Exploring Analogy of Debates to Approach the Encounter between Orthodox Theology and Quantum Physics

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This article adopts the Analogical Comparative Theological Approach (ACTA) to explore the encounter between Orthodox theology and quantum physics. The ACTA approach integrates the intuitions of the analogical isomorphism and comparative theology methods by focusing on issues that are of high relevance for both theology and physics. The specific issues addressed here are the ones emerging within the context of two important debates: a) between St Gregory Palamas and Barlaam the Calabrian in the fourteenth century, and b) between Albert Einstein and Niels Bohr in the twentieth century. The first debate refers to some of the key aspects of Orthodox theology and spirituality. The second debate is related to the never-ending challenges of the interpretation of quantum mechanics and the nature of physical reality. The analysis suggests that the controversial issues in the two debates are deeply rooted in disagreements about the nature of knowledge, the interplay between epistemological and ontological issues, the challenges of applying logical arguments, the role of apophaticism, the challenges of knowing and the ways these challenges affect the interpretation and sharing of human experience. The discussion of the role of apophaticism is of particular interest since it shows a common need of going beyond representation, assertion and negation by focusing on the epistemological conditions of knowledge emerging through union and participation. This need is more sharply expressed in Orthodox theology where the apophatic does not emerge as a comment on representation, but as an opportunity for participation. The fundamental presupposition of the article is that one can learn a lot about theology and quantum physics by adopting the ACTA exploratory lens to examine the potential similitudes between the ways theologians and physicists debate about their ways of knowing and the challenges of articulating their personal experience with reality. One of the key benefits of the suggested approach is its ability to examine similitudes between two so different domains of human experience – one based on Divinely revealed knowledge, the other on the proactive and dialogical human engagement with the deepest layers of physical nature. The study does not pretend to be conclusive. It should be considered as part of an ongoing reflection on the value of exploring the encounter between theology and physics.

Introduction

The interaction between theology and physics usually happens as an encounter,[1] i.e. not as part of a peaceful dialogue, but a kind of co-creative confrontation and struggle. Even when they could be considered in the context of a constructive mutually beneficial interaction, theology and physics always seem to end up finding themselves engaged in a dialogical struggle. The struggle is rooted in the co-existence of a fundamental contextual difference between the ultimate directions of their existential concerns and, at the same time, of a certain similitude between their unique epistemological and linguistic challenges of dealing with the invisible, the unknown and the unspeakable. The exploration requires the adoption of an analogical comparative perspective which opens the question about the appropriate method of analysis that could result in potential scientific and theological insights. According to Michael Heller, the interface between science and theology must be based on extremely fine-tuned principles, because the "so-called 'building bridges' between science and theology without any balanced methodological care easily results in doctrinal anarchy, and even deepens the existing conflict between them."[2]

In previous studies I suggested a combination of two comparative methods as a basis for the articulation of a constructive approach to the exploration of the encounter between theology and physics: the Analogical Comparative Theological Approach (ACTA).[3] The first method is analogical isomorphism, the second – the comparative theological method. Analogical isomorphism[4] seeks to generate insights by uncovering parallels between two supposedly similar issues, concepts, or relations in two different domains of human experience by, *first*, examining how these issues, concepts, or relations emerge and operate within their own natural contextual environment and, *second*, using the examination as a lens focusing on exploring the differences and similarities in the applications of the concepts and the unfolding of

[1] One of the meanings of the term *encounter* is "a confrontation or unpleasant struggle". The origin of the term can be found in Old French *encontrer* (verb), *encontre* (noun), which are based on the Latin in- 'in' + contra 'against': https://en.oxforddictionaries.com/definition/encounter

[2] Michael Heller, 'Where Physics Meets Metaphysics', in Alain Connes et al., eds. *On Space and Time* (Cambridge: Cambridge University Press, 2008), 238–77, 241.

[3] The articulation of ACTA was inspired by both my theological research and teaching experience. The foundations of this approach were set in my *Energy in Orthodox Theology and Physics. From Controversy to Encounter* (Eugene, OR: Wipf & Stock, 2017) and then complemented by the development of comparative theological perspective in a science and theology context: S. Tanev, 'The Encounter of Theology with Physics: An Eastern Christian Perspective', Ch. 15 in John Slattery, ed., *T&T Clark Handbook of Christian Theology and the Modern Sciences*, (London: T&T Clark, 2020), 209-222; S. Tanev, 'Using the Concept of Energy to Encounter Orthodox Theology with Physics: An Analogical Comparative Theological Approach (ACTA)', in Gayle Woloschak & Vasilios Makrides, eds., *Orthodox Christianity and Modern Science: Tensions, Ambiguities, Potential*. Science and Orthodox Christianity Series, Vol.1, (Turnhout, Belgium: Brepols, 2019), 127-146; S. Tanev, 'Adopting an Analogical Comparative Theological Approach to the Encounter of Orthodox Theology with Physics', *Theoforum*, 49 (2018): 153-173.

[4] Stoyan Tanev, *Energy in Orthodox Theology and Physics. From Controversy to Encounter* (Eugene, OR: Wipf & Stock, 2017).

the relations.[5] Thus, analogical isomorphism could be qualified as a relatively "soft method" since it leaves the inquirer with a certain space for interpretation. It neither affirms nor denies the similarity between the terms, the concepts and the relations but allows to explore the interplay between comparison, distinction and analogy in shaping new insights. Analogy here is used in a dynamic and exploratory way:

> The concept of analogy belongs to the family of those concepts that being important for scientific or philosophical discourse, are at the same time fuzzy and change their meaning depending on the context. In spite of some heroic attempts, undertaken mainly by philosophers, linguists and logicians, we use them by basing them on our intuition rather than on some hard analyses. … The concept of analogy seems to be, from its very nature, multi faced and adapting its meaning to various situations. It is a dynamic concept.[6]

I have found the application of analogical isomorphism method highly valuable in exploring the parallels of the distinction between essence and energy in theology and physics.[7]

The second method is based on insights emerging from comparative theology—an emerging discipline within theology that explores the creative tension between the comparative and the theological aspects of interreligious endeavors.[8] It represents a special type of theological practice committed to deep interreligious learning while staying rooted in a specific religious tradition. Clooney emphasizes the distinctive legitimacy of comparative theology by comparing it with comparative religion, theology of religions, and interreligious dialogue.[9] In contrast to theology of religions, comparative theology is a theology of learning that engages in an in-depth study of the particularities of other religious traditions. It is 'not primarily about which religion is the true one, but about learning across religious borders in a way that discloses the truth of my faith, in the light of their faith'.[10] In this sense, it is much more than a mere attempt to clarify the relationship between Christian faith

[5] Bernard Lonergan, 'Isomorphism of Thomist and Scientific Thought', in Frederick Crowe and Robert Doran, eds., *Collected works of Bernard Lonergan – Collection* (Toronto, ON: University of Toronto Press, 1988), 133–141, 133. See also Yann Schmitt, *L'Être de Dieu. Ontologie du théisme* (Paris: Ithaque, 2016).

[6] Michael Heller, 'Analogy, Identity, Equivalence', in Werner Arber, Jürgen Mittelstraß and Marcelo Sánchez Sorondo, eds., *Proceedings of the Plenary Session on Complexity and Analogy in Science: Theoretical, Methodological and Epistemological Aspects*, held on 5-7 November, 2012 (Vatican City: The Pontifical Academy of Sciences, 2015), 257-267, 264.

[7] First in Stoyan Tanev, 'Essence and Energy – an Exploration in Orthodox Theology and Physics', *Logos - Journal of Eastern Christian Studies*, 50, 1-2 (2009) 89-153, and in some more detail in Tanev, *Energy in Orthodox Theology and Physics*.

[8] Francis Clooney, *Comparative Theology: Deep Learning Across Religious Borders* (Chichester, England: Wiley-Blackwell, 2010); Klaus Von Stosch, 'Comparative Theology as Challenge for the Theology of the 21st Century', *Religious Inquiries*, 1 (2012): 5–26; Paul Hedges, *Comparative Theology. A critical Methodological Perspective* (Leiden: Brill, 2017).

[9] Clooney, *Comparative Theology*, 15.

[10] Ibid., 15–16.

and other religious traditions by focusing on how other religions can be understood in light of the normative claims of the Christian faith.

The generative principles of comparative theology were systematically presented by Klaus von Stosch.[11] *First*, comparative theology is characterized by its micro-logical approach and attention to the particular. It acknowledges that the adoption of specific language games affects the meaning and expression of religious convictions as well as the quality of the encounter between different religious traditions.[12] *Second*, comparative theology is concerned with contemporary problems and addresses highly relevant questions. It focuses on theological problems and concerns related to lay questions about sense, ultimate purpose, salvation, and truth, in addition to issues raised by academics and specialists. *Third*, comparative theologians deal with specific religious beliefs but, at the same time, attempt to incorporate their deeper understanding of the position of the other into their own theology. Ideally, comparative theologians should have studied more than one theology and should be able to switch back and forth between the two different confessional perspectives.[13] *Fourth*, comparative theology needs the instance of a third position—an issue, a problem, or a concern that comes to the two religious traditions as a challenge from the outside while, at the same time, offering an opportunity for the two traditions to engage dialogically in addressing the issue by using the potential of their internal resources. A third position must be concrete, highly relevant, and able to provide a continuous reference to the dialogue by playing the role of a controlling instance and driving the logic of the comparison. *Fifth*, comparative theology focuses on praxis followed by reflection—the praxis of different religious traditions and a reflection upon further developments within the interreligious dialogue. *Sixth*, the adoption of dialogical open-mindedness should make comparative theologians aware of the vulnerability of their judgements within the context of their own tradition. Such vulnerability could emerge from the existence of competing theological interpretations exactly within one specific tradition. Comparative theology considers such competing interpretations as opportunities that could enable a constructive reflection on existing open questions or controversies.

The usual application of the comparative theological approach in a science and theology context should focus on a scientific issue as a third position providing a reference for the encounter of two different religious traditions. An example of one such third position could be, for example, the dominant cosmological understanding of the creation of the universe. In this sense, the usual way of applying the comparative theological approach needs to be adjusted in order to fit the context of the encounter between theology and physics. The first adjustment is that, in this case,

[11] Von Stosch, 'Comparative Theology as Challenge', 5–26. The summary of the comparative theological principles presented here follows von Stosch's logic.

[12] Von Stosch, 'Comparative Theology as Challenge', 12.

[13] Ibid., 13.

physics needs to take the place of one of the traditions — i.e., the encounter will be between the theological perspective of a specific religious tradition and the scientific understanding of a particular concept or theory. The second adjustment is that the (third) position, which provides the comparative background for the encounter, needs to be specific and highly relevant for both theology and physics. If we take again as an example the creation of the universe, the encounter will be between the articulation of the doctrine of creation in the religious tradition and the emergence of one of the dominant scientific cosmological understandings of the beginning of the universe. In this sense, the role of the third position is taken by the concept of creation itself, which is now considered from the viewpoint of the two different perspectives—the theological and the scientific one.[14]

The ACTA approach to the exploration of the encounter between theology and physics integrates the intuitions of the analogical isomorphism and comparative theology methods. In fact, the comparative theology method could be considered as an instrumental enhancement of analogical isomorphism. If properly applied, ACTA can be used to explore the relations between theology and any scientific discipline, not just physics. The question one could ask is: Why quantum physics? The answer to this question could be based on completely secular arguments in support of the so-called Primacy of Physics Constraint (PPC) principle – the methodological rule that is "observed in the history of recent science to the effect that practitioners of special sciences at any time are discouraged from suggesting generalizations or causal relationships that violate the broad consensus in physics at that time, while physicists need not worry reciprocally about coherence with the state of the special sciences."[15] According to Hellman and Thompson "Mathematical physics, as the most basic and comprehensive of the sciences, occupies a special position with respect to the over-all scientific framework."[16] PPC points therefore to the existence of a generic asymmetry: "special sciences do not relate to physics the way that it relates to them."[17]

The emergence of a special status of physics could be associated with its unprecedented progress in the nineteenth and twentieth centuries, including the explanation of new phenomena in the life sciences, chemistry, and the materials sciences. Physics is perhaps the only science that has been transforming itself over the last couple of centuries by passing through several epistemological revolutions. The last such revolution consisted in the discovery of quantum theory and the development

[14] It should be noted that the concept of creation could be explored from the perspectives of other scientific disciplines in addition to physics or cosmology, such as, for example, evolutionary biology or anthropology.

