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Essