thereby admit at the very same time that a thing in itself underlies them, although we are not acquainted with this thing as it may be constituted in itself, but only with its appearance, i.e., with the way in which our senses are affected by this unknown something (Kant, 2004, 4:315).



Although I have presented the arguments for the existence of transphenomenal reality in chronological order—from Aristotle to modern philosophers—now I step back in time to consider the views of John Locke, who preceded Kant. This reversal is intentional: Locke offers a clearer and more direct articulation of the argument for an unknown substratum than Kant does.

Despite being classified as an empiricist, Locke does not confine the origin of knowledge exclusively to sensory experience. In fact, while defending the notion of abstract ideas, he recognizes two “fountains of knowledge, from whence all the ideas we have, or can naturally have, do spring” (Locke, 1997, 109): namely, external sensible objects and the internal operations of our minds. That is, the understanding is nourished not only by data from the senses but also by the mind’s own operations upon that data.

At this juncture, Locke introduces a fundamental distinction between ideas and qualities. The former are mental entities—what the mind perceives in itself—while the latter pertain to bodies. As he explains, “Whatsoever the mind perceives in itself, or is the immediate object of perception, thought, or understanding, that I call *idea*; and the power to produce any idea in our mind, I call *quality* of the subject wherein that power is” (Locke, 1997, 134, italics in the original). This distinction lays the groundwork for Locke’s argument for the existence of a transphenomenal reality—one that lies beneath and beyond our immediate ideas. To unpack the structure of this argument, I must first examine the nature of qualities and how they relate to ideas.

According to Locke’s taxonomy of ideas, simple ideas are derived from basic sensory or reflective experiences—such as red, sweet, or motion. Complex ideas are formed by the combination of simple ideas, for instance, the idea of gold, which includes yellow, heavy, and metallic, or the idea of a horse, which combines tall, fast, and strong, among others. A third category consists of abstract ideas, which are generated by the mind through the process of abstraction—such as justice, murder, or virtue (Locke, 1997, 159–161). As previously mentioned, Locke holds that qualities are features in bodies that have the power to produce ideas in our minds. He insists that such qualities are inseparable from the material substances



in which they inhere—even when those substances are divided beyond the limits of perception. To illustrate this, Locke offers the example of a grain of wheat, instructing that “divide it into two parts, each part has still *solidity, extension, figure, and mobility*; divide it again, and it retains still the same qualities: and so divide it on, till the parts become insensible, they must retain still each of them all those qualities” (Locke, 1997, 135, italics in the original). The critical metaphysical question Locke raises at this point is: In what do these qualities subsist? That is, what is the underlying support or bearer of these qualities—especially once all perceptible features have been abstracted away?

In response to the question of what qualities subsist in, Locke introduces *the idea of particular sorts of substances*. He argues that for every kind of being of which we have an idea—such as “man, horse, gold, water, etc.”—there must be a corresponding particular substance (Locke, 1997, 269). Locke’s argument for the existence of substances underpinning each particular kind is, in part, a reply to a long-standing metaphysical problem. As is well known, ancient philosophers attempted to explain the diversity of qualities in nature by classifying all beings under four fundamental elements: earth, fire, water, and air. However, this classificatory scheme soon proved inadequate, since it failed to account for the observable differences between objects that fell under the same elemental category. For instance, both iron and magnet are classified as forms of earth and share the same arche. Yet, while magnets exhibit attractive and repulsive forces, iron does not—despite being in the same elemental category. To resolve this inadequacy, Locke proposes a more refined ontological approach: namely, that each particular kind of being must have its own distinct underlying substance. Thus, a magnet exhibits attraction or repulsion not because it shares a general elemental nature, but because it possesses specific properties or qualities—such as the power to attract or repel—that belong to a particular substance associated with that kind.

