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ARTICLE

Quantum Monadology: Glimmers of a Metaphysics of Universal Harmony

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Abstract

Despite its extraordinary predictive power, quantum mechanics has been hailed as a paradoxical, self-contradictory theory of nature. How does it question the intelligibility of physical worldview? The wave-particle dualism, the incompatibility of physical quantities, the complementarity between the space-time description and the causal description of phenomena question key-notions of the traditional metaphysics, such as substance and cause, but they also call attention to the vital dialectical contrast between the continuous and the discrete, the infinite and the finite, consciousness and matter, and to the essential relational character of measuring, seeing, and knowing. Does quantum physics also question the Western way of thinking? The aim of this article is to show how *quantum monadology* not only breathes new life into Leibniz's and Nicholas of Cusa's monads, but also echoes Nishida's 'dialectical monadology' and orients our gaze towards a metaphysics of universal harmony, i.e., a metaphysics of the *dialectical universal* or a metaphysics of indeterminacy.

When Albert Einstein suggested considering light as composed of quanta, he was aware of the difficulty of reconciling the description of light as a wave phenomenon (electromagnetic field) with the image of light as a corpuscular phenomenon (beam of photons). Conceiving light both as a wave and a particle seemed to challenge human understanding: the difficulty of reconciling mutually exclusive aspects in the behavior of nature stands as a conundrum at the heart of quantum physics.

If the corpuscular nature of light could be read as a revival of Newton's theory, the wave-like behavior of matter that was revealed by quantum interference phenomena was completely unexpected and puzzling. In classical physics, interference is a property of *waves*. A wave is a perturbation of a continuous medium (field), or of a medium composed of myriads of point-like particles. Surprisingly, in quantum physics interference is something that applies to a *single* photon. As the well-known double-slit experiment shows, the interference pattern that takes shape on a detector-screen when both slits are open, and it is not observed which slit the photons are passing

through, results from a process of accumulation of *independent single events*. Trajectory and interference are *incompatible observable quantities*, jointed by Heisenberg's uncertainty principle. This 'intertwining' of attributes is expressed in the wave-particle dualism. The contradiction involved, apparent or real depending on the interpretation, is resolved by Niels Bohr with a 'complementarity principle' according to which certain aspects characterizing the classical description of phenomena cannot be observed simultaneously.

> The very nature of quantum theory thus forces us to regard the space-time co-ordination and the claim of causality, the union of which characterizes the classical theories, as complementary but exclusive features of the description, symbolizing the idealization of observation and definition respectively. (Bohr 1961: 54–55)

The wave-particle dualism corresponds, on a formal level, to the *complementarity* between the deterministic description of the evolution of unobserved physical systems, given by a complex wave function, and the probabilistic prediction of the possible values of observable quantities. Only at the moment of measurement does the superposition state described by the wave function dissolve or *collapse* into the state corresponding to the value of the measured observable, and only then can a *property* be assigned to the system. What is then the collapse? If it is a real phenomenon, it is legitimate to ask whether the particle – a material thing – did not possess that property before the measurement. In Bohr's opinion, only at the moment of measurement, when an 'irreversible act of amplification' takes place, does a quantum phenomenon become a phenomenon; it is only because of the *act* of measurement that physical reality takes shape, that *what is potential becomes actual*. But for Einstein, this would mean renouncing the very concept of physical reality, abandoning all-natural causality, and accepting the idea that God 'plays dice with the world'. How could the actual Infinite escape its own self-determination?

At first, the idea of an essential indeterminacy, inherent to the physical world, seems to demotivate any appeal to ontology and *geometric reason*. Thus, the very possibility of a metaphysics understood as ontology seems to vanish. The very notion of necessity, both scientific and logical, that the philosophical tradition had largely embraced is questioned, while the possibility of a *metaphysics of indeterminacy* is foreshadowed. Indeed, what emerges from the quantum measurement problem is a kind of structural indeterminacy[1], inherent in the very notion of physical reality. It is not surprising then that quantum indeterminism is unacceptable and baffling, not only to Einstein.

Nevertheless, in a perspective free of ontological or metaphysical prejudices and dogmas, that idea might seem not entirely illegitimate. Looking back at the history of philosophy, the seed of a *quantum* science of nature – i.e., a physics detached from solid foundations in a theory of immutable being – was sown, if not in the Pythagorean Garden, then in the garden of monads. And it has found resonances in worldviews in

[1]On this topic, see Fetcher & Taylor (2021).

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which contradiction is not a stumbling block to reason, but a *conditio sine qua non* for a dialectic of *acting* and knowing.

In the following, looking back and also looking East, an attempt will be made to disclose the harmony of quantum indeterminacy in the light of a 'dialectic of nothingness', and to show how the idea of a 'dialectical monadology' – as an ideal junction between Nicholas of Cusa, Leibniz, and the Japanese philosopher Nishida Kitarō – can lead to a quantum monadology. The goal is to broaden the horizon to a worldview that, without renouncing a speculative framework, takes shape and consistency against the background of a metaphysics of nothingness, or a *metaphysics of indeterminacy*. This is a metaphysics that can be labelled 'poor', insofar as it questions the linearity of the ratio seeing/knowing, being/existing, and regards the dialectical opposition of matter and spirit, immanent and transcendent, many and one, finite and infinite, as an 'absolutely contradictory self-identity' functional to the very possibility of knowing.