[15] James Ladyman and Don Ross, with David Spurrett and John Collier, *Every Thing Must Go – Metaphysics Naturalized* (Oxford: Oxford University Press, 2007), 38.

[16] G. P. Hellman and F. W. Thompson, "Physicalism: Ontology, determination, and reduction," *Journal of Philosophy* 72 (1975): 551–64, 551.

[17] James Ladyman and Don Ross, *Every Thing Must Go*, 39.

of quantum mechanics. The revolutionary nature of the transition from classical to quantum mechanics was determined by the fact that quantum mechanics introduced a new and relatively complete system of concepts that referred to the same type of material objects (atoms, electrons, photons etc.) by opening some completely new dimensions of reality. For example, the new conceptual system enabled the description of new physical phenomena such as the quantization of energy and wave-particle duality – the ability of quantum objects to behave either as waves or particles depending on the type of experimental setup they are investigated with. The newly discovered quantum phenomena allowed the Danish physicist Niels Bohr to speak about the emergence of a radically new situation in the understanding of micro-physical objects and, on the other hand, about the need for the adoption of a new epistemological paradigm which extends beyond the domain of quantum physics to "enlighten" other sciences. The new epistemological paradigm emerged from the need to adapt the language of classical physics in a way that would allow the description of the new phenomena emerging from the manifestation of the quantum nature of the physical micro-objects. "This epistemology is that of knowledge and conceptualization (only) in terms of effects, while it leaves the nature and character of the ultimate objects and processes responsible for these effects beyond all available knowledge or even conceptualization, and yet understood as essentially, fundamentally responsible for these effects. … Reciprocally, the existence of such irreducibly unknowable or even inconceivable objects and processes can only be inferred from the peculiar character of its effects, for example, the individual character of all effects involved and the complementary character of some of them."[18] The new epistemological paradigm enlarged the scope of traditional physical knowledge by making the ways of knowing quantum objects become part of the object of scientific research itself. One could claim that there has not been any other science that has manifested such sharp epistemological self-awareness and ability for self-reflection about its own ways of knowing.[19] This is what makes quantum physics a scientific discipline capable of formulating epistemological insights that are of high relevance to other disciplines and theology in particular. In what it concerns Orthodox theology, however, I will argue that this relation is not generically asymmetrical. According to Christos Yannaras the ecclesial attitude to the ontological problematics is of particular relevance since it appears to be the only one outside of the scientific domain that works from within an experiential perspective on truth. [20] The ecclesial experience is based on an apophatic attitude to language and reality that is similar to the one that has emerged within the context of modern physics. This is a perspective which

[18] Arkady Plotnitsky, *Reading Bohr: Physics and Philosophy* (Dordrecht, The Netherlands: Springer, 2006), 45.

[19] I owe this insight to my philosophy of physics University Professor Ivanka Apostolova (+2006) (Иванка Апостолова, *Физиците пред аксиологически проблеми* (София: Наука и изкуство, 1992)).

[20] Yannaras, *The Meaning of Reality*, 64.

makes modern physics and theology co-workers in the field of the human encounter with reality.

In what follows, I will apply the ACTA perspective to the exploration of the encounter between Orthodox theology and quantum physics. The adopted third position will be formulated in broader terms – the issues emerging within the context of two important debates: a) between St Gregory Palamas and Barlaam the Calabrian in the fourteenth century,[21] and b) between Albert Einstein and Niels Bohr in the twentieth century. The first debate refers to some of the key aspects of Orthodox theology and spirituality such as *Theōsis* or Deification. The second debate focuses on the still ongoing challenges of the interpretation of quantum mechanics and the nature of physical reality. As we shall see, both debates are deeply rooted in disagreements about the nature of knowledge, the challenges of knowing and the ways these challenges affect the interpretation of human experience, and the application of logical arguments. The assumption is that we can learn a lot about theology and quantum physics if we adopt the ACTA exploratory lens to examine the potential parallels between the ways theologians and physicists debate about their ways of knowing and the challenges of articulating their experience.

The debate between St Gregory Palamas and Barlaam the Calabrian

St Gregory Palamas confronted Barlaam of Calabria (c. 1290–1348) with respect to several issues, two of which were his understanding of the nature of Divine knowledge and the ways of using logical propositions about God.[22] Barlaam was a highly learned Greek monk born in Southern Italy who had moved to Constantinople to focus on studying Aristotle on the basis of the original Greek texts (he had already mastered the Aristotelian Categories and Physics, having studied them in Latin translation).[23]

[21] Georgi Kapriev, 'Gregory Palamas', in *Encyclopedia of Medieval Philosophy: Philosophy Between 500 and 1500*, ed. Henrik Lagerlund, 520–530 (Dordrecht: Springer, 2011).

[22] I am mostly relying on secondary sources to provide a reliable presentation of some the key points of the controversy in a way that will help demonstrating the application of ACTA to the encounter of theology and physics. My main sources about the debate are: John Romanides. 'Notes on the Palamite Controversy and Related Topics', Part I, *The Greek Orthodox Theological Review* 6 (1960–61): 193–202; Stavros Yangazoglou, 'Philosophy and Theology: The Demonstrative Method in the Theology of Saint Gregory Palamas', *The Greek Orthodox Theological Review* 41.1 (1996): 1–18; Иван Христов, 'Битие и съществуване в дискусията за метода между св. Григорий Палама и Варлаам,' in Хуманизъм, култура, религия (София: Лик, 1996), 37–48; Robert Sinkewicz, 'The Doctrine of Knowledge of God in the Early Writings of Barlaam the Calabrian,' *Medieval Studies* 44 (1982): 181–242; Георги Каприев, *Византийска философия*, второ издание (София: Изток-Запад, 2011) (earlier edition in German: Georgi Kapriev, *Philosophie in Byzanz* (Wuerzburg: Koenigshausen und Neumann, 2005) 344); Иван Христов, *Византийското богословие през XIV век. Дискурсът за божествените енергии* (София: Изток-Запад, 2016); Norman Russell. *Gregory Palamas and the Making of Palamism in the Modern Age* (Oxford University Press, 2019). The latest contribution to this topic can be found in David Bradshaw, 'Natural Theology in St. Gregory Palamas', in David Bradshaw and Richard Swinburne, eds., *Natural Theology in the Eastern Orthodox Tradition* (St Paul, Minessota: IOTA publications, 2021), 51-64.

[23] John Romanides. 'Notes on the Palamite Controversy and Related Topics', Part I, *The Greek Orthodox Theological Review* 6 (1960–61): 193–202, 192.

In Constantinople he taught syllogistics, algebra, geometry, astronomy, music, and pretended to be one of the greatest interpreters of Dionysios the Areopagite. He was characterized as 'brilliant but sharp-tongued' and 'thoroughly versed in the classics, an astronomer, a mathematician, as well as a philosopher'. However, 'this formidable learning was coupled with an arrogant, sarcastic manner, so caustic at times that he put off even friends and allies'.[24] During the years 1333–1334, Barlaam was assigned by the Emperor to lead the negotiations with the representatives of Pope John XXII focusing on a potential agreement for union between Rome and Constantinople. He wrote twenty-one treatises against the Latins in which he opposed the primacy of the Pope and the *Filioque*—the doctrine of the procession of the Holy Spirit from the Father *and from the Son* (Filioque).

Around 1336, Gregory Palamas received copies of Barlaam's treatises against the Latins, condemning their insertion of the *Filioque* into the Nicene Creed. Although this was the position of the Eastern Orthodox Church, Palamas engaged in a critique of Barlaam's way of supporting it. Soon after that, the focus of the debate shifted from the *Filioque* to the nature and presuppositions of Orthodox theological methodology, the relationship between secular philosophy and theology, and to the question of the possibility of direct communion with the uncreated life of God.[25]

The application of logical proofs in theology

The anti-Latin Treatises written by Barlaam in 1335 to explain the Orthodox point of view attempted to offer a refutation of the use of Aristotelian logical proofs by the papal representatives in their defense of the *Filioque*. Barlaam's approach to the discussions with the Latins aimed at proving that their syllogisms are neither apodictic nor dialectic and, therefore, fallacious. In order to show the impropriety of their apodictic syllogisms about the *Filioque*, Barlaam examined whether they met the requirements formulated by Aristotle in his *Posterior Analytics*.[26] For example, in an apodictic syllogism, the premises should reveal the essence of the object and be the cause of the conclusion, but in a theological syllogism the premises cannot express the essence of God, who is unknowable. The premises must also refer to the same genus as the proposition, but there is no being that is in the same genus as God. In addition, the premises must be the causes of the conclusion, but there is no humanly conceived definition that could be the cause of any aspect of reality that is in the realm of the Divine.[27] Barlaam's approach to the refutation of the dialectic

[24] Colin Wells, *Sailing From Byzantium: How a Lost Empire Shaped the World*. (New York, Random House, 2006), 47.

[25] Stavros Yangazoglou, 'Philosophy and Theology: The Demonstrative Method in the Theology of Saint Gregory Palamas', *The Greek Orthodox Theological Review* 41.1 (1996): 1–18, 4.

[26] The discussion here follows the logic of Христов, '*Битие и съществуване,' 41; Христов, Византийското богословие през XIV* век, I.4.

[27] Sinkewicz, 'The doctrine of the knowledge of God', 190.

logical propositions of the Latins was based on a similar approach—he summarized Aristotle's principles on the subject and indicated how the Latin arguments did not meet their requirements. He insisted that in dialectic syllogisms it is necessary to formulate one's arguments based on opinions accepted by both opponents. This, however, was impossible since there was no agreement between the Latin and the Greek positions on the procession of the Holy Spirit.[28]

Interestingly, St Gregory himself did not start with an open critique in his early discussions with Barlaam. In his first letter to Barlaam, Palamas pointed out that he had merely been setting forth an alternative opinion and that Barlaam's view was equally legitimate — i.e., 'it was unimportant if one spoke proof in a general sense or more specifically of apodictic demonstration, so long as the truth is preserved in all its clarity'.[29] At one point however Palamas escalated the strength and the directedness of his argumentation, showing a masterful handling of Aristotelian logic in the theological domain. The reason for the escalation was an insulting remark in the first letter of Barlaam:

> Not without a touch of mockery, Barlaam opened his letter to the Athonite by saying that, if Palamas had gone off to seek the heights of contemplation and forgotten the skills of expression, he should be more careful in his criticisms, because he has in fact failed to understand the problems at question.[30]

The evidence of St Gregory's mastership of Aristotelian logic[31] suggests that St Gregory was trying to refute Barlaam in a way similar to the one Barlaam himself had used to refute the Latins—by accusing Barlaam of ignorance of Aristotelian logic.[32] According to Stamatios Gerogiorgakis, it was Gregory Palamas 'who retained a good deal of the spirit of the Aristotelian theory of demonstration. Barlaam misinterpret-

[28] Ibid.

[29] As referenced by Sinkewicz, 'Doctrine of Knowledge of God', 208.

[30] Sinkewicz, 'The Doctrine of Knowledge of God', 223.

[31] See Norman Russell, *Gregory Palamas and the Making of Palamism in the Modern Age*. Russell refers to Philotheos Kokkinos, *Discourse on Gregory*, *Archbishop of Thessalonika* 11 in: Philotheos (Patriarch of Constantinople), Dēmētrios G. Tsamēs. *Philotheou Kōnstantinoupoleōs tou Kokkinou Hagiologika erga*, Volume 4 of Thessalonikeis Vyzantinoi Syngrapheis (Thessaloniki: Kentron Byzantinon Ereunon, 1985). According to Philotheos Kokkinos, St Gregory was a pupil of Theodore Metochites, who 'distinguished himself in physics and logic—in a word, in all Aristotelian studies—so much so that … the Grand Logothete [Theodore Metochites], once in the presence of the emperor began a discussion with Gregory on Aristotle's treatment of logic, and was so struck by what he heard the youth utter that he could not contain himself or conceal his admiration but turning to the emperor in amazement said: "Even Aristotle himself, if he were present and had heard this young man, would in my opinion praise him more than a little. And I would here add … that those who study philosophical treatises, especially the complex works of Aristotle, should possess such a spirit and aptitude."'

[32] See Христов, 'Битие и съществуване,' 36–48; Христов, *Византийското богословие през XIV век*, I.4; Христов, "Естествения разум и свръхестественото озарение," 125–34. Comments on the validity of this assumption can be also found in: Gunnarsson, *Mystical Realism in the Early Theology of Gregory Palamas*, 24; 95.

ed the Aristotelian theory in many respects'.[33] According to Ivan Christov, what St Gregory did was to go beyond the typical Aristotelian substantialist understanding of logical forms by offering a specific existential interpretation. He reconsidered the ontological foundations of Aristotelian logic and demonstrated how syllogistic proofs could be applied from within an entirely theological perspective. In another publication, Julia Konstantinovsky provided a very similar interpretation:

> Palamas was as interested in and knowledgeable of Aristotelian logic as Barlaam or as any Western scholastic. Being a man of his age, Palamas used Aristotle as an intellectual framework for his own philosophical theology. Crucially, Palamas' syllogizing is at the service of Christian dogmatic theology and epistemology, and as such pursues theological purposes of its own. Palamas, therefore uses Aristotle creatively and transforms him.[34]

The argumentation of St Gregory Palamas against Barlaam focuses on a different articulation of the nature of syllogistic proofs based on the distinction between essence, being, and existence. It is no longer the Divine essence that is the subject of syllogistic proofs but those aspects of the Divine being that are open to participation—the Divines energies, life, wisdom, and providence.[35] In other words, the ground for participation is that part of the essence that is open for participation to created beings. Due to its existential orientation, St Gregory calls this part of the Divine essence 'nature'.[36] This essence or nature is the source of the Divine energies, making possible the knowledge and experience of God, and opening the possibility for an authentically theological approach to syllogistics. Causality in theological syllogisms pertains to the things around God — i.e., it is based on the reality of the Divine energies.

> The distinction between the uncreated, incommunicable divine essence and the uncreated but communicable divine energies, according to the Orthodox tradition, allows for the active and charismatic relationship between the uncreated and transcendent God, and the created world. Regarding knowledge of God's essence (*what* God is), then, the uncreated God is totally unknown to created beings, even to the saints who receive the gift of God's uncreated grace. No contact with, or knowledge of, the divine essence is possible and thus no logical demonstration can possibly be produced for it. The fact that God exists, however, as both One and Three (*that* God is, and *who* God is),

[33] Gerogiorgakis, Stamatios. 'The controversy between Barlaam of Calabria and Gregory Palamas on demonstrative and dialectical syllogisms revisited'. Philotheos 10 (2010): 157–169.
[34] Konstantinovsky, 'Dionysius the Areopagite versus Aristotle?', 313–320.
[35] Христов, 'Битие и съществуване,' 47; Христов, *Византийското богословие през XIV век*, I.4.
[36] Ibid.

> and that 'around' God are the various properties of the divine nature and hypostases, can be investigated and demonstrated. Needless to say, an obvious prerequisite for all this is the fact that God personally revealed these things to humanity within the framework of the salvific economy, renewing a charismatic relationship with humanity through the Church. The experience of life in Christ teaches that there exists the possibility of direct communion and relationship with God through God's uncreated energies. Thus, when there is contact between God and knowledge, there is demonstration.[37]

The role of philosophy in theology

St Gregory Palamas critiqued the Calabrian for both his overly enthusiastic Hellenism and his insistence on the reality of divine illumination in pagan philosophers. According to Sinkewicz, 'On the surface, there is nothing particularly shocking in this, at least not to the modern reader. Palamas, however, perceived that there was something suspicious behind these statements and attacked Barlaam regarding them'.[38]

For Barlaam, philosophy is a source of knowledge about God and 'the pagan philosophers were illuminated by God just like the Church Fathers, because the truth to be found in both philosophy and theology is one'.[39] According to Palamas, however, 'pagan philosophy can in no way lead us to an understanding of the nature of the human person created in the image and likeness of God; such an understanding is the fruit of revelation alone'.[40] That is why he was 'scandalized by Barlaam's claim that because truth is one, the products of divine revelation and human reasoning may be considered in some sense on a par with each other'.[41] Palamas was not against philosophy in general. For him there was no doubt that 'philosophy can become a divine gift if it is connected to the faith and love of God. … Reborn through divine grace, philosophy is transformed into something "new" and "divine-like", it becomes a discourse of edification, it knows and accepts the gifts of the Holy Spirit. It becomes the wisdom from above of those who "philosophize in Christ"'.[42]

Barlaam rejected the possibility of using apodictic proofs in theology and believed instead in the suitability of the dialectical method 'because it begins with, and has as its premises in, the universal laws and the data of created reality, which are subsequently applied to God. In this way, Barlaam sought the eternal and uncreated

[37] Stavros Yangazoglou, 'Philosophy and Theology: The Demonstrative Method in the Theology of Saint Gregory Palamas', *The Greek Orthodox Theological Review 41*.1 (1996): 1–18, 7.

[38] Sinkewicz, 'The Doctrine of Knowledge of God', 181–242, 241.

[39] Norman Russell. *Gregory Palamas and the Making of Palamism in the Modern Age*, 115.

[40] Ibid., 138.

[41] Ibid.

[42] Stavros Yangazoglou, 'Philosophy and Theology: The Demonstrative Method in the Theology of Saint Gregory Palamas', *The Greek Orthodox Theological Review* 41.1 (1996): 1–18, 16.

within the temporal and the created'.[43] He clearly ignored the Biblical and patristic distinction between created and uncreated, as well as the direct revelatory presence and activity of God in the history of the Church and humankind in general. For him,

> …no vision or direct experience of God is possible without created intermediaries. Any gift of God, even the light of Tabor, inasmuch as it was perceived by the physical senses, constitutes a 'created spirit' or a 'created symbolic representation.' On the basis of such created representations, the soul rises through philosophy toward the immaterial archetypes which constitute perfection and the fullness of *theognosia*. Barlaam… denied methodologically the empirical basis for *theognosia* because he rejected the uncreated presence and participation of God, especially, in the liturgical and ascetic life of the Church.[44]

According to Barlaam, there can be no contemplation of a divine light per se because the only light that can be contemplated by the intellect is related to the knowledge of creatures or "the knowledge expressed in words."[45] And the knowledge possessed by the mind remains always associated with rational discourse.[46] This relationship between Divine knowledge, knowledge about creatures, and the language expressing them was a point that became the subject of Palamas' criticism.

Language, apophatic theology and experience of God in the Holy Spirit

St. Gregory accuses Barlaam for claiming that "there is nothing above knowledge"[47] and that it is only "spoken knowledge" that is light.[48] According to St. Gregory there are two philosophies, a philosophy in words and another in deeds, and that there are "many and various differences" between them.[49] He sees Barlaam's philosophy as being strictly discursive, bounded by language, and ultimately incapable of true knowledge of the divine realm. The problem of such philosophy is in its restriction of the mind to discursive reasoning alone which makes the cognitive aspects of contemplation merely impossible. Whenever Barlaam speaks of contemplation, he reduces it to the level of the knowledge of created beings. That is why the monks

[43] Ibid., 16–17.
[44] Ibid., 17.
[45] Gregory Palamas, *The Triads*, II, 3.71. The quotations from the Triads provided here are a translation by Scott Pentecost, *Quest of the Divine Presence: Metaphysics of Participation and the Relation of Philosophy to Theology in St. Gregory Palamas' Triads and the One Hundred and Fifty Chapters*. PhD dissertation (Washington, DC: Catholic University of America, 1999).
[46] Gregory Palamas, *The Triads*, II.3.35.
[47] Gregory Palamas, *The Triads*, II.3.11.
[48] Ibid., II.3.71.
[49] Ibid., II.1.21.

"did not think it fit to call him a contemplative."[50] The focus on discursive knowledge alone "evidences a denial that one can go beyond words to the reality they indicate. That is, we can speak about God but, since he is transcendent, cannot encounter God himself."[51] And "it is not the same to say something about God as it is to possess and see God. For apophatic theology is a word, whereas contemplation surpasses words."[52] "The intellect, theologizing apophatically, thinks those things that are different from God, and thus acts by discursive reasoning. But in the other case there is union. … Contemplation is not simply abstraction and negation, but union and deification."[53] The light seen by the Hesychasts is a pledge of union with God and a true encounter with Him. For Barlaam the contemplation of light is restricted to the realm of concepts, to discursive thought and to words related to natural phenomena.[54] "The philosopher teaches that the knowledge we have from creatures is the most perfect vision of God"[55] but the knowledge of natural phenomena cannot be the measure of human progress towards the likeness of God. "Such knowledge is trapped by a superficial consideration of phenomena—paralleling the superficiality of words—since 'every being that knows is established and remains in that which it knows.'"[56]

The discussion of the relationship between apophatic theology and the experience of God is an important issue in the context of the present study. In a recent reflection on the theological contributions of Christos Yannaras, Federico Aguirre points out that

> [i]n the context of Orthodoxy, apophaticism does not define —not even by negation— a field of knowledge —'divine' reality—, but it highlights a principally methodological issue, which defines a 'way' of accessing knowledge in general: the absolute priority of experience regarding its formulation. As Lossky points out, apophaticism is 'an existential attitude which involves the whole man: there is no theology apart from experience'.[57] … Firstly, what defines apophaticism is not attributing 'negativity' to God —which is, in fact, a paroxysm of affirmation— but the relative character of both assertion and negation. Secondly, the interpretation of the notion in question —just like in the case of any testimony to tradition—cannot be lured to an a priori category; on the contrary, it takes on full meaning and validity only from

[50] Pentecost, *Quest of the Divine Presence*, 61.
[51] Ibid., 62.
[52] Gregory Palamas, *The Triads*, I.3.17.
[53] Ibid., II.3.15.
[54] Pentecost, *Quest of the Divine Presence*, 63.
[55] Gregory Palamas, *The Triads*, II.3.67.
[56] Pentecost, *Quest of the Divine Presence*, 69, referring to *The Triads*, II.3.76.
[57] V. Lossky, *The Mystical Theology of the Eastern Church* (St. Vladimir's Seminary Press: Crestwood, NY, 1976), 39.

its connection to the other historical testimonies of tradition and, above all, from an 'ecclesiastical' experience that is alive and dynamic.[58]

In an insightful reflection on the theological contributions of St Symeon the New Theologian, Nikolaos Loudovikos describes his times as characterized by an estrangement from God emerging from the identification of the contemplation in the Holy Spirit with the scholastic "reworking of meaning in the mind."[59] The context is different but the understanding of apophaticism manifests an impressive similarity with the arguments of St Gregory Palamas:

> The grace of Baptism was scorned, since study of the texts alone was considered 'precise and certain information concerning the Holy *Trinity*.' Worship of the text stifled its spirit, and contemplation became speculative representation, or, according to Symeon 'foolishness.' Foolishness, then, is a preference for representation: when scholars hear about the triune radiance of the one divinity, they immediately conjure up in their minds a 'simile' of three suns and 'foolishly consider to perceive divinity – and thus the holy, consubstantial and undivided Trinity – as being the same as the simile.' But representation excludes 'union in knowledge' as a false and deceptive concept, whereas, in fact, it is 'knowledge through will,' that is, free, existential communion. … This union, then, happens through the will, without being representative; the communion obviates the need for representation, establishing apophaticism as experience of the Being: 'But if, indeed, they were united to Him, they would never dare speak about Him, seeing that everything in Him is inexpressible and incomprehensible; and not only the mysteries about Himself but also the great part of His works are unknown to all.'[60]
>
> It is union, therefore, as communion in existence, which gives rise to apophaticism. It is not the apophatic as a comment on representation, but an opportunity for participation. … This nonrepresentational, apophatic knowledge, being the result of participation, redefines the content of faith. Because otherwise faith risks ending up as a radical unfamiliarity with Being.[61]
>
> According to Gregory Palamas, *Theognosia*

[58] Federico Aguirre, 'Theological Apophaticism and Philosophical Nihilism, Towards a Theory of Knowledge', *Teología y Vida* 60.2 (2019): 229-242, 231.

[59] Nikolaos Loudovikos, *Analogical Identities: The Creation of the Christian Self, Beyond Spirituality and Mysticism in the Patristic Era* (Turnhout, Belgium: Brepols Publishers n.v., 2019), 91.

[60] Ibid., referring to Symeon the New Theologian, *Hymns* 3.261.

[61] Ibid., 92.

> … is an event, a direct charismatic experience given to those who are pure of heart and mind, who are illuminated in body and soul by the uncreated light of divine grace. The prophets, the apostles and the saints of the Church ascended and ascend to this height of vision and communion with God. Together with this charismatic theology, which is basically a theophany of God, rationalistic theology has its place. The latter begins from and elaborates upon the insights of the former.[62]

We can see how the discussion of the legitimacy of using apodictic syllogisms in theology turned into a discussion of the nature—created or uncreated—of the theophanies in the Old and the New Testaments, as well as of the physical or sensible nature of the divine light seen by the Apostles during the Transfiguration of the Lord on Mount Tabor.[63] Fr John Romanides explicitly pointed out the Latin theological point of departure of the Calabrian monk.[64] For Barlaam, if the light shining at Mount Tabor was visible to the Apostles, it had to be created, definable and physically perceptible (i.e., it could not have been uncreated). For Palamas, this light was uncreated, eternal, and undefinable, transcending both the intellect and the natural laws of physical sensation. For him this is the Divine glory that is not an objectively given reality that can be perceived by anyone present, because its vision requires the transformative effect of the Divine grace and energies. A reference to the first homily of St Gregory Palamas on the Transfiguration of Christ will help in clarifying this point:

> The light of the Lord's transfiguration does not come into being or cease to be, nor is it circumscribed or perceptible to the senses, even though for a short time on the narrow mountain top it was seen by human eyes. Rather, at that moment the initiated disciples of the Lord 'passed', as we have been taught, 'from flesh to spirit' by the transformation of their senses, which the Spirit wrought in them, and so they saw that ineffable light, when and as much as the Holy Spirit's power granted them to do so. Those who are not aware of this light and who now blaspheme against it think that the chosen apostles saw the Light of the Lord's Transfiguration with their created faculty of sight, and in this way they endeavour to bring down to the level of a created object

[62] Stavros Yangazoglou, 'Philosophy and Theology: The Demonstrative Method in the Theology of Saint Gregory Palamas', *The Greek Orthodox Theological Review* 41.1 (1996): 1–18, 17.

[63] Stoyan Tanev, 'Created and Uncreated Light in Augustine and Gregory Palamas: The Problem of Legitimacy in Attempts for Theological Reconciliation', *Analogia — The Pemptousia Journal for Theological Studies* 4.3, Special issue on St Gregory Palamas, Part 2 (2018): 81–114. On the transformative effect of the Old and New Testament theophanies see Bogdan Bucur, *Scripture Re-envisioned: Christophanic Exegesis and the Making of a Christian Bible* (Leiden; Boston: Brill, 2019).

[64] John Romanides, 'Notes on the Palamite Controversy and Related Topics', Part I, *The Greek Orthodox Theological Review* 6 (1960–61):193–202, 194.

> not just that light—God's power and kingdom—but even the power of the Holy Spirit, by which divine things are revealed to the worthy.[65]

In this passage, St Gregory referred to St Maximus the Confessor to emphasize that it was actually Christ's disciples who were transfigured by the Spirit and made able to see his divine glory.[66] In addition, he relates the experience of the apostles to the experience of Moses:

> Everything about the blessed divine nature is truly beautiful and desirable, and is visible only to those whose minds have been purified. Anyone who gazes at its brilliant rays and its graces, partakes of it to some extent, as though his own face were touched by dazzling light. That is why Moses' countenance was glorified when he spoke with God (Exod. 34:29). Do you observe that Moses too was transfigured when he went up the mountain and beheld the Lord's glory? But although he underwent transfiguration, he did not bring it about, in accordance with him who said, 'the humble light of truth brings me to the point where I see and experience God's radiance'.[67]

A necessary condition for the theophanic experience is that the visionary is in the proper state of soul under the influence of grace.[68] The divine light is not accessible to the human capacities in the way they naturally operate. It is physically invisible and inaccessible to them. Every human being can prepare by good works, purification of the heart, and prayer, but the vision of the Divine light is ultimately given by the transformation of the natural human capacities through the enabling power of the gifts of the Holy Spirit, the Eternal Spirit of the Father and the of the Son, who proceeds from the Father and rests on the Son. The Spirit who rests upon Christ and his humanity rests as well on those who are gathered in the Body of Christ – the Church.

> It has always been the Orthodox judgment that union with Christ can be lived only in the Holy Spirit, and that the experience of being in the Holy

[65] St Gregory Palamas, 'Homily Thirty Four on the Holy Transfiguration of our Lord and God and Saviour Jesus Christ', in *The Homilies*, transl. Christopher Veniamin (Dalton, PA: Mount Tabor Publishing, 2009), 266–74, 269.

[66] Andrew Louth, *Maximus the confessor* (London: Routledge, 1996), 106, *Difficulty* 10, 1125D–1128A: 'They beheld Him transfigured, unapproachable because of the light of his face, were amazed at the brightness of his clothes and in the honor shown Him by Moses and Elijah who were with Him on either side, they recognized his great awesomeness. And they passed over from flesh to spirit, before they had put aside this fleshly life, by the change in their powers of sense that the Spirit worked in them, lifting the veils of the passions from the intellectual activity that was in them'.

[67] St Gregory Palamas, 'Homily Thirty Four', 271. In this passage, St Gregory refers to St Gregory the Theologian's *Oration on the Holy Theophany, that is to say, On the Birth of Our Saviour* XXXVIII.

[68] Cory Hayes, *Deus In Se Et Deus Pro Nobis*: The Transfiguration in the Theology of Gregory Palamas and its Importance for Catholic Theology (PhD diss.: Duquesne University, 2015), 94.

> Spirit is nothing other than union with Christ. The more vividly one knows Christ and the more one comes to live in him, the more one knows and lives in the Holy Spirit. The more spiritual a life one leads the more lovingly is one bound to Christ.[69]

In this sense, the spiritual empowerment enabled by the Holy Spirit is both Christological and Trinitarian. It is the Trinitarian divine activity that transforms or transfigures the sight of Moses and of the Apostles, originating from the Father, through the Son, in the Holy Spirit, so that they could start seeing this same Light according to the degree of their receptivity, and according to the divine will for them. It is, however, Christ himself who appears in the theophanies, since it is him who sends the Spirit from the Father, he is the one in whom all things were created and hold together.

The debate between Albert Einstein and Niels Bohr

Classical vs quantum epistemology

Quantum physics began challenging the epistemology of classical physics in the beginning of the 1920s and resulted in the famous debate between Albert Einstein and Niels Bohr. The key issues in the debate are still reverberating and it was just in the last quarter of the twentieth century that modern physics experiments demonstrated that the fundamental issues in the famous Einstein-Bohr debate have been resolved in Bohr's favor. The outcome of the debate was the disclosure of a profoundly new relationship between the parts and whole of physical entities, which is completely 'non-classical'. This new relationship suggests that the classical conception of the ability of a physical theory to disclose the whole as a sum of its parts, or to describe reality-in-itself, is no longer acceptable. Modern physics experiments have made it perfectly clear that these assumptions of classical physics are no longer valid.[70]

The uncertainty principle and the problem with visualization

It took more than two decades after the discovery of quantum physics before it became possible to formulate a theory that was similar in functioning to Newtonian mechanics. Quantum mechanics was introduced in 1925 and 1926 by Schrödinger and Heisenberg in two different but mathematically equivalent versions. Schrödinger suggested his equation in 1925 as a description of the idea of the French physicist

[69] Dumitru Staniloae, 'Trinitarian Relations and the Life of the Church', in Dumitru Staniloae, *Theology and the Church*, tr. Robert Barringer (Crestwood, NY: St. Vladimir's Seminary Press, 1980), 14.

[70] Robert Nadeau and Menas Kafatos, *The Non-Local Universe: The New Physics and Matters of the Mind* (Oxford: Oxford University Press, 1999).

Louis de Broglie that all quantum particles could behave like waves. Schrödinger's equation ascribed to a particle a wave function (denoted ψ and called also the ψ-function) from which the particle's future behavior can be predicted. The wave function was a purely mathematical expression, not directly related to anything observable.[71] It soon "evolved into the notion of 'quantum state' ψ, endowing it with heavy ontological weight. This conceptual step was wrong, and dramatically misleading. … The idea that the quantum state ψ represents the 'actual stuff' described by QM has pervaded later thinking about the theory. … To be fair, Schrödinger himself realized soon the problems with his early interpretation, and became one of the most insightful contributors to the long debate on the interpretation; but the misleading idea of taking the 'quantum state' as a faithful description of reality stuck."[72]

Heisenberg's version of quantum mechanics was presented in virtually non-classical terms and led to the formulation of the so-called *uncertainty principle*.[73] When applied to a particle, Heisenberg's uncertainty principle means that having more precision in measuring the particle's position leads to less precision in measuring its velocity, and vice versa. We cannot see the quantum object, we cannot point to its specific position, speak of its specific trajectory, or see it moving from point A to point B. We can just evaluate its chances of being in a specific space region. The emergence of the new situation could be described as part of the apophatization of quantum theory, i.e. its growing challenges of using classical physics language and conceptualization of physical reality.

One of the key questions was how to connect the invisible particle, or its mathematically ascribed wave function, to properties that are observable in an experiment. The first insight that opened the door to an improved understanding of the new situation came from Max Born in 1926, and it was not well received by most physicists at the time. Born adopted Heisenberg's theoretical insights and, together with Pascual Jordan, helped to articulate them in a matrix form, leading to the formulation of matrix quantum mechanics—its first conceptually autonomous and logically consistent formulation. In addition, Born argued that the amplitude of Schrödinger's wave function is related to a probability—'specifically, the probability that you will find the particle at that position if you detect it experimentally'.[74] According to the so-called Born's

[71] Philip Ball, 'Mysterious Quantum Rule Reconstructed From Scratch', *Quantamagazine*, February 13, 2019: https://www.quantamagazine.org/the-born-rule-has-been-derived-from-simple-physical-principles-20190213/#

[72] Carlo Rovelli, 2018 'Space is blue and birds fly through it', *Philosophical Transactions of the Royal Society* A 376 (2018): 1-13, 2. http://dx.doi.org/10.1098/rsta.2017.0312.

[73] Werner Heisenberg, 'Über quantentheoretische Umdeutung kinematischer und mechanischer Beziehungen', *Zeitschrift für Physik*, 33.1 (1925): 879–893. An English translation can be found in B. L. van der Waerden, trans., ed., *Sources of Quantum Mechanics* (New York: Dover, 1968), 261–276.

[74] Philip Ball, 'Mysterious Quantum Rule Reconstructed From Scratch', *Quantamagazine*, February 13, 2019: https://www.quantamagazine.org/the-born-rule-has-been-derived-from-simple-physical-principles-20190213/#

rule, this probability is provided by the square of the wave function: ψ^2. Thus the new theory provided the probability of locating a particle within a specific region and the range of velocities that characterize its movement. What greatly disturbed physicists was that Born's definition of the term probability did not refer to the behavior of a system in a way that could be described in classical terms. He was referring to an inherent measurement aspect of all quantum mechanical events, which considered their behavior probabilistic by nature and did not allow to predict precisely where a particle would be observed no matter what improvements were made in both theory and experiments. The radicalness of Born's proposal consisted in the fact that

> [i]n most physics equations, the variables refer to objective properties of the system they are describing: the mass or velocity of bodies in Newton's laws of motion, for instance. But according to Born, the wave function is not like this. It's not obvious whether it says anything about the quantum entity itself—such as where it is at any moment in time. Rather, it tells us what we might see if we choose to look. It points in the wrong direction: not down toward the system being studied, but up toward the observer's experience of it. 'What makes quantum theory puzzling is not so much the Born rule as a way of computing probabilities,' … 'but the fact that we cannot interpret the measurements as revealing some pre-existing properties of the system.' What's more, the mathematical machinery for unfolding these probabilities can only be written down if you stipulate how you're looking. If you do different measurements, you might calculate different probabilities, even though you seem to be examining the same system in both cases.[75]

The principle of complementarity and the breakdown of classical logic

The particle-like understanding of light emerged after Planck's discovery of the quanta, primarily due to Einstein's explanation of the photoelectric effect. It was around 1920 when light 'acquired' in physics an explicitly dual, i.e. wave-particle, character that was unexplainable by the existing laws of classical physics. Almost at the same time the pervasive nature of this duality at the quantum level became apparent as well. Both light and particles, under different complementary circumstances, can manifest their presence in a wave-like or particle-like manner.

It is quite significant that the point at which mathematical theory meets the realm of the un-visualizable is exactly the point at which classical logic breaks down as well. This required a new logical framework that was originally developed by Niels Bohr in an effort to explain wave-particle dualism in quantum physics.[76] The mutual exclusivity

[75] Ibid.

[76] Niels Bohr, 'The Quantum Postulate and the Recent Development of Atomic Theory'. *Nature* 121 (1928): 580–90. See also Steen Brock, 'Old Wine Enriched in New Bottles: Kantian Flavors in Bohr's View-

of wave and particle behaviors of single quantum entities was the basis for him to define the principle of complementarity—a single quantum entity can either behave as a particle or as wave, but never simultaneously as both. One of the basic laws of Aristotelian logic is the law of the excluded middle, which claims that x is either y or not y, or that an attribute belongs or does not belong to an object and there is no middle ground on which two essentially opposite attributes could belong to the same object. Traditional normative logic, which is premised on this law, is based on our dealings with macro-level phenomena and does not hold in the quantum domain where the quantum nature of physical reality requires a new logic and new epistemology.[77] The need for the new logical framework was based on the fact that, in addition to the need to represent the opposition of two sets of properties that preclude one another in any given experimental situation, both these sets were necessary to achieve a comprehensive understanding of the quantum object. Such framework does not only refer to the measurability or knowability of the properties of an object but, more importantly, it accounts for the limitations of the actualization and manifestation of these properties in the physical world. Thus, the character of physical reality is determined by the ways of energetic manifestation of its properties, which are limited by the trade-offs between the two aspects of its dual wave-particle nature. The emergence of complementarity in a quantum system occurs when one considers the specific circumstances under which we attempt to observe or register its properties. As Bohr noted, the principle of complementarity 'implies the impossibility of any sharp separation between the behaviour of atomic objects and the interaction with the measuring instruments which serve to define the conditions under which the phenomena appear'.[78]

In what way exactly the principle of complementarity does not conform to classical logic? The problem does not consist in the fact that two profoundly different models of behavior (wave vs particle), that preclude one another in any given situation, are both necessary to achieve a complete understanding of a quantum object. The principle of complementarity ensures that we can never apply both models to the same entity at the same time (i.e., to the same experimental configuration or measurement). It is only when we tried to apply both models simultaneously to the same entity that contradictions would appear. For Bohr, however, '[t]he aim of the idea of complementarity was to allow of keeping the usual logical forms while procuring the extension necessary for including the new situation relative to the problems of observation in atomic physics'.[79]

point of Complementarity', in: Michel Bitbol, Pierre Kerszberg, Jean Petitot (eds.), *Constituting Objectivity, Transcendental Perspectives on Modern Physics* (Berlin: Springer Science + Business Media B.V., 2009) 301–316, 314.

[77] George Birkhoff and John von Neumann, 'The Logics of Quantum Mechanics', *Annals of Mathematics* 37 (1936): 823–43.

[78] Niels Bohr, 'Discussion with Einstein on Epistemological Problems in Atomic Physics', in *Albert Einstein: Philosopher-Scientist*, ed. Paul Arthur Schilpp, 199–241 (Evanston: The Library of Living Philosophers, 1949), 210.

[79] Ibid., 115–16.

Interestingly, Bohr refers to *a new situation*. What was this new situation? Before the emergence of quantum physics, all physical objects were known to behave in experiments in one out of two ways—as a particle or as a wave. As a result, some of the physical objects existing in nature were considered to possess the properties of a particle and others to possess the properties of a wave. There was no way for a classical object to deviate from its wave or particle properties in different experimental setups. After the emergence of quantum physics, scientific experiments clearly showed that an individual physical object can manifest properties of either particles or waves depending on the specific experimental configuration they are put into. In other words, it "became possible" for physical objects to drastically alter their manifested properties depending on the personal engagement of the observer, resulting in a specific experimental design. In other words, one could not speak anymore of objectively existing properties of quantum objects independently of observer's experimental intervention. The quantum object exists objectively, but its properties emerge within the context of the experimental setup and observer's intention behind it. This makes quantum physics experiments to a great extent personal and subjective. The world 'makes itself known to each of us through our own private internal perceptions.'[80]

Albert Einstein vs Niels Bohr

The famous debate between Bohr and Einstein began at the fifth Solvay Congress in 1927 and continued until Einstein's death in 1955. The argument took the form of a discussion of thought experiments in which Einstein would try to attack the validity of Heisenberg's uncertainty principle by demonstrating that it was theoretically possible to simultaneously measure, or at least determine, the precise values of two complementary constructs in quantum physics—position and velocity. Bohr would then respond with a careful analysis of the conditions and the results of the thought experiments and demonstrate that there were fundamental ambiguities Einstein had failed to resolve.[81]

Einstein eventually accepted Heisenberg's uncertainty or indeterminacy principle. He, however, never really entered the discussion of the principle of complementarity.[82] The essential point of subsequent disagreement in the debate became whether quantum theory was a complete theory. Einstein's position can be expressed by one of his most famous quotes today: 'Quantum mechanics is certainly imposing. But an

[80] N. David Mermin, 'Physics: QBism puts the scientist back into science'. *Nature* 507 (2014): 421–23: https://www.nature.com/news/physics-qbism-puts-the-scientist-back-into-science-1.14912.

[81] An insightful discussion of the nature of the debate between Einstein and Bohr can be found in: Robert Nadeau and Menas Kafatos, *The Non-Local Universe: The New Physics and Matters of the Mind* (Oxford: Oxford University Press, 1999), 162.

[82] N. P. Landsman, 'When champions meet: Rethinking the Bohr–Einstein debate', *Studies in History and Philosophy of Modern Physics* 37, 212–242, 217.

inner voice tells me that it is not yet the real thing. The theory says a lot, but does not really bring us any closer to the secret of the "Old one". I, at any rate, am convinced that He does not throw dice'.[83] According to Einstein, if our current understanding about the nature of quantum objects is probabilistic, this only shows that we are missing something and there should be some 'hidden variables' that escape our knowledge but will be certainly discovered as our theories keep improving over time. In other words, our ignorance about the variation of these hidden variables makes quantum reality appear as probabilistic, unpredictable, and unknowable in classical terms. Therefore, future knowledge of these hidden variables would supposedly make the description of quantum systems completely deterministic. In other words, although quantum indeterminacy may be a property of a quantum system in practice, it does not need to be so in principle. In this sense, the physical attributes of quantum systems can be viewed as objective or real even in the absence of measurement and we could assume, as Einstein did, a one-to-one correspondence between every element of the physical theory and the physical reality.

Bohr agreed that the existing theories may and will improve with time but believed that this improvement will still need the principles of uncertainty and complementarity because they are inherent characteristics of the nature of quantum objects. He looked at quantum objects in terms of their energetic manifestations in the effects of their interaction with measuring instruments rather than in terms of the properties they manifest in isolation and independently of an observer. In Bohr's ultimate view all available quantum phenomena are defined strictly in terms of the manifestations of particular aspects of their inner nature in recorded effects, such as the click of a photo-detector, rather than in terms of properties that are pre-assigned to the quantum objects independently of their involvement in an experiment. The assignment of such properties to particles in advance, when they are on their own and outside of a specific experimental configuration, is unacceptable in view of the impossibility of any sharp separation between the behavior of atomic objects and their interaction with the measuring instruments that serve to define the conditions under which the observable phenomena appear. In this sense, quantum discreteness, discontinuity, individuality, and indivisibility are transferred to the level of the phenomena and their effects. This transfer requires a terminological adjustment. All terms now apply to certain physically complex and apparently non-localized entities, each involving the whole experimental arrangement, rather than to single physical entities that are narrowly localized in space. In Bohr's view, there is no God-like perspective from which we can know physical reality in

[83] Letter to Max Born (December 4, 1926), in Max Born and Albert Einstein, *The Born-Einstein Letters*, transl. Irene Born (New York: Walker and Company, 1971). Einstein used slightly different versions of this quote at other times. For example, in a 1943 conversation with William Hermanns recorded in William Hermanns, *Einstein and the Poet – In search of the Cosmic Man* (Wellesley, MA: Branden Books, 1st edition, 2011), 58, where Einstein was quoted to have said: 'As I have said so many times, God doesn't play dice with the world'.

itself. Thus, we are forced to recognize that our knowledge of physical reality is in principle local and, therefore, incomplete.

Bohr's way of expression, especially in the early stage of the development of quantum mechanics, did not help much in providing clarity to his positions. Even his own followers shared an uneasiness with respect to his way of using words and sometimes expressed wide disagreements with respect to what he really meant to say. For example, Paul Ehrenfest wrote to him in a letter from July 17, 1921: 'Now, dear Bohr, every person I know wails only over the fact that you write your things so briefly and compactly that one always has the greatest trouble fetching all of the ideas out of the fruit cake'.[84] The point here is that Bohr appeared to struggle with finding the proper language to talk about the emerging quantum theory. One could, however, look at Bohr's struggle in another way. Heisenberg noted several times that Bohr did not have a problem with language but was in the process of creating a new one. In this process, he 'tried to keep the words and the pictures without keeping the meaning of the words and of the pictures, having been from his youth interested in the limitation of our way of expression, the limitation of words, the problem of talking about things when one knows that the words do not really get hold of the things'.[85] Heisenberg's view provides another indication for the existence of a process of apophatization that quantum physics was, and still is, undergoing.

A more balanced approach to the interpretation of the debate

According to a recent interpretation of the debate between Einstein and Bohr suggested by N. P. Landsman,[86] in the early stages of the debate Bohr was the undisputed winner. However,

> after decades of derision by the Copenhagen camp, Einstein's star as a critic of quantum mechanics has been on the rise since about the early 1980s. … Bohr's reputation as an interpreter of quantum mechanics seems to be travelling in the opposite direction. During his lifetime, Bohr was revered like a demi-god by many of his contemporaries, certainly because of his brilliant pioneering work on quantum theory, probably also in view of the position of inspirer and even father-figure he held with respect to Pauli (who seems to have been Bohr's greatest admirer) and especially Heisenberg.[87]

[84] Catherine Chevalley, 'Niels Bohr's Words and the Atlantis of Kantianism', in *Niels Bohr and Contemporary Philosophy*, eds. Jan Faye and Henry Folse, 33–55 (Dordrecht: Kluwer Academic, 1994), 33.

[85] Ibid.

[86] N. P. Landsman (2006) When champions meet: Rethinking the Bohr–Einstein debate. *Studies in History and Philosophy of Modern Physics 37*, 212–42.

[87] Ibid., 214.

While most of the presentations of the Einstein–Bohr debate closely follow Bohr's perspective,[88] Landsman agrees with Beller (1999)[89] that 'Bohr's account was written from a winner's perspective, concentrating on parts of the debate where he indeed emerged victorious, if not "triumphant"'.[90] Things seem to be changing after a recent reevaluation of the importance of the so-called EPR (Einstein, Podolsky, and Rosen) paper[91] to the extent that the most recent critique of Bohr's position has become extremely biased and even intellectually embarrassing.[92]

The EPR paper was published in 1935 to suggest a thought experiment intended to demonstrate an inherent paradox in the early formulation of quantum theory.