Locke’s account, thus far, has not addressed the deeper metaphysical question concerning the nature of substance itself. His earlier solution—exemplified through the analogy of the grain of wheat—focuses primarily on the observable qualities of objects and presupposes that these qualities are empirically accessible. Even when a magnet is divided into



imperceptibly small parts, each part retains its attractive or repulsive force. This aspect of Locke's metaphysics aligns with the framework of classical mechanics, wherein reality is assumed to be fully accessible through empirical investigation and scientific inquiry is presumed to validate such claims. However, when it comes to the transphenomenal dimension of substance, Locke distinguishes between "the secret and abstract nature of substance in general" (1997, 270) and "*the ideas we have of particular distinct sorts of substances*" (1997, 270, italics in the original). While the latter consist merely in "several combinations of simple ideas" (Locke, 1997, 270), they are nonetheless supported by the former—a general and abstract idea of substance that remains hidden from direct epistemic access. This notion of substance in general corresponds to what is here called transphenomenal reality, since such substances "portray things which subsist themselves" (Bolton, 1976, 489), existing independently of how they appear to us.

The metaphysical connection between particular substances and the idea of an ultimate substance remains unknown; however, Locke offers a compelling explanation of the epistemic and logical connection between them. His account unfolds in two dimensions: the first pertains to how we arrive at the idea of ultimate substance, and the second addresses our motive for positing its existence despite our lack of epistemic access. Beginning with the first, as noted above, Locke maintains that we form the idea of ultimate substance through abstraction. That is, substance is "nothing but several combinations of simple ideas, co-existing in such, though unknown, cause of their union, as makes the whole subsist of itself" (Locke, 1997, 270). This approach differs markedly from the *reductio ad absurdum* strategies employed by Aristotle or Kant. Rather than arguing for the existence of the substance itself, Locke repeatedly emphasizes that what we have is merely the idea of substance (1997, 268, 269, 270), and that its metaphysical reality remains a supposition.

This brings us to the second aspect—our motive for such a supposition. According to Locke, the reason we posit an ultimate substance is not that we observe or deduce its existence, but rather that we cannot conceive how qualities or ideas could exist independently. He contends that "not imagining how these simple ideas can subsist by themselves, we accustom ourselves, to suppose some *substratum*, wherein they do subsist, and from



which they do result; which therefore we call *substance*” (Locke, 1997, 268). In contrast to the abstraction process by which we generate the idea, the motive for positing the existence of substance aligns more closely with the reductio-based strategies found in other modern philosophers: we are compelled to assume the existence of a transphenomenal, though unknowable, reality, “because we cannot conceive how they should subsist alone, nor one in another, we suppose them existing in, and supported by some common subject; *which support, we denote by the name substance*” (Locke, 1997, 269).

2. Revisiting Different Interpretations of QM from Modern Lenses

As noted, the philosophers discussed above bear intrinsic philosophical affinities with specific interpretations of QM. To outline the trajectory of the following analyses: Aristotle’s realist account of substance and his commitment to causal explanation resonate with objective collapse theories—especially the Ghirardi–Rimini–Weber (GRW) theory—which posit an observer-independent mechanism that collapses the wave function and sustains ontological realism. Descartes’ substance dualism, along with his deterministic and mechanical account of *res extensa*, finds a conceptual parallel in the pilot-wave theory (Bohmian mechanics), which postulates a deterministic subquantum reality guiding observable quantum phenomena. Similarly, Locke’s empiricist framework and his argument for an unknowable substratum align with pilot-wave theory as well: in both, what is empirically accessible is limited to the subjective knowledge of secondary qualities or observable outcomes, rather than any direct access to the underlying substance or ontological foundation itself.

To begin with Aristotle and the GRW theory, recall that for Aristotle, substance is not merely reducible to a collection of potentialities; it transcends the mere possibility of form instantiation. Rather, substance embodies both matter and form, where the actualization of forms depends on inherent causal principles immanent to the thing itself. This metaphysical framework—particularly the distinction between potentiality (associated with matter) and actuality (associated with form)—bears a striking parallel to the quantum mechanical distinction between the superposition of states and the collapse into a definite outcome upon measurement. In the GRW theory, this collapse is conceived as an objective, spontaneous process



rather than an observer-dependent one, echoing Aristotle's view that actuality must be grounded in intrinsic causal structures rather than merely extrinsic or epistemic factors.

At this point, let me introduce two fundamental concepts of QM for the unfamiliar reader. Unlike in classical mechanics, the primary qualities of waves and particles are, in quantum theory, conceptually and metaphysically incompatible. That is, an object cannot simultaneously possess both sets of properties in the classical sense. However, QM introduces the notion of *superposition*, in which a quantum object can exist in a state that encompasses both wave-like and particle-like potentials simultaneously. This feature underlies what Bohr formulated as *the principle of complementarity*: quantum objects exhibit mutually exclusive yet jointly necessary descriptions depending on the experimental setup, as exemplified in the well-known case of wave-particle duality. According to this principle, quantum entities behave as waves in some experimental contexts and as particles in others—but never both at once within the same context (Bohr, 1934). Thus, the experiments reveal not the objective, intrinsic properties (primary qualities) of quantum objects as they are in themselves, but rather secondary qualities that are contextually dependent and observer-relative. These shifting appearances from one experiment to another suggest that the underlying quantum reality eludes direct access and cannot be reduced to a single, definite state, even though a definite outcome is observed in each individual measurement.

The GRW model of objective collapse posits that wavefunction evolution³ is not merely observer-dependent but a physical process transforming an indeterminate quantum superposition into a determinate, classical reality. It combines continuous Schrödinger evolution with spontaneous localization events, which occur frequently enough to prevent macroscopic systems from remaining in superposition (Ghirardi et al., 1986, 477–480). These collapses suppress distant superpositions, ensuring the emergence of classical behavior. Thus, superposition pertains primarily to the microscopic level (Ghirardi et al., 1986, 480). Crucially, Aristotle's rejection of

³ While the Schrödinger evolution governs quantum systems between measurements, the spontaneous Gaussian localization process prevents macroscopic superpositions from persisting indefinitely, thereby giving rise to a determinate classical world.



radical indeterminacy and his belief in transphenomenal causes align with GRW's view of collapse as a principled physical process, not an arbitrary one.

Turning to Descartes, the Pilot-Wave theory—especially in its Bohmian formulation—lends itself to a Cartesian reading. Briefly, the theory holds that particles follow definite trajectories, guided deterministically by a hidden wave function. This interpretation posits a continuous interaction between transphenomenal reality and observable phenomena. In contrast to the Copenhagen interpretation's probabilistic stance, Bohm asserts that the observables are:

not properties belonging to the observed system alone, but instead potentialities whose precise development depends just as much on the observing apparatus as on the observed system. In fact, when we measure the momentum 'observable,' the final result is determined by hidden parameters in the momentum-measuring device as well as by hidden parameters in the observed electron. Similarly, when we measure the position 'observable,' the final result is determined in part by hidden parameters in the position-measuring device. Thus, the statistical distribution of 'hidden' parameters to be used in calculating averages in a momentum measurement is different from the distribution to be used in calculating averages in a position measurement (1952, 187).

Bohm argues that observables are not intrinsic properties of the system alone, but depend on hidden parameters within both the system and the measuring apparatus. This suggests that quantum indeterminacy masks a deeper, deterministic structure—echoing Descartes' view of the universe as a mechanistic system governed by laws. The reliance on hidden variables implies a reality beyond direct observation, inaccessible yet fundamentally explanatory.

This aligns with Descartes' view of the physical world, governed by deterministic laws that can be seen as a transphenomenal layer of reality. Descartes argued that the mechanical processes of the universe, though observable, can be deceptive and must instead be understood through reason and mathematical analysis. This distinction between what can be observed and what can be comprehended further suggests the existence of a transphenomenal reality concealed from our perception.



Regarding the transphenomenal reality as *res extensa*, contemporary works support this alignment on the ground of Descartes' reductio argument. Mermin defends an idealist position, asserting that "We now know that the moon is demonstrably not there when nobody looks" (1985, 38). In contrast, Bricmont, citing Mermin, appeals to the reductio argument as a cornerstone of scientific realism. He argues that "nothing emerges out of nothing, just because some limit is taken in an equation. If there is nothing real on the microscopic scale, then there is nothing real on the macroscopic one either" (2016, 92). This principle of *nihil ex nihilo fit* underpins the reductio argument. As Bricmont contends, "the fact that ordinary quantum mechanics does not give us a description of what happens on the micro scale does not prove that such a description is impossible" (2016, 93). In this way, one could, in a Cartesian vein, maintain that the micro-mechanical processes governing the universe can be understood through reason and mathematical analysis.