Looking back

Quantum theory has been viewed as a Pythagorean theory of nature in so far as the very notion of *quantum* stems from the Pythagorean doctrine that the essence of things dwells in numbers. Thus, it should come as no surprise that those ancient mathematicians were the first to encounter *incommensurable* quantities and see the measurement problem. Then, it was in Plato's doctrine of ideas that the gulf between the finite and the infinite made way for a dialectical contrast between the visible – i.e., 'observable' – and the intelligible, between the immanent and the transcendent.

In the shadow of form

Plato did not fail to see that the separation between the visible world and the intelligible world, between the immanent form of perceivable things and the true transcendent form of ideas, between a being that is always identical and a world that continually becomes something else, if radically assumed, negates not only metaphysics, but also a theory of knowledge that has the character of truth. There could be two ways out: that of a *metaphysics of participation* (μέθεξις) that admits a weak, simply paradigmatic causality, for which ideas function as explanatory and paradigmatic principles of the things that participate in them, and that of a *metaphysics of light* that involves a third, intermediate entity between the ideal and physical sphere.

The need for an *intermediary* agent becomes the key to the construction of the cosmos described in the *Timaeus*. The god of *Timaeus* does not create from nothing: he is a craftsman whose work presupposes an ideal form and a material that is flexible to form. The creative act is conceived as a transmission of form from the invisible ideas to matter. Because the generation of the cosmos is an act, it requires an agent. Its role, in the *Timaeus*, is twofold: to give form to the visible world, and to give life to the invisible form. Since eternal, unchanging forms cannot generate what is always changing, an artificer is needed.

Space and time enter the scene in different ways. Space appears as a 'formative principle' inherent in matter itself. Time, on the other hand, did not exist before heaven, it is created as a moving image of eternity. Its nature is related to the peculiar intermediate essence that the demiurge assigns to the soul (*Timaeus*, 34c-35a). Just as the

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human soul dwells in the body and transcends it, the world soul expands from the center of space-matter and envelops it externally, like a veil. In the intelligible world, every form is eternal and, therefore, has all its properties simultaneously. In the visible world, however, the nature of things is realized in the course of time. Time was born together with heaven: there was no *empty*, eventless time. The generation of the cosmos is not an event at the beginning of time: it is an *act*, the act that marks the *vanishing point* of eternity.

In the shadow of light

In the *Timaeus*, the idea of the Good guides the demiurge to give visibility to the beauty of geometric forms by ordering the universe, in the 'measure of the possible': it is not the light of the sun, but it performs its function (analogically or anagogically). With the demiurge leaving the scene, the function of intermediation passes to the light. According to the biblical narrative, there is no amorphous, chaotic universe before creation: divine artifice originates from nothing. To give form, God must create 'something extended' and the light to make it visible.

It is Robert Grosseteste who, following the Platonic ideal of mathematical reason and operating a synthesis between the cosmogonic doctrine of *Genesis* and the Aristotelian cosmology of *De caelo*, in his *De luce*, posits the theoretical conditions of a metaphysics of light that he presents as an explanation of the 'beginning of forms'.

> The first corporeal form which some call corporeity is in my opinion light. For light of its very nature diffuses itself in every direction in such a way that a point of light will produce instantaneously a sphere of light of any size whatsoever, unless some opaque object stands in the way. […] But a form that is in itself simple and without dimension could not introduce dimension in every direction into matter […] But the first form cannot introduce dimensions into matter through the power of a subsequent form. Therefore, light is not a form subsequent to corporeity, but it is corporeity itself. (Grosseteste 1942: 10)

If the dialectical contrast of matter-form, visible-invisible, many-one, characteristic of classical metaphysics, had required a form of mediation to be resolved, that need for mediation is dispelled by a monistic theory for which corporeality corresponds to the extension of matter, even though, as a simple substance, matter is devoid of any dimension. To extend itself, matter must take on the nature of light, which is to propagate in all directions. But the transition from the invisible, or inextended, to that which has dimension – the *quantum* – requires a *leap*, a process of *infinite* multiplication of the simple substance of light.

> This extension of matter could not be brought about through a finite multiplication of light, because the multiplication of a simple being a finite number of times does not produce a quantity (*quantum*)… However, the multiplication of a simple being an infinite number of times must produce a finite quantity, because a product which is the result of an infinite multiplication exceeds infinitely that through the multiplication of which it is produced. (Grosseteste 1942: 11)

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Interpreting with scientific sensitivity the vision of created nature of the founder of the Franciscan Order to which he belongs, Grosseteste seeks the meaning of spiritual reality in the physical world. Light is not only the first substantial form of created beings, but also the element that connects the being of God with the being of created nature. Light is the analogue of divine grace, it is an *active principle* that, thanks to the laws of geometric optics, can be analyzed mathematically. It is against this background, thanks to the development of studies on *natural perspective*, that light can acquire full dignity as a natural phenomenon and instrument of science. The metaphysics of participation and the metaphysics of mediation, intrinsic to the Platonic conception, coalesce into a conception of metaphysics very close to a theory of knowledge detached from ontology and rather interested in declining aspects of the theological and mystical tradition. One might also think of a kind of *symbolic mathesis*.

Towards a dialectical monadology

If, in line with the Platonic tradition, the separation between the world of ideas and the sensible world creates the space in which mathematical entities dwell, it is in symbolical mathematics that Nicholas of Cusa identifies the key to attain the 'unattainable truth'. According to Hermann Weyl:

> With regard to the essence of mathematical knowledge, considered as a symbolical *mathesis universalis* [universal knowledge], Cusanus had visions, and expressed ideas, which do not recur in more determinate form until the days of Leibniz; visions, indeed, of which we seem to be acquiring full understanding only at present in the latest attempts to master the antinomies of the infinite by purely symbolical mathematics. (Weyl 2009: 39)

Divine monad and numbers

For Nicholas of Cusa, unlike Platonists, the world-soul does not exist: 'only God is "world-soul" and "world-mind" – in a manner whereby "soul" is regarded as something absolute in which all the forms of things exist actually' (*De docta ignorantia*, II.9). But if 'the Absolute God cannot be commingled with matter and does not inform [it]' (ibid., III.2), the crucial issue is to spell out what Nishida would call a 'contradictory self-identity' of creator-*and*-creature (as will be shown in the next section). On the one hand, the mediation function of *Timaeus*' demiurge is dissolved; on the other hand, the actual infinity of God is absorbed or 'contracted' into the finite human body of the Son, the divine Word. The medium is none other than God Himself, but God in the figure of the Logos. The Father incarnating Himself in the Son, not the Father *per se*, becomes the medium between the absolute transcendence of the infinite Unity and the contingency of the world. Along with John's Gospel – 'In the beginning was the Word, and the Word was with God, and the Word was God […] Through him all things were made' – the conception of generation, the so-called 'Hellenic creationism', is transformed into the notion of *filiatione*, which, according to Nicholas of Cusa, is nothing but the passage from the ineffable level of onto-theology to a symbolic metaphysics that, unable to comprehend being, sees it through its image (*De filiatione dei*, 1445).

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As he clarifies to his fellow-brother Conrad of Wartberg, divine filiation makes it possible to achieve a *theosis* through which it becomes possible to consider the One in the diversity of modes. Although it is one with the Father ('of the same substance as the Father'), it is unknowable (beyond the limit of rational power), as *filiatione* makes itself accessible as a manifestation of God, as if God were the image reflected on the surface of a purest flat mirror. When brought from the theological to the cognitive plane, the relationship between the Father and the Son is the relationship between the One (the divine monad) and numbers:

> [The situation] is as if someone were to speak of the innumerable unit, which, nevertheless, is every number; and in every number the innumerable unit is counted. […] For example, the number ten has from the unit all that which it itself is […] all that which it is is unit. Nevertheless, the number ten does not give number to the unit; but, rather, the innumerable unit remains uncountable in terms of the number ten, just as it is also uncountable in terms of any other number, for it is exalted above all numbers. (*De filiatione dei*, IV.72)

The very concept of *filiatione* is captured in the relationship between the monad and numbers. Although mathematical numbers, generated by human mind, are not the divine number, they are images of the divine number (*De mente*), and this entitles one to speak *symbolice et rationaliter* of the number that proceeds from the divine mind.

Elaborating on his symbolic reflection on the divine, Nicholas of Cusa recognizes that Aristotelian logic, which is a logic of the finite, symmetrical to the theory of being addressed in Book Gamma of *Metaphysics*, cannot lead to 'unconditioned divine being' beyond all conceptual distinctions of discursive knowledge. However, mathematics and its symbols allow him to overcome a mystic conceived of as a passive contemplation, unable to come to terms with the intellectual act through which the divine reveals itself to us. The true love of God is *amor Dei intellectualis*. 'We witness here', as Hermann Weyl notes, 'a strange occurrence, unique in the history of philosophy: the exactness of mathematics is sought not for its own sake, nor as a basis for an explanation of nature, but to serve as a foundation for a more profound conception of God' (Weyl 1932: 39).

Living mirrors

In *De docta ignorantia*, the symbolic function of mathematics allows the Platonic notion of 'otherness', i.e., the clear cut between the truth of things and the truth of ideas, between the finite and the absolute, to be revived and made productive.

> The finite intellect, therefore, cannot know the truth of things with any exactitude by means of similarities, no matter how great. For the truth is neither more nor less, since it is something indivisible… *The intellect is to truth as the polygon is to circle*… For the truth is absolute necessity, which can never be more nor less than it is; whereas our intellect is only possibility. *(De filiatione dei,* I.3*)*

And yet, the ideal vision conveyed through mathematical forms and symbols suggests that the limitations of human perception and measure can be offset.

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The unbridgeable gulf between the finite limits of reasonand the absolute necessity of truth becomes functional to cognitive experience itself. A metaphysics of necessary being, which provides foundation to a cognitive reality that could not be otherwise, is replaced by a metaphysics of mind which guarantees the validity of experience and gives knowledge its relative truth. Even though the truth of things is attained as it is by the divine intellect alone, human understanding partakes of that truth 'with a degree of *otherness*'[2]. It is the notion of *contractio* that translates in gnoseological terms the Platonic and neo-Platonic ontology of participation.