> The paradox involves two particles which are entangled with each other according to quantum mechanics. Under the Copenhagen interpretation of quantum mechanics, each particle is individually in an uncertain state until it is measured, at which point the state of that particle becomes certain. At that exact same moment, the other particle's state also becomes certain. The reason that this is classified as a paradox is that it seemingly involves communication between the two particles at speeds greater than the speed of light, which is a conflict with Einstein's theory of relativity.[93]

As Landsman pointed out, 'EPR was really a confused and confusing mixture of Einstein's earlier attack on the uncertainty relations with his later "incompleteness" arguments against quantum mechanics' but, at the same time, 'the immediate response to EPR by the Bohr camp reveals their breathtaking arrogance towards Einstein's critique of quantum theory'.[94] Bohr and his supporters did not see in this paper any new relevant arguments against their position and kept bluntly applying their previous logic in refuting it. According to Landsman, they did that 'with an obscurity surpassing that of EPR' but, more importantly, 'this attitude must count among the most severe errors of judgement in the history of physics'.[95] This is because EPR has become

[88] Niels Bohr, 'Discussion with Einstein on epistemological problems in atomic physics', in P. A. Schilpp, ed., *Albert Einstein: Philosopher-scientist* (La Salle: Open Court, 1949), 201–241.

[89] M. Beller, *Quantum dialogue* (Chicago: University of Chicago Press, 1999).

[90] Landsman, 'When champions meet', 215.

[91] A. Einstein, B. Podolsky and N. Rosen, 'Can quantum-mechanical description of physical reality be considered complete?' *Physical Review* 47 (1935): 777–80.

[92] See for example Adam Becker, *What Is Real? The Unfinished Quest for the Meaning of Quantum Physics* (New York: Basic Books, 2018), 5–6, who ascribes to Bohr an antirealist philosophical view that cannot be found anywhere in his writings, neither in the writings of his closest followers.

[93] Andrew Zimmerman Jones, 'EPR Paradox in Physics. How the EPR Paradox Describes Quantum Entanglement'. *ThoughtCo.* https://www.thoughtco.com/epr-paradox-in-physics-2699186 (last accessed on May 12, 2019).

[94] Landsman, 'When champions meet', 217.

[95] Ibid.

> arguably the most famous paper ever written about quantum mechanics. For although Einstein's original intention might have been to press what he felt to be a *reductio ad absurdum* argument against quantum theory, the paper is now generally read as stating a spectacular prediction of quantum theory, viz. the existence of what these days are quite rightly called EPR-correlations. The theoretical analysis of these correlations … revitalized the foundations of quantum theory, and their experimental verification … was done in one of the most stunning series of experiments in twentieth-century physics.[96]

In other words, Einstein suggested the configuration of a quantum entanglement experiment in order to demonstrate that such entanglement was impossible, but the experiment proved the opposite (i.e., Einstein demonstrated his greatness by being wrong). As a result, one could claim together with Landsman that 'Amazingly, the one outcome of the Bohr-Einstein debate that is of lasting value for physics therefore concerns a phenomenon whose existence Einstein actually denied… and whose significance Bohr utterly failed to recognize!'[97]

The discussions between Einstein and Bohr focusing on the incompleteness of quantum mechanics 'were incredibly fruitful and informative for later developments in the foundations of quantum mechanics' and, 'with the exception of his controversial reply to EPR, Bohr's refutations of Einstein's arguments were extremely thoughtful and elegant'.[98] According to Abraham Pais, a scientist who knew both Einstein and Bohr very well, Bohr is 'not only a major figure in physics but also one of the most important twentieth-century philosophers. As such he must be considered the successor to Kant'.[99]

Independently of their disagreements, 'Bohr and Einstein were both quite worried about the problem of objectification in physics, especially in quantum mechanics… Bohr claimed objectification of a quantum system through the specification of an experimental context; Einstein claimed objectification of any physical system to arise from its (spatial) separation from the observer'.[100] Landsman shows mathematically that the positions of our two giants overlap significantly: 'a point

[96] See Stuart Freedman and John Clauser, 'Experimental Test of Local Hidden-Variable Theories', *Physical Review Letters* 28 (1972): 938–41; Alain Aspect, Philippe Grangier, and Gérard Roger, 'Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: A New Violation of Bell's Inequalities', *Physical Review Letters* 49 (1982): 91–94; Alain Aspect, Jean Dalibard, and Gérard Roger, 'Experimental Test of Bell's Inequalities Using Time-Varying Analyzers', *Physical Review Letters* 49 (1982): 1804–7; W. Tittel, J. Brendel, H. Zbinden, and N. Gisin, 'Violations of Bell Inequalities More Than 10km Apart', *Physical Review Letters* 81 (1998): 3565–66. For a broader list of similar experiments, the reader could visit: https://en.wikipedia.org/wiki/Bell_test_experiments.

[97] Landsman, 'When champions meet', 217–218.

[98] Ibid., 216.

[99] Abraham Pais, *The genius of science* (Oxford: Oxford University Press, 2000), 23.

[100] Landsman, 'When champions meet', 216.

both failed to recognize, probably not merely for the ideological reason stated above, but undoubtedly also because of the desire of both to defeat the opponent'.[101]

Bohr's focus on the importance of classical physics concepts in describing quantum mechanical phenomena is particularly interesting. According to Bohr the key point is that, in contrast with the situation in classical physics, in quantum mechanics it is no longer possible sharply to distinguish between the autonomous behaviour of a physical object and its inevitable interaction with other bodies serving as measuring instruments.[102]

> We are faced here with an epistemological problem quite new in natural philosophy, where all description of experiences so far has been based on the assumption, already inherent in the ordinary conventions of language, that it is possible to distinguish sharply between the behaviour of objects and the means of observation. This assumption is not only fully justified by everyday experience, but even constitutes the whole basis of classical physics . . . [In light of this situation] we are, therefore, forced to examine more closely the question of what kind of knowledge can be obtained concerning objects. In this respect, we must … realize that the aim of every physical experiment—to gain knowledge under reproducible and communicable conditions—leaves us no choice but to use everyday concepts, perhaps refined by the terminology of classical physics, not only in accounts of the construction and manipulation of measuring instruments but also in the description of actual experimental results.[103]
>
> …
>
> The argument is simply that by the word "experiment" we refer to a situation where we can tell others what we have done and what we have learned and that, therefore, the account of the experimental arrangement and of the results of the observations must be expressed in unambiguous unambiguous language with suitable application of the terminology of classical physics.[104]

[101] Ibid., 218.

[102] Kristian Camilleri, 'Why do we find Bohr obscure? Reading Bohr as a philosopher of experiment', in Jan Faye and Henry Folse, eds., *Niels Bohr and the Philosophy of Physics – Twenty First Century Perspectives* (London: Bloomsbury Academic, 2017), 19-46, 29.

[103] Niels Bohr, 'Natural Philosophy and Human Cultures', in *Atomic Physics and Human Knowledge: The Philosophical Writings of Niels Bohr, Vol. II, Essays 1932-1957* (Woodbridge, CT: Ox Bow Press, 1987), 23-31, 25.

[104] Niels Bohr, 'Discussions with Einstein on epistemological problems in atomic physics', in P. A. Schilpp, ed., *Albert Einstein, Philosopher-Scientist: The Library of Living Philosophers, Vol. 7* (Evanston, IL: Open Court, 1949), 201-241, 209.

It appears therefore that we can speak of a type of contextual realism where, for Bohr, the epistemological problem was how experimental knowledge of quantum objects is possible through specifically designed experiments.[105] Bohr's focus on the necessity of classical concepts could be characterized as an articulation of the need for a quantum "economy" of knowledge where we have to give up any attempts to talk about the inner nature of quantum objects and focus on what we can learn about them through the objective description of the experimental situation by the linguistic means of classical physics – the only way accessible to us to share our personally acquired experience and knowledge.

A theological analogy could help in understanding the positions of Einstein and Bohr

Landsman's article is particularly relevant for our discussion. The author is a well-known theoretical physicist[106] who, interestingly, employed a theological argument to enlighten the essence of the disagreement between Einstein and Bohr:

> More importantly, the agreement between Einstein and Bohr on the solution to the problem of objectification in quantum theory paves the way for an identification of their exact disagreement on the issue of the (in)completeness of the theory. Namely, the technical parts of their debate on the (in) completeness of quantum mechanics just served as a pale reflection of a much deeper philosophical disagreement between Bohr and Einstein about the knowability of Nature. For Bohr's doctrine of classical concepts implies that no direct access to the quantum world is possible, leaving its essence unknowable. This implication was keenly felt by Einstein, who in response was led to characterize his opponent as a 'Talmudic philosopher'.[107]

Landsman showed how astute the characterization of Bohr as a Talmudic philosopher was through a theological analogy comparing Bohr and Einstein with Maimonides and Spinoza, respectively, on the unknowability of God. Bohr insisted that the formalism of quantum theory provided a complete description of physics and accepted as a given the incompleteness of the knowledge the theory provides. This for Einstein was equivalent to a mere acceptance of ignorance. He was most probably following Spinoza (Einstein's intellectual engagement with Spinoza's

[105] Kristian Camilleri, 'Why do we find Bohr obscure? Reading Bohr as a philosopher of experiment', in Jan Faye and Henry Folse, eds., *Niels Bohr and the Philosophy of Physics – Twenty First Century Perspectives* (London: Bloomsbury Academic, 2017), 19-46, 29.

[106] https://scholar.google.co.uk/citations?hl=nl&user=PTyjucMAAAAJ&view_op=list_works&sortby=pubdate

[107] Landsman, 'When champions meet', 218. Landsman refers to A. Einstein, Letter to Erwin Schrödinger (June 19, 1935), in A. Fine, *The Shaky Game: Einstein Realism and the Quantum Theory* (University of Chicago Press, Chicago, 1986), 35.

thought is well known and documented), who spoke about the 'complacency of ignorance' in reference to the scholastic philosophers who defended the unknowability of God.[108] In a letter to Schrödinger from 19 June 1935, Einstein portrays Bohr as follows: 'The Talmudic philosopher doesn't give a hoot for "reality", which he regards as a hobgoblin of the naïve'.[109] According to Landsman, the 'Talmudic philosopher' label reveals the true and insurmountable disagreement that is manifested in the opposition between Einstein's claim that 'God doesn't play dice with the world',[110] and Bohr's reply to him that he 'should stop telling God what to do'.[111]

As Landman indicates, some of the commentators on the Bohr-Einstein debate 'tend to put Einstein in the Talmudic tradition, leaving Bohr at the side of Eastern mysticism (a case supported by Bohr's choice of the yin-yang symbol as the emblem of his coat of arms following his Knighthood in 1947)'. Others will emphasize that Bohr was not religious and did not believe in the existence of a 'God's-Eye View' on quantum reality.[112] The theological analogy suggested by Landsman 'is between the knowability of Nature in physics, as limited by Bohr's doctrine of classical concepts, and the knowability of God in theology, highly restricted as the Old Testament claims it to be. Indeed, Bohr's idea that the quantum world can be studied exclusively through its influence on the ambient classical world has a striking parallel in the 'Talmudic' notion that God can only be known through his actions'. To illustrate this analogy, Landsman quotes from Maimonides' *Guide of the Perplexed*:

> THAT first and greatest of all thinkers, our teacher Moses, of blessed memory, made two requests and both his requests were granted. His first request was when he asked God to let him know His essence and nature; the second, which was the first in point of time, was when he asked Him to let him know His attributes. God's reply to the two requests was to promise that he would let him know all His attributes, telling him at the same time that they were His actions. Thereby He told him that His essence could not be apprehended in itself, but also pointed out to him a starting point from which he could set out to apprehend as much of Him as man can apprehend.