Kant's influence on the philosophy of QM can be understood through two primary aspects: (1) in QM, measurements are structured forms of experience, manifesting as phenomena, and (2) quantum reality remains veiled as noumena. These two aspects merge, as our knowledge of the noumenal quantum objects is limited to the measurement-dependent knowledge of the quantum phenomena.

Concerning the first aspect, Bohr stresses the individuality of quantum phenomena, arguing that the quantum system under observation cannot be separated from the measuring instrument. He asserts that the "observation of atomic phenomena will involve an interaction with the agency of observation not to be neglected. Accordingly, an independent reality in the ordinary physical sense can neither be ascribed to the phenomena nor to the agencies of observation" (Bohr, 1934, 54). Unlike classical mechanics, where the effect of the measuring device can be isolated, QM presents a different situation: "the interaction between system and measuring instrument does not satisfy the law of continuity of causality" (Pringle, 2007, 78). Pringle further argues that one "cannot synthesize the contingent data of a measurement according to the concept of a cause as the effect of a quantum object in space and time" (2007, 78), ultimately concluding that "spatio-temporal and causal representation of a quantum object is impossible"



(2007, 78). This suggests that, as reality, the domain of quantum objects is inherently veiled and cannot be represented in the same way as classical objects. Karakostas affirms this view, noting that “quantum mechanics has displaced the verificationist referent of physics from ‘mind-independent reality’ to ‘contextual’ or ‘empirical reality’” (2012, 57). This shift marks a transcendental departure from classical realism, positioning quantum objects within an ontology similar to Kant’s noumena. The contextual or empirical aspect of reality emerges “as an abstraction in the human perception through deliberate negligence of the all-pervasive entangled (non-separable) correlations between objects and their environments” (Karakostas, 2012, 57).

Regarding (2), quantum reality remains veiled as noumena. Neo-Kantian interpretations of QM carefully distinguish their position from subjective idealism. Quantum reality exists independently of us; however, there is a Kantian balance between this veiled reality and its measured-phenomenal aspect. While quantum reality exists mind-independently, our knowledge is limited to the observed and measured phenomena. In fact, QM “establishes an area of *physically* necessary ignorance (the quantum ‘world’), just as Kant’s Critical philosophy establishes an area of *transcendentally* necessary ignorance (the transcendent/noumenal ‘world’)” (Palmquist, 2013, 300). d’Espagnat further explains that “at least according to the veiled reality conception, even though these micro or macro objects depend on us they (just as rainbows) do not depend exclusively on us. Their existence (as ours) proceeds from that of ‘the Real’” (2006, 348). Similarly, Bitbol asserts that QM does not describe reality as it is but as it appears to us under measurement, emphasizing that measurement instruments are inseparable from the observed phenomena (1996, 211-261).

Heisenberg’s uncertainty principle further supports the concept of veiled quantum reality, aligning with Bohr’s complementarity principle discussed earlier. According to Heisenberg, one cannot simultaneously measure both the position and momentum of a particle. There is an inverse relationship between the precision of position and momentum measurements (Heisenberg, 1927), which means that quantum reality is veiled—measurement tools, inseparable from the observed phenomena, provide limited information rather than revealing the quantum reality as it truly is.



Heisenberg's principle, alongside the unobservability of quantum objects, leaves the noumenal reality as "completely unknown (*or unknowable*)" (Palmquist, 2013, 293).

Regarding Locke's concept of the unknown substratum and its epistemology, three key parallels emerge. First, much like Locke's substratum underlying observable qualities, the Bohmian interpretation of QM posits a guiding wave—an underlying reality that determines particle motion and gives rise to measurement outcomes, akin to Locke's ideas. Second, both frameworks address epistemic access: Locke holds that we know the substratum only through secondary qualities, while Bohmian mechanics contends that the guiding wave is not directly observable but inferred through its effects—our grasp of reality is reconstructed from phenomena shaped by an underlying, inaccessible structure.