Concerning the relationship between human limits and the perfect truth, Nicholas of Cusa observes that the human mind, although incapable of reaching the ultimate precision, this being the domain only of God, can apply its notion of finite-infinite measure to the external world and see the harmony of the universe because of its creation according to proportion which is the number of the divine mind. If God's way of thinking and creating the ordered multiplicity is through the number, the human way of knowing is through the science of number. Thus, the metaphysics of the mind becomes engaged with a theory of measurement that can handle the disproportion between the finite and the infinite without having to deny it.

According to Nicholas of Cusa, the metaphysics of light of Grosseteste and the Franciscan masters promotes the encounter between theosis and theophany, legitimizing a theory of knowledge that finds its most pregnant formulation in the metaphor of mirrors. Forms appear equal in straight mirrors but appear to be less than equal in curved mirrors. Nicholas of Cusa sees the loftiest light, in which God Himself appears, as a Mirror-of-truth that is completely straight and most perfect, and all creatures as mirrors with different degrees of contraction and differently-shaped curves. Among these creatures, the intellectual natures are considered free living mirrors, capable of curving, straightening, and cleaning themselves. His claim is that One and the same reflected-brightness appears variously in all mirror-reflections. In the first, most straight reflected brightness, all the other mirrors appear as they are; in each of the other mirrors (contracted and curved), things appear in accordance with the condition of the receiving mirror. Receiving the first Mirror's reflected light, the intellectual living mirror also receives the Mirror of truth as it is and beholds (within itself) the truth of all the mirrors.

> For the more simple and less contracted and more bright, clean, straight, just, and true [the intellectual mirror] is, the more clearly, joyously, and truly it will behold within itself God's glory and all mirrors. Therefore, in that first Mirror, [viz.,] the Mirror-of-truth (which can be said to be God's Word, Logos, or Son), the intellectual mirror obtains sonship, so that (1) it is all things in all things, and (2) all things are in it, and (3) its kingdom is the possession, in glorious life, of God and all things. (*De filiatione dei*, II. 67)

Looking East

Nicholas of Cusa's methodological reflection finds an intriguing resonance in Nishida Kitarō's thought. Nishida takes Nicholas of Cusa's conception of God to its limits, as he

[2]On the notion of eternal 'otherness' in Nicholas of Cusa, see Cassirer (1972: 23–24).

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clearly sees God's absolute infinity as 'absolute nothingness'[3]. It is through a relentless effort to see 'the form of what has no form', to grasp that which gives life to form, that Nishida achieves his notion of 'place' (*basho,* 場所). His philosophical reflection focuses on the nature of the self and looks for the standpoint 'from which everything emerges and to which everything returns' (Yusa 2002: 301). His main goal is to capture 'that which establishes the operation of consciousness itself' beyond, or prior to, the operation of consciousness. Thus, the concept of *basho* allows the nature of consciousness to be viewed no longer as an acting force, or *will*, but as a *seeing place*. Accordingly, the transformation 'from that which is created to that which creates' (Yusa 2002: 272) shows that *basho* determines itself; the form determines the form itself. In the self-expression of the world by means of symbols, the way of the subject contrasts the way of the predicate, and the way of the object contrasts the way of acting. Being can be considered in either direction, but that which exists and moves by itself, namely, the true reality, dwells in neither of them: it exists in the contradictory identity of the two directions. Hence, *basho* is 'the dialectical universal', namely, the place of the 'absolutely contradictory self-identity'.

> 'Nothingness' (*mu*) means 'absolutely contradictory self-identity' (*zettaimujunteki jikodōitsu*). From this perspective, all that exists is 'being' and 'non-being' at the same time. 'Absolute Nothingness' is that which is totally transcendent of everything and yet that by which everything is established. (Yusa 2002: 303)

Logic of place

Nishida's logic of *basho* is a logic of 'encompassment', which proceeds through concentric levels of awareness until the *basho* of absolute nothingness is reached: from the *basho* of being, which takes in the natural world, through the *basho* of oppositional nothingness, which embraces the world of awareness, to the *basho* of absolute nothingness, which encompasses the intelligible world. Crucial, at the intermediate level of his system, is the notion of *self-awareness* or *self-awakening*, which consists of the self seeing itself within itself. Nishida does not describe the logic of *basho* as a logic of abstraction, and gradually makes explicit its essentially dialectical character. Unfolding the logic of *basho* means unfolding the essential structure of reality, 'seeing the form of the formless'. Thus, the logic of *basho* combines a logic of *seeing* with a dialectic of *acting*, the intellectual vision of Nicholas of Cusa's living mirror with the relational being of quantum phenomena.

Two central questions in Nishida's philosophical reflection – 'What is the role of the self in the knowing act?' and 'What is true reality?' – could not remain unaffected by quantum physics. To clarify his view that 'at the root of the *agent* there is always a *seer*', Nishida (2023) considers how physical phenomena are formed and what their background is. He holds that what makes time, space, and physical forces thinkable is the self-awareness of the will. The dialectical opposition of the self and the world mirrors the dialectical opposition of space and time, of matter and force. The *dynamic*

[3]See Nishida (1990, § II.10 and § IV.4). As Nicholas of Cusa remarked, 'the great Dionysius says that our understanding of God draws near to nothing rather than to something (Nicholas of Cusa, *De docta ignorantia* I.17.51).

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nature he bestows on *intuition* gradually assimilates the essential character of a physical field wherein forces dwell. Thus, it is the idea of a force field in which self-awareness finds its acting place that guides Nishida to his idea of *basho.* In addition to the physical concept of field, Plato's χώρα and Leibniz's *analysis situs* have certainly fuelled the idea of *basho*. In *basho,* the geometrical network of monads seems to emerge from the 'formative matter' (χώρα) of *Timaeus*. As Nishida observes: 'At first, I took the word "place" (*basho*) from the εἶδος of Platonism. But it can also be thought of as the *topos* of today's topology, which developed from the idea of force field or physical space' (Nishida, 'Logique et mathématiques' [1944], in Nishida 2001, X: 59).

Dialectical monadology

In *The System of the Universals in Light of Self-Awareness*, the encompassment levels correspond to encompassing relations between the individual and the universal. Nishida comes to identify a type of universal that, not opposing but encompassing the individual, makes conceptual knowledge of the individual possible. In contrast to Aristotle's view of the universal resulting through successive degrees of abstraction, for Nishida, a universal must include the 'principle of individuation' and retain the singularity of the individual. Therefore, the individual becomes the self-determination of the 'concrete universal'. In fact, the most universal is not the most abstract but rather the most concrete. The concrete universal is not determined from without, rather it forms itself from within. Thus, the *basho* of absolute nothingness becomes the *basho* in which relationships between individuals and between the individual and the universal (world) come about. Here the logic of the 'absolutely contradictory self-identity' comes into play. It can be seen as a structure that operationally relates contradictory elements, as each one denies itself in order to refer absolutely and dialectically to its opposite. In this perspective, the logic of the absolutely contradictory self-identity is a dialectical logic, a dialectic of *basho*. It clarifies how continuity and discontinuity are both inherent in the 'determination of (absolute) nothingness as self-awakening'.

As for the question of what is real, Nishida argues that the real world must be a world of individuals, as 'the universal is mere potentiality' (Nishida 1970: 163). But the existence of the individual can only be conceived in relation to other individuals, since one single individual is meaningless (like one point or *situs*). From the physical to the historical world, the notion of the 'absolutely contradictory self-identity' is intended to spell out the meaning of an absolutely independent individual entity, which is independent insofar as it opposes another in the way it acts and expresses itself reciprocally; in fact, the individual, however independent and self-determined it may be, is never an isolated system. The question is traced to Leibniz's monadology. If Leibniz must appeal to pre-established harmony to account for the apparent action of monads, the dynamical nature of absolutely contradictory self-identity allows Nishida to construct a *dialectical monadology*[4].

> The centre of my thought lies in the dialectical movement of the world, from that which creates to that which is created, and in the contradictory self-identity.

[4]For a more extensive discussion, see Berland (2023).

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> The centre of Leibniz's world lies rather in the world of compossibles, which he thought of as material. My thinking is therefore not spiritualist in the sense of monadology, but it is not materialist either. The world is self-forming as the world of the contradictory self-identity of the many and the one, and the individual acts as an act of expression. In the dialectic world, things are expressive. (Nishida 2000 [1938]: 252)

Thus, Nishida's dialectic maintains the tension between contradictory terms, bringing out both their contradictions and their self-identity. Here is the full meaning of 'absolutely contradictory self-identity' (Tremblay 2000: 114). It is a 'dialectic of acting' to be distinguished from both the Hegelian dialectic (of logos) and the materialist dialectic. Rather, it may be seen as a 'logic of concomitance' akin, in many ways, to Bohr's 'logic of complementarity'[5].

Quantum multiverse

It is a great achievement of quantum theory to have read the divide between observable quantities and continuous transformations as a dialectic contrast and to have made it the source of physical meaning. Although a quantum system evolves with continuity in space and time, its observables, as mentioned above, have a discrete spectrum of values. Therefore, a measurement on the system provokes a change of its state: a collapse from the superposition state of (*potentially*) measurable values, described by the continuous wave function, into the state corresponding to the 'real' measured value. It is only because of measurement that a random element, an element of *necessary* randomness, enters the evolution of the system. To eliminate randomness would be to eliminate the very act of measurement. Something similar is indicated by Nicholas of Cusa's *oculus vivus*: insofar as it makes every intellectual operation possible, it inevitably leads it back to a particular mode, which does not belong to the object, but to the subject that knows and performs measurement (*De fil.*, II.67). Closing the living eye of the Cusanian observer would allow a return to a metaphysics of absolute truth to be contemplated. Closing that eye would mean closing off one's personal experience, no longer being able to see any *object*.

But in the quantum world, to eliminate the act of measurement is not just to remove visibility from the object and cancel the cognitive experience of the subject, it is also to cancel reality itself, to cancel all ontology. Couched in Nishida's language, the contradictory self-identity of the self and the world means that the self cannot be severed from the world.

> In the world described by quantum mechanics there is no reality except in the *relations* between physical systems. It isn't things that enter into relations but, rather, relations that ground the notion of 'thing'. The world of quantum mechanics is not a world of objects: it is a world of events. Things are built by the happening of elementary events. (Rovelli 2016)

[5]For a detailed discussion, see Tremblay (2018).

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If there exists no element of physical reality prior to measurement, then it is the act of measurement that *generates* the value of a physical quantity, that brings any element of physical reality into temporal existence. In Bohr's view, for an irreversible amplification from potential to actual to occur, the quantum system (micro) must interact with a classical object (macro), the measuring device or observer. But how are we to distinguish between quantum and classical objects? After all, any demarcation criterion – micro-macro, reversible-irreversible, physical-mental – may be arbitrary and, for this reason, the logic of complementarity may appear incoherent. A coherent way out of the impasse has been proposed by Hugh Everett III and involves a kind of quantum *monadology* to be set in the *basho* of absolute nothingness.

Back to Leibniz

According to the American physicist John A. Wheeler, Leibniz came close to Bohr's ideas on quantum measurement, up to the point that one could speak of a 'quantum monadology' (Furlan 2020). In fact, Wheeler seems to pinpoint Leibniz's monad as a key to enter the quantum world. What Leibniz wrote about the monad would be more relevant to the 'quantum phenomenon' than to anything one has ever called an 'atom'. A conjecture that is certainly daring at first becomes even more so when tracing Leibnizian monadology to the *visio Dei intellectualis* involved in Nicholas of Cusa's monad and his symbolic mathematics and metaphysics. Hence, a no less daring possibility of comparing those problems of logical consistency, such as the dual nature of the Word, to the problems at the heart of quantum theory. For Wheeler, particles, force fields and space-time itself are only intermediate entities in the construction of the universe. The general principle of modern physics is the quantum, and the elementary *yes-no* quantum phenomenon is the building element: 'It is an abstract entity. It is not localized in space and time. Its interior is inscrutable, untouchable. The combinatorics of such entities is a new and rich problem' (Wheeler 1982: 570). How does it relate to the monad?

Leibniz describes a monad as a *simple substance* and a *unity of perceptions*. As a simple substance, it enters compounds and has no parts (like a point). As a unity of perceptions, it is not properly a thing that is perceived, but rather a 'subject' that perceives (similar to consciousness or the eye). As elements of things, the monads are 'the true atoms of nature'; and yet, because they have no parts, they have neither extension, nor shape, hence they are not observable. Since monads cannot differ in magnitude, they must have some 'qualities' or modes. Since they have no windows, their 'natural changes' must come from an *internal principle*. Leibniz makes it clear that there must be diversity (*un détail*) in that which changes; more precisely, 'this diversity must involve a multitude in the unity'. Finally, 'the *passing state* which involves and represents a multitude in the unity or in the simple substance is nothing other than what one calls *perception*' (*Monadologie*, 13–14).

The plurality of relations (or states) characteristic of each monad is an ideal perceptual multiplicity, corresponding to that of a quantum observable. As an example of a simple substance with an internal diversity, Leibniz mentions first the soul (*Mon. 16*). Then, claiming that monads have in themselves a certain perfection, a sufficiency that makes them the sources of their internal actions, he speaks of 'incorporeal automata' (*Mon. 18*). Precisely because of this multiplicity in unity, resulting from an internal

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principle of continuity and change, the substance of the monad could recall that of the 'elementary quantum phenomenon' before an act of measurement determines the transition from the possible to the real. In some sense, it is as if the constant transition state of the monad – as a state of superposition (unity of perceptions) – were captured in a 'wave function'. But it would be a transcendent function, unable to explain its *self-collapse* from the compossible unity to the individual acts, i.e., the 'contradictory self-identity of the many and the one'.

How do we explain the 'collapse' from the metaphysics of monads to the system of nature? How can a monad have perceptions (acquire or transmit information) without interacting with the outside world? But a monad does not *have* perceptions, it *is* a unity of perceptions. Leibniz states his view as follows:

> I believe that the entire universe of created things consists only in simple substances or monads, and in collections of them. These simple substances are what one calls mind in us and in higher intelligences (*les Genies*), and soul in animals. […] One cannot even conceive of there being anything other than this in simple substances and, consequently, in all of nature. The collections are what we call bodies. (Letter to Nicolas Remond [July 1714], in Leibniz 1969)

Stability, universality, necessity do not concern bodies, which are not substances, but well-founded phenomena: different appearances for different observers, and yet related insofar as they come from the same foundation, like different views of the same city. For Leibniz, all monads are living mirrors, devoid of material substance, unlike the material points of Newtonian physics: 'No more is it necessary to conceive monads as points in a real space, as moving each other, as pushing each other, or as touching each other; it suffices that the phenomena make it appear so, and this appearance has some truth to the extent that the phenomena are founded'.