[108] A. Donagan, 'Spinoza's theology', in D. Garrett, ed., *The Cambridge Companion to Spinoza* (Cambridge: Cambridge University Press, 1995), 343–82, 347.

[109] D. Howard, 'Einstein on locality and separability', *Studies in History and Philosophy of Science* 16 (1985): 171–201, 178 (Howard's translation).

[110] See note 82.

[111] Landman refers to R. Kroehling, *Albert Einstein: How I see the world* (PBS Home Video, 1991). In the video, Abraham Pais says about Einstein that 'he had a certain type of arrogance. He had a certain belief that—not that he said it in those words but that is the way I read him personally—that he had a sort of special pipeline to God, you know. He would always say that God doesn't play dice to which Niels Bohr would reply "but how do you know what God's doing?"'

[112] David Farvholdt, 'Niels Bohr and realism', in Jan Faye and Henry Folse, eds., *Niels Bohr and Contemporary Philosophy*, 77–96 (Dordrecht: Kluwer Academic Publishers, 1994), 88.

This quotation correlates with Bohr's view, in which the philosophy of quantum theory is 'bound up with the impossibility of man's knowing himself, and his not being able to know the external world completely because he himself was a part of the external world'.[113]

One of the nicely surprising features of Landsman's theological analogy is its correspondence with some of the key insights of Orthodox theology with respect to the distinction between the unknowable Divine essence and the knowability of the God's energies or activities. Examining the relationship between the Talmudic and the Eastern Christian understanding of the distinction between divine essence and energies is beyond the scope of the present study. We can only mention that a link between the two traditions could be found in Philo of Alexandria (c. 20 B.C.E.–40 C.E.), a Hellenized Jew who spanned two cultures, the Greek and the Hebrew. For him the divine essence is strictly unknowable, and God is known through his powers, which he identifies with the divine glory.[114] 'Philonic metaphysics, rooted in the antinomy between divine transcendence and immanence, begins with the distinction between God's incommunicable divine essence and his participable divine operation, or energy'.[115]

Landsman's analogy indicates the potential of the essence-energy distinction as an exploratory lens in the interpretation of the debate between Einstein and Bohr. This is a unique example of a theological insight offering a deeper understanding of the conceptual development of quantum physics as well as a great example of an insight that could be enhanced through the adoption of the ACTA approach.

The QBist interpretation of quantum mechanics – a basis for a deeper encounter with theology

The describe the current situation of quantum mechanics I will use the testimony of David Mermin – a physicist who has made some genuine contributions to the

[113] See the statement of Sir Nevil Mott, who visited Bohr's Institute in 1928 and wrote in a letter to his mother of October 6, 1928: '...and so Bohr began to talk about the Philosophy of the Quantum Theory and how it was all bound up with the impossibility of man 's knowing himself, and his not being able to know the external world completely because he himself was a part of the external world'. Reference provided by David Farvholdt, 'Niels Bohr and realism', 90.

[114] David Bradshaw, *Aristotle East and West – Metaphysics and the Division of Christendom* (Cambridge University Press, 2004), 59–64; John Dillon, *The Middle Platonists*, Second Edition (Ithaca: Cornell University Press, 1996), 155–70. See also Philo of Alexandria (c. 20 B.C.E.–40 C.E.), *Internet Encyclopedia of Philosophy* https://www.iep.utm.edu/philo/: 'Philo produced a synthesis of both traditions developing concepts for future Hellenistic interpretation of messianic Hebrew thought, especially by Clement of Alexandria, Christian Apologists like Athenagoras, Theophilus, Justin Martyr, Tertullian, and by Origen. He may have influenced Paul, his contemporary, and perhaps the authors of the Gospel of John (C. H. Dodd) and the Epistle to the Hebrews (R. Williamson and H. W. Attridge). In the process, he laid the foundations for the development of Christianity in the West and in the East, as we know it today'.

[115] Tikhon Alexander Pino, 'An essence–energy distinction in Philo as the basis for the language of deification', *The Journal of Theological Studies*, NS, 68.2 (2017): 551–71.

foundations of quantum mechanics, quantum information science, and physics in general.

> More than ninety years after the invention of quantum mechanics, we find ourselves in a strange situation. Quantum mechanics works. Indeed, no theory of physics has ever had such spectacular success. From ignorance about the structure of matter, quantum mechanics has brought us, in less than a century, to an understanding so broad, powerful, and precise that virtually all contemporary technology relies on it. And the theory has enabled us to make sense of phenomena far beyond anything technology has yet been able to exploit. Yet despite this unprecedented success there is notorious disagreement about…. The sentence fades away because it is not so easy to say what the disagreement actually *is* about. …
>
> What we lack is any consensus about what one is actually talking about as one uses quantum mechanics. There is an unprecedented gap between the abstract terms in which the theory is couched and the phenomena the theory enables us so well to account for. We do not understand the meaning of this strange conceptual apparatus that each of us uses so effectively to deal with our world. … What the hell are we talking about when we use quantum mechanics? For practical purposes ordinary everyday quantum mechanics is just fine, and what I have to say is of little or no interest. It is my hope to interest those who, like me, are impractical enough always to have been bothered, at least a bit, by not knowing what they are talking about.[116]

According to Mermin, a recent interpretation of quantum mechanics, called QBism, is "by far the most interesting game in town."[117] It was suggested by Carl Caves, Chris Fuchs, and Rüdiger Schack and builds on many of the insights of the founders of quantum theory. According to Caves, Fuchs and Schack, the confusion at the foundations of quantum mechanics arises out of a confusion about the nature of probability. The dominant view among physicists is the frequentist view of probability: probabilities describe objective properties of ensembles of identically prepared systems. Caves, Fuchs, and Schack take a personalist Bayesian view: An agent assigns a probability p to a single event as a measure of her or his belief that the event will actually take place.[118] They maintain that, if probability is understood in this way, the notorious quantum paradoxes either disappear or assume less problematic forms.

[116] N David Mermin, 'Making better sense of quantum mechanics', *Reports on Progress in Physics*, 82 (2019): 012002 (16pp): https://doi.org/10.1088/1361-6633/aae2c6, 1-2.

[117] N David Mermin, 'Fixing the shifty split', in *Why Quark Rhymes with Pork: and Other Scientific Diversions* (Cambridge: Cambridge University Press, 2016), 219-226, 222.

[118] https://en.wikipedia.org/wiki/Thomas_Bayes#Bayesianism

The personalist Bayesian view of probability has profound implications for the meaning of quantum mechanics, which Fuchs and Schack call quantum Bayesianism, hence its name – Qbism. Since quantum states are used to determine probabilities, if probabilities are indeed assigned by an agent to express her degree of belief, then the quantum state of a physical system is not objectively inherent in that system but assigned by an agent or observer to encapsulate her beliefs about it in a future experiment or observation. State assignments, like probabilities, are relative to a specific agent. We could say therefore that QBism offers a fundamentally personalist perspective on quantum mechanics. Mermin summarizes the ingredients of QBism as follows.[119]

Focus on personal experience

QBism recognizes that individual personal experience is at the foundation of the story each of us tells about the world. The traditional Copenhagen (or so-called "orthodox", a term that, obviously, has nothing to do with theology) interpretation of quantum mechanics overlooks this central role of private personal experience because of its "deep desire to objectify and make impersonal what is, at the most fundamental level, unavoidably subjective and personal. To eliminate the confusion, it is necessary to acknowledge that science in general, and quantum mechanics in particular, is a tool that each of us uses to organize and make sense of our own private experience."[120] At the most fundamental level 'experience' does not mean a unique body of common human experience; it is private to the person having that experience. The same applies to the picture of the world that each of us constructs from our own private experience. There is a common external world in addition to the many distinct individual personal external worlds. The common world must be understood as the mutual construction that all of us have put together from our distinct private experiences, using our most powerful communication tool – human language.

Language

Personal experience is private, but language enables each one of us to communicate it to others. 'Language' is any way someone else can induce experiences in me, in a way that I can get some sense of the content of her or his personal experiences. My experience of others provides me with highly plausible evidence that they do indeed have experiences of their own, which play for them the same role that my experience plays for me. Language enables us each to hypothesize features that are common to our otherwise private personal experiences. This is how we can each arrive at something like a common understanding of major parts of the worlds that each of us has built from their own experience. We are in the habit of calling 'the world' this

[119] Here I am summarizing the ideas of Mermin in: N David Mermin, 'Making better sense of quantum mechanics', 2-5.

[120] Ibid., 2.

common understanding we all arrive at through language. Quantum mechanics is just a tool that we use to help us make sense of our personal worlds.

Actions

The world acts on every individual person, inducing the private experiences out of which he or she builds an understanding of the world. Reciprocally, individual persons act on the world and can infer the consequences of their actions on the world from the experiences the world creates back in them through its response to their personal actions. An action on the world can be gentle and implicit or as intrusive and explicit as, for example, using or reading about a complex apparatus that performs and records what happens in a carefully designed experiment.

> The outcome of an action, being an experience, is subjective. It is private to the person taking that action. But its representation in language can be communicated to other people. What I call the objective world is built out of such linguistically shared subjective experiences. Language is the only means we have for trying to compare the personal outcomes of all such users, and for trying to convey all those outcomes to users who were not watching or otherwise experiencing those actions and their consequences.[121]

Bettability – articulating the anticipation of things to happen

My prior experiences provide a basis for me to form expectations for the responses of the world to my potential actions. Those expectations can be expressed in terms of probabilities, i.e. as the odds at which I am willing to place or accept bets.

> Laws of science are the regularities we have discerned in our individual experiences, and agreed on as a result of our communications with each other. Science, in general, and quantum mechanics, in particular, impose further constraints on my probabilistic expectations. They help each of us place better bets on our subsequent experience, based on our earlier experience. We are able to navigate the world better because it is bettable. This is obvious for the laws of quantum mechanics, which are explicitly probabilistic. It also holds for classical physics, though bettability can be obscured in classical physics by a widespread misunderstanding of probabilities that are often very close to zero or one.[122]

For Mermin science can be viewed as a user's guide to the world and scientific laws are simply guides to action, which have proved to be spectacularly successful. Thus, the laws of science find their meaning in the actions they inspire in every user of science.

[121] Ibid., p. 4.
[122] Ibid.

Probability one – being confident about a potential outcome

According to Mermin, with the advent of quantum mechanics, deterministic mechanisms disappeared from physics. QBism holds that probability assignments are personal judgments even when p = 1, i.e. when we are absolutely certain about the specific outcome of an event resulting from our actions. Probability 1 indicates a particular intensity of belief: a supreme confidence in the positive outcome of a future event. It does not imply the existence of a deterministic mechanism guaranteeing the positive outcome. The fact that the assignment of probabilities of 1 or 0 are personal judgments is essential to the coherence of QBism.

> This view of probability 1 or 0 has the virtue of undermining the temptation to find any kind of 'nonlocality' in quantum mechanics. When a single photon is observed at one slit, nothing changes at the other slit when the probability of observing it there instantly drops to 0. The instantaneous change is in the expectations of whoever made the observation.[123]

Most physicists take it for granted that an outcome with probability 1 must be enforced by an objective mechanism. For a QBist, the assignments of a probability of 1 are also personal expressions of the willingness to place or accept bets.

Object and subject

For most physicists, science should be formulated in a way that makes no reference whatever to the personal experience of the individual user of science. Such conviction makes it impossible to articulate any of the above ingredients of QBism. According ot Mermin, it underlies almost a century of confusion about the meaning of quantum mechanics.

> The fact is that my science has a subject (me) as well as an object (my world). Your science has a subject (you) as well as an object (your world). Alice's science has a subject (she) as well as an object (her world). I make the same point three times to underline both the plurality of subjects, and the plurality of worlds that each of us constructs on the basis of our own individual experience. While each of us constructs a different world, the world of science is our joint construction of the vast body of phenomena that we try to infer, through language, to be common to our own individual worlds. Science arises out of our use of language to indicate to each other our individual experiences out of which we each construct our own individual worlds.[124]

[123] Ibid.,
[124] Ibid., 5.