As both themes converge on the tension between epistemology and ontology, they can be addressed in a unified framework. Recall that Locke posits an ultimate substance—a veiled ontological foundation beneath observable qualities. Similarly, the Bohmian interpretation of QM proposes a hidden layer of reality, embodied in the guiding wave, which underlies the outcomes of measurements. Bohm's critique of the standard Copenhagen interpretation, represented by Bohr, lies in its epistemic modesty: while consistent, it excludes other equally coherent frameworks that admit additional ontological elements—namely, hidden variables. In such alternative systems, it is possible to express the laws governing the individual members of a statistical ensemble in terms of hidden variables (Bohm, 1952, 168). The usual interpretation simply omits these variables, assuming they are irrelevant or non-existent. Bohm, by contrast, maintains that hidden variables are essential for an accurate description of reality at small scales (1952, 169). He concludes that "our present quantum-mechanical averages are similarly a manifestation of hidden variables, which have not, however, yet been detected directly" (1952, 168). In this light, the totality of hidden variables can be seen as corresponding to Locke's unknown substratum: both constitute veiled realities that, while not directly accessible, underpin observable phenomena. Even though Bohm argues that his interpretation is a better alternative to the orthodox view, he admits that we remain ignorant of "the precise initial conditions of the particle" (1952, 171).



However, unlike Locke, Bohm does not appeal to the *reductio* argument. His reasoning is grounded in physical limitations of our perceptual and cognitive apparatus. Our senses—vision, for instance—can only process a limited quantity of quantum data at a time. Even if the brain could register the states of particles and their wave functions, our embodied condition imposes restrictions. In such a context, Bohm and Hiley suggest that “the overall quantum ‘world’ can manifest itself in the more limited classical ‘sub-world’” (1993, 147). Translated into Lockean terms, the ultimate substance manifests itself through the secondary qualities of particular substances. This parallel offers a philosophical foundation for Bohmian QM, wherein the plurality of particular substances coexists with the notion of an underlying, unified reality. Dürr and colleagues affirm this view, arguing that the Bohmian framework supports an ontological picture in which the apparent multiplicity of phenomena is grounded in a deeper unity, akin to Locke’s idea of the ultimate substance (Dürr and et al., 2013, 26–29).

Conclusion

In conclusion, the exploration of transphenomenal reality—from Aristotle to Locke—reveals enduring philosophical concerns that remain highly relevant in contemporary interpretations of quantum mechanics. This study has shown that questions about the existence and nature of a reality beyond epistemic access have not only persisted through centuries of metaphysical thought but have also found new expression in quantum theory. By examining the positions of Aristotle, Descartes, Kant, and Locke, we see how their arguments—whether based on *reductio* reasoning, ontological dualisms, or epistemological limits—echo in modern debates on quantum reality. The conceptual bridges between classical metaphysics and quantum interpretations underscore the continued significance of philosophical inquiry in scientific contexts. The metaphysical structures proposed by early thinkers continue to inform and shape our understanding of the quantum world, where the distinction between what is observed and what lies beyond observation remains central. Thus, this synthesis of historical and contemporary thought not only deepens our grasp of transphenomenal reality but also reaffirms the philosophical roots of science’s most perplexing questions.