Interestingly, the 'visual geometry' underlying monadology involves a radical change in perspective from Newtonian and even Cartesian conception of space and geometry. In Leibniz, space becomes *system*, and its structure stems from the *analysis situs*. As in Leibniz's *Characteristca geometrica*: 'Situs *est relatio unius ad aliud secundum locum*. Motus *est mutatio situs continua*' (Leibniz 1995: 304). A *situs* is thought of qualitatively according to congruence: it is that which can only be distinguished from an infinity of others congruent to it solely by *co-perception*. The *situs* therefore acquires dignity as a geometric *quantity*. If space is a structure, it is so insofar as it is the space of all possible relative positions of points[6]; in Nishidian terms, as the field (*basho*) of the play of the individual and the universal.

Movement, which the Western metaphysical tradition has considered identifiable with a becoming incompatible with the logical and ontological necessity of science and reaches its maximum demonstrative cogency in Euclidean geometry, comes to be identifiable with a becoming inherent in science and geometric reason. As the science of the whole of space and the dynamic concept of congruence, geometry is based on movement. In contrast to Descartes' analytical geometry, which 'uses

[6]For a comprehensive analysis, see Debuiche (2013).

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imagination in the wrong way', Leibniz's 'geometric analysis' is functional to the construction of a true *science of imagination*. What Leibniz has in mind is a productive, non-figurative imagination, an art that, by assigning appropriate characters to the qualities that differentiate similar points through geometric analysis, leads to understanding the secrets of nature. In this perspective, geometric analysis reflects the logical and metaphysical background of the entire Leibnizian universe, prefiguring both modern topology and Nishida's concept of *basho*.

Just the relative and perceptive essence of the *situs* expresses the substance of the monad, the formative energy of movement inherent in the notion of congruence has a logical foundation in the principle of continuity. The possibility of organizing monads in a system thus derives from their essentially relational character, i.e., their *perceptive correlation*. But the influence of one monad on another is only ideal. A created monad cannot have physical influence on another, except through the mediation of God.

> For God, comparing two simple substances, finds in each reasons that require him to adjust the other to it; and consequently, what is active in some respects is passive from another point of view: *active* insofar as what is known distinctly in one serves to explain what happens in another; and *passive* insofar as the reason for what happens in one is found in what is known distinctly in another. (*Mon. 52*)

God alone knows from the beginning of things what every monad rightly demands (*Mon. 51*). In fact, God is the 'primitive unity', the first simple substance, from which all monads are generated (*Mon. 47*). It is by virtue of *universal harmony* then that each substance expresses exactly all the others through the network of relationships it has with them. Each substance expresses the whole universe from a different perspective. The different perspectives of Leibnizian monads recall what Nicholas of Cusa described as different images of the same light of truth, reflected by different mirrors, of unequal purity. Images that are as equal – and yet as different – as numbers, which have nothing in themselves but the monad that generates them all, different from each other and different from the absolute transcendent unity. But for Leibniz, as for Nicholas of Cusa, universal harmony requires the intervention of God.

Universal wave function

Just as in monadology, in the quantum universe, the transition from the infinite multitude of possible states to the state ascertained by a measurement involves a leap. Excluding the mediation of a transcendent agent, the multiplicity of possible states must correspond to a multiplicity of observers, a multiplicity of individual acts of measurement. While this correspondence makes it possible to resolve the theoretical superposition of possible states in the *quantized* experience of real values, it renders the description of the observer-observed system incoherent. This is why Hugh Everett III proposed a 'pure wave mechanics'[7] as an alternative formulation to the generally accepted quantum mechanics: the physical state of the universe is expressed by a

[7]Quantum theory, according to Everett, does not offer a coherent picture of the universe as a whole, because it considers observers to be external elements of the physical system, while the observers are

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'universal wave function' that describes in a perfectly continuous and linear manner the evolution of the superposition of possible states. In Nishidian terms, this might correspond to the self-aware system of the universal.

The aim of Everett's formulation would be to solve the quantum measurement problem by describing the empirical predictions of the theory as subjective experiences of observers included in the quantum physical system. Is the aim achieved? In fact, in Everett's wave mechanics, the problem only appears shifted, from the act of measurement to the moment immediately preceding that act. And this is because eliminating collapse means considering a multiplicity of compossible observers, corresponding to the multiplicity of possible states in the superposition[8]. If the physical problem remains, however, there is a metaphysical benefit: universal harmony is not broken. As Alexander Stern points out in a letter to Wheeler, who intended to elicit a constructive interference between Bohr's complementarity logic and Everett's 'universal wave function method', if it were not for the interference of physicists, i.e., observers, quantum theory would be an elegant deterministic and complete theory. It is not unlikely that in Stern's eyes, Everett's theory recalls Leibniz's monadology. Indeed, he writes:

> If Everett's universal wave equation demands a universal observer, an idealized observer, then this becomes a matter of theology. If a complete knowledge of the state of the composite system (…) involves practically an infinite number of observers which cannot communicate with one another, then we are talking metaphysics. One may invoke the image of a large number of mystics in different 'resonant' states. (Everett 2012: 217)

Which metaphysics are we talking about?

Conclusion

How does quantum monadology affect metaphysics? What remains of the traditional conception of metaphysics after quantum physics?