QBism and the adoption of quantum mechanical perspectives in the human sciences

The QBist way of understanding probabilities in terms of the content, limitations and anticipation of personal information acquired in our personal interactions with the world around us helps in highlighting the value of quantum mechanics for science in general and the for human sciences in particular. "It can help us see quantum mechanics, not as an anomaly in the space of physical theories, but rather as their deepest archetype."[125] This is because quantum theories are not to be understood as an indirect representation of some reality beyond the phenomenal level of experimental information, but as a direct expression of some fundamental bounds of the availability of this information. Recent developments in the use of quantum theories can be considered as an implicit confirmation of the relevance of such information-theoretic reading.

> One case is especially striking: it is a recent generalization of quantum theory that applies to several domains of the human sciences such as decision theory, semantics, and the psychology of perception. This application of quantum theory to the human sciences shows that no matter who or what responds (human beings or things), the probabilistic structure that is to be used to anticipate the responses is the same. A set of human beings making choices that depend on the options which are presented to them, and on the order of the decisions to be taken, behave exactly like a set of electrons on which one evaluates several incompatible observables. … There is nothing shocking about the fact that it should be so. For this implies strictly nothing about some alleged similarity between electrons and humans at the level of their profound being. There is only a formal isomorphism between the possibilities of epistemological access to electrons and to humans: an isomorphism of their phenomenal reactions to being solicited, and of their informational dispositions. Such universal applicability of quantum theories to any domain whatsoever in which the replies to experimental solicitations depend on their order, strongly suggest that these theories are precisely that, and only that: a general procedure for anticipating probabilistically the replies to context-dependent experimental solicitations. They do not even offer a hint in the quest of a faithful representation of some independent reality out there, behind phenomena.[126]

[125] Michel Bitbol, 'Why should we use quantum theory? The case of human sciences." In B. Coecke and A. Lambert-Mogiliansky, eds., *Quantum Interactions 2018*, LNCS 11690 (2019), 3–21, 3. https://doi.org/10.1007/978-3-030-35895-2_1

[126] Michel Bitbol, 'A Phenomenological Ontology for Physics,' in H. Wiltsche & P. Berghofer (eds.) *Phenomenological approaches to physics* (Heidelberg: Springer, 2020) hal-03039509, 3-4.

Christopher Fuchs – one of the most articulated proponents of QBism, suggested an ontology of participatory realism that was inspired by John Wheeler's post-Bohrian idea that quantum mechanics involves "observer-participancy". According to Wheeler "The strange necessity of the quantum as we see it everywhere in the scheme of physics comes from the requirement that—via observer-participancy—the universe should have a way to come into being." Fuchs agrees that each act of observer-participancy is an act of creation which brings out the reality of the world of which we can actually speak about.[127] Thus the current status of the development of quantum mechanics suggests that there is no such thing as a reality independent of us and our agency. We should therefore give up any attempts for representation and devote our efforts to making sense of the participatory reality of the quantum realm simply because we can not speak of what there is as if we were describing it from outside.

> Participatory realism is truly useful, because it sketches the only conception of reality that is immediately compatible with quantum mechanics, and by doing so satisfies our want for mental pictures without indulging in wrong representations. Indeed, this mental picture is the only one that fully acknowledges the core reason of Bohr's prohibition of global ontological representations in quantum mechanics. It is a mental picture of the reason of the inadequacy of pictures. We could also say that participatory realism succeeds because it does not ascribe "reality" any positive predicate, but only a negative predicate: the impossibility of neatly splitting it into a spectator-like knower and a play-like known. This introduces us to what may be called "negative metaphysics", similar to the famous (or infamous) "negative theology". In the same way as "negative theology" may be taken by some as a good reason to abstain from theology, "negative metaphysics" may be taken by some (the instrumentalists) as a good reason to abstain from metaphysics.[128]

I can not think of a better hint pointing to the isomorphic relation between the roles of apophaticism in quantum mechanics and theology.

Conclusion

The present article adopted the Analogical Comparative Theological Approach (ACTA) to examine the encounter of Orthodox theology with physics. It offers a comparative exploration of the issues that emerged in the debates between St

[127] According to Bitbol (see footnote above), this could be considered as an anti-metaphysical move inspired by Wittgenstein's famous statement that "What we cannot speak about we must pass over in silence".

[128] Michel Bitbol, 'A Phenomenological Ontology for Physics,' 12.

Gregory Palamas and Barlaam the Calabrian (fourteenth century), and between Albert Einstein and Niels Bohr (twentieth century). The comparative analysis follows the logic of the ACTA approach which requires a 'third position', a controversial issue or a conceptual challenge that could be used as an exploratory lens that would allow a productive engagement with these two domains of human experience and knowledge.

We can start the conclusion by making a methodological point. It should be admitted that the application of the ACTA approach depends on the content of narratives of the two debates in the way they were presented here. The shaping of the content of the narratives includes a certain degree of subjectivity that could result in missing some relevant points. Such subjectivity could be considered as part of the "softness" of the ACTA method and should be seen in a positive way since it leaves space for creativity and insightful reflection. For example, the two narratives presented here clearly emphasize the relevance, the intensity, and the impact of the two debates in both theology and physics. This is completely inline with the logic of the ACTA approach. There is however another related point that deserves to be mentioned. The two debates have a very interesting temporal overlap. Quantum theory was discovered in the 1920s and has been passionately debated since then. This is the exact time when the theology of St Gregory Palamas began to be rediscovered in the lively debates between Russian Orthodox emigre and Catholic theologians in Paris.[129] Since then the debates have acquired a more moderate and constructive format but there are still reverberating issues across the different denominations and within Orthodox theology itself. In both cases – theology and quantum physics – the emerging positions were articulated and refined in a controversial environment through a process of ongoing personal self-identification in the context of a particular tradition associated with, sometimes, an intentional contra-positioning (encounter) and even radicalization. In this sense, we can seek an analogy in terms of the similitude of the dialogical struggles that took place almost at the same time and in a similar polemical context.

Another issue emerging from the analogical analysis refers to the ways of using logic in both theology and quantum physics. In the case of Orthodox theology this issue was naturally associated with the discussion of what is actually knowable and provable about God, as well as with the distinction between Divine essence (unknowable) and energies (knowable). What is knowable about God should be considered from a participatory perspective. The ground for participation is that part of the essence that is open to created beings. In this sense, causality in theological syllogisms pertains to the things around God – the reality of the Divine energies. The distinction between the uncreated, incommunicable divine essence and the uncreated but communicable divine energies allows for an active relationship

[129] See the first chapters in Stoyan Tanev, *Energy in Orthodox Theology and Physics*.

between the uncreated God and the created world. The ultimate expression of this personal relationship is the experience of God as light which is made possible by the transformation of the natural human capacities through the enabling power of the gifts of the Holy Spirit. The union with Christ can be lived only in the Holy Spirit, and that the experience of being in the Holy Spirit is nothing other than union with Christ.[130]

In quantum physics the discussion of the need for a quantum correction of classical logic has emerged in a different context related to the complementarity of the manifestation of wave and particle properties of quantum objects. For Bohr, the aim of the idea of complementarity was to allow the application of the usual logical forms while providing the extension that was necessary for dealing with the new situation related to the problems of observation.[131] The key moment in the new situation was the realization that one could not speak anymore of objectively existing properties of quantum objects independently of observer's experimental intervention. It provided quantum physics experiments with a personal aspect by associating the objectivity of the reality of the quantum objects with the specificity of the participatory role of the observer in the design of the experimental setup. The key epistemological question for Bohr was how experimental knowledge of quantum objects was possible through specifically designed experiments.[132] We can see again how the challenges of applying the traditional logic were associated with what is experientially knowable about the quantum object by forcing the phenomenal manifestation of some of its natural energies. Most interestingly, we have seen how a contemporary theoretical physicist such as N. Landsman can apply a theological argument referring to the distinction between Divine essence and energies to explain the supposedly fundamental difference between the scientific worldviews of Bohr and Einstein.[133]

The most amazing similitude between the theological and quantum physics domains seems to be related to the ways apophaticism plays a role in them. This issue touches on some of their deepest epistemological aspects. A closer look at the controversial issues shows a common need of going beyond the challenges of representation, assertion and negation to the epistemological conditions of knowledge emerging through union and participation. This trend is more sharply expressed in Orthodox theology where theologians have emphasized that such union and participation in the Divine life removes the need for any representation, be it positive or negative, of the Divine and establishes apophaticism as way of communion in existence. The apophatic does not emerge as a comment on representation, but as an opportunity for participation. It allows to talk about an apophatic realism which

[130] Dumitru Staniloae, 'Trinitarian Relations and the Life of the Church', 14.

[131] Ibid., 115–16.

[132] Kristian Camilleri, 'Why do we find Bohr obscure? Reading Bohr as a philosopher of experiment', in Jan Faye and Henry Folse, eds., *Niels Bohr and the Philosophy of Physics – Twenty First Century Perspectives* (London: Bloomsbury Academic, 2017), 19-46, 29.

[133] Landsman, 'When champions meet', 218.

focuses on the subtleties and the quality of participation instead of the need for negation in speaking about the Divine realities.

According to Richard Healey, "quantum theory makes a radical break with previous physics not because of the weirdness of the physical behavior it represents, but … (because) quantum theory is simply not in the business of representing what happens in the physical world"[134] We have seen Heisenberg's comment on Bohr's challenges of using language in addressing the new epistemological situation in quantum physics where he tried to keep the words and the pictures of classical physics "without keeping the meaning of the words and of the pictures, having been from his youth interested in the limitation of our way of expression, the limitation of words, the problem of talking about things when one knows that the words do not really get hold of the things'.[135] Bohr's focus on the need of using classical concepts is a manifestation of the need for an "economy approach" to quantum knowledge that could be compared to a similar approach in theology – the focus of our theological epistemology on what was made accessible to us through the person and the activities of Jesus Christ, the Son of God, and trough the gifts of the Holy Spirit in the history of salvation, instead of focusing on reflections about the Holy Trinity which remains inaccessible to us in its essence. This original apophatic sensitivity of quantum physicists was fundamentally enhanced by the current QBist interpretation which brings its participatory realistic perspective very close the characteristics of the apophatic realism that was described above.

The last point that will be made here refers to the concept of probability. Obviously, it is a technical term that emerges from within the context of quantum physics. Does it have a place in theology? I believe that the QBist personalist Bayesian view on probability offers an opportunity for theology to explore the potential value of the adoption of such perspective in a theological context. For example, the personalist Bayesian view on probability could relate to the context of prayer. I know this may sound strange to many Christians but just think about it. Our prayers emerge from the depths of our personal existential situations. But there is no determinism in our prayers. In the Gospel of Matthew 7:7 our Lord and God Jesus Christ said: "Ask, and it will be given to you; seek, and you will find; knock, and the door will be opened to you. For everyone who asks receives; he who seeks finds; and to him who knocks, the door will be opened." But nobody says that what we will receive will be what we have actually wanted. God's thoughts are not our thoughts, neither are our ways His ways (Isaiah 55:8). He is the one having the best answers for us even though we may have not seen them in advance as such. In this sense, our prayers are an expression of our personal beliefs about our best future based on our personal experience and existential context. God respects our freedom and can satisfy all of our requests but He does also have a plan for us that may not result in what we have actually wanted

[134] R. Healey, *The Quantum Revolution in Philosophy* (Oxford: Oxford University Press, 2017), 3.
[135] Catherine Chevalley, 'Niels Bohr's Words and the Atlantis of Kantianism', 33.

in a particular moment of time. This is a point that would definitely benefit from a more comprehensive elaboration and will be addressed in future studies.

We can continue to deep dive into the exploration of the similitudes emerging from the application of the ACTA approach. The present article should be considered as an invitation to such deeper exploration. The ACTA approach counts on the participatory engagement of the reader in making the connections and personally exploring any other emerging similitudes (a term suggested by Fr John Breck as a better alternative to 'analogy')[136] between Orthodox theology and quantum physics.

[136] Fr. John Breck, *Beyond These Horizons, Quantum Theory and Christian Faith* (Alhambra, CA: Sebastian Press; Wadmalaw Island, SC: Kaloros Press, 2019), 70.