References

- Adams, R. M. (1997). Things in Themselves. *Philosophy and Phenomenological Research*, 57(4), 801–825.
- Aristotle. (1998). *The Metaphysics* (H. Lawson-Tancred, Trans.). Penguin Books.
- Baldner, K. (1988). Causality and Things in Themselves. *Synthese*, 77(3), 353–373.
- Bitbol, M. (1996). *Schrödinger's Philosophy of Quantum Mechanics*. Springer.
- Bohm, D. (1952). A suggested interpretation of the quantum theory in terms of “hidden” variables I. *Physical Review*, 85(2), 166–179. <https://doi.org/10.1103/PhysRev.85.166>
- Bohm, D., Hiley, B. J. (1993). *The Undivided Universe: An Ontological Interpretation of Quantum Theory*. Routledge.
- Bohr, N. (1934). *Atomic Theory and the Description of Nature*. Cambridge University Press.
- Bolton, M. B. (1976). Substances, Substrata, and Names of Substances in Locke's Essay. *The Philosophical Review*, 85(4), 488–513.
- Bricmont, J. (2016). *Making sense of quantum mechanics*. Springer.
- Chen, C.-H. (1957). Aristotle's Concept of Primary Substance in Books Z and H of the *Metaphysics*. *Phronesis*, 2(1), 46–59.
- Descartes, R. (1982). *Principles of Philosophy* (V. R. Miller & R. P. Miller, Trans.). Kluwer.
- d'Espagnat, B. (2006). *On Physics and Philosophy*. Princeton University Press.
- Dürr, D., Goldstein, S., Zanghi, N. (2013). *Quantum Physics Without Quantum Philosophy*. Springer.
- Ghirardi, G. C., Rimini, A., & Weber, T. (1986). Unified dynamics for microscopic and macroscopic systems. *Physical Review D*, 34(2), 470–491. <https://doi.org/10.1103/PhysRevD.34.470>
- Heisenberg, W. (1927). Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik. *Zeitschrift für Physik*, 43, 172–198.



- Kant, I. (1998). *Critique of Pure Reason* (P. Guyer & A. W. Wood, Eds. & Trans.). Cambridge University Press.
- Kant, I. (2004). *Prolegomena to Any Future Metaphysics* (G. Hatfield, Ed. & Trans.). Cambridge University Press.
- Karakostas, V. (2012). Realism and Objectivism in Quantum Mechanics. *Journal for General Philosophy of Science*, 43(1), 45–65.
- Loughlin, G. (1987). Noumenon and Phenomena. *Religious Studies*, 23(4), 493–508.
- Mermin, D. (1985). Is the moon there when nobody looks? Reality and the quantum theory. *Physics Today*, 38, 38–47.
- Palmquist, S. R. (2013). Kantian Causality and Quantum Quarks: The Compatibility between Quantum Mechanics and Kant's Phenomenal World. *Theoria: An International Journal for Theory, History and Foundations of Science*, 28(2), 283–302.
- Peramatzis, M. (2015). What is a Form in Aristotle's Hylomorphism? *History of Philosophy Quarterly*, 32(3), 195–216.
- Pringe, H. (2007). *Critique of the quantum power of judgment: A transcendental foundation of quantum objectivity*. Walter de Gruyter.
- Scarrow, D. S. (1972). Descartes on His Substance and His Essence. *American Philosophical Quarterly*, 9(1), 18–28.
- Sowaal, A. (2004). Cartesian Bodies. *Canadian Journal of Philosophy*, 34(2), 217–240.
- Zepeda, J. (2014). The Concept of Space and The Metaphysics of Extended Substance in Descartes. *History of Philosophy Quarterly*, 31(1), 21–39.

Öz: Bu çalışma, transfenomenal gerçeklik kavramını felsefe tarihinde nasıl ele alındığını ve kuantum mekaniğiyle olan ilişkisini incelemektedir. Bu amaçla çalışma iki bölüme ayrılmaktadır: Birinci bölüm, Aristoteles, Descartes, Kant ve Locke'un görüşlerini ele alarak transfenomenal gerçekliğe yönelik farklı yaklaşımlarını ortaya koymaktadır. İkinci bölüm, bu klasik bakış açılarını çağdaş kuantum teorileriyle karşılaştırmaktadır. Aristoteles'in radikal belirsizliği reddetmesi, Ghirardi-Rimini-Weber teorisindeki dalga fonksiyonu çöküşüyle,



Descartes'ın mekanist felsefesi ise Bohmîyen determinizm ile örtüşmektedir. Kant'ın fenomenler ve noumenler arasındaki ayrımı, kuantum mekaniğindeki ölçüm problemiyle paralellik gösterirken, Locke'un bilinmeyen alt yapısı, gizli değişkenler kavramına yansımaktadır. Çalışma, tarihi ve çağdaş bakış açıları arasında derin bir bağlantı olduğunu sonucuna varmaktadır.

Anahtar Kelimeler: Transfenomenal gerçeklik, töz, modern metafizik, kuantum mekaniğinin ontolojisi, kuantum mekaniğinin epistemolojisi.