Addressing these questions, the very fact that a physicist like John Wheeler, while struggling with crucial issues at the boundaries of the extremely large and the extremely small, could look for inspiration in Leibniz's *Monadology* appears worthy of particular attention. Both Wheeler and Leibniz had ideas which were 'too far ahead of their time', both felt they could not avoid addressing crucial questions such as 'How come existence?', hence, respectively, 'How come the quantum?', 'How come the monad?'[9].

Both Wheeler and Leibniz possessed a kind of 'geometrodynamical' mind and an acute *topological* vision. What is most relevant for the present discussion is how, following similar argumentative strategies, they both came to see the need for the 'universal

part of the universe. But if measuring devices and observers are described by the deterministic linear law, then the collapse theory is logically inconsistent.

[8]Everett's theory is often referred to as the 'many-worlds' formulation of quantum mechanics, or 'parallel universes', although Everett himself never used such expressions. If anything, it seems more appropriate to associate Everett's 'relative states' model (1957) with a multiverse of potentialities.

[9]See Wheeler 1986.

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harmony' and grasped the ultimate building block of the whole construction in what Nishida named a dialectic of *acting*. As for the metaphysics involved, from Nicholas of Cusa to Nishida it is the dialectical monadology that acts as a mirror reversing its ontological foundation from the substance of the Word to absolute nothingness.

Wheeler's path towards a quantum geometrodynamics traces the regions of 'black holes' to 'beyond the last star' before finally returning to look for some 'pre-geometry'. Then, a kind of 'conceptual mirroring' of gravitational collapse elicits the ultimate root of the physical universe in the *quantum,* namely, in the 'elementary quantum phenomenon'. For Wheeler, like for Bohr, there exists no physical reality prior to measurements. It is the *act* of measurement that generates the value of a physical quantity. The reality, which is supposed to be 'out there', independent of us and which history is supposed to faithfully document, is *informed* by acts of measurement. Without the observer and the act of measurement, there is no universe.

Turning to Leibniz's universe, even if pre-established by a transcendent God, universal harmony descends from the *principle of sufficient reason*. As he wrote to M. de Remond:

> So far we have just spoken as simple *physicists*; now we must rise to *metaphysics*, by making use of the great principle, little used, commonly, that *nothing takes place without sufficient reason*, that is, that nothing happens without it being possible for someone who knows enough things to give a reason sufficient to determine why is so and not otherwise. (Leibniz 1989: 210)

A reason is also needed to explain how the soul can perceive the motions of its own body. Again, the reason is in the *pre-established* harmony. Like every monad, every soul has been created in such a way that it must agree with all that takes place in bodies and in particular in its own. Therefore, as Leibniz wrote to Arnould, 'I cannot guess where one can still find the slightest shadow of difficulty, unless we are to deny that God can create substances so constituted from the beginning that by virtue of their own nature, they thereafter agree with the phenomena of all the others' (Leibniz 1969: 340). What difficulties could arise from denying an agent of creation who decrees *universal harmony*?

Leibniz addresses the question in his search for a good argument to encourage the Chinese to join the Christian Church. The doctrine of creation proves to be the main obstacle. The ancient Chinese also recognized a fundamental harmony in the world, i.e., a harmony of resonant possibilities. But they never saw this harmony as having a reason: the 'reason of things' is in their interconnection, in the logic of immanence (Jullien 1993). And yet, Leibniz himself, when he speaks as a physicist or a mathematician rather than as a metaphysician, seems to share that view. Although the principle of sufficient reason claims the harmony to be established by the divine intellect, the harmony stems from the 'nature of things'. As a metaphysician, Leibniz knows that an ultimate reason can only be transcendent, as a mathematician he recognizes that there is no reason for the harmony of things.

> What then is the reason for the divine intellect? The harmony of things. What is the reason for the harmony of things? *Nothing*. For example, no reason can be

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> given for the ratio of 2 to 4 being the same as that of 4 to 8, not even in the divine will. (Letter to Magnus Wedderkopf [May 1671], in Leibniz 1969: 146; my italics).

Finally, what metaphysics is at issue? A metaphysics that has replaced the concept of objective property with that of correspondence and the chain of causes with the criteria of interconnection. A logic of immanence and acting which renounces a necessary ontological substratum and replaces it with a fabric of relations and a harmonious network of compossibilities, of which even the scientist, strictly speaking even the God guarantor of those relationships, is a *son*. An ontologically empty system, an absolute nothingness as the condition of possibility of self-awakening, as the *basho* of form. A metaphysics that does not erase Leibnizian pre-established harmony but makes it clear that its consistency does not depend on any transcendent legislator or guarantor – in Wheeler's words, 'a law without a law'. A problem for the theologian perhaps, but not for the mathematician or the physicist, not for those who can see the form of what has no form, the necessity of a universal harmony devoid of logical necessity and yet inherent in the nature of things. Thus, a *metaphysics of uncertainty* because it is founded on interrelations, on the aleatory nature of phenomena, on the logic of immanence; a *metaphysics of shadow* as the condition of possibility of 'a commerce of light' between living mirrors, be they monads, quanta or cultural traditions.

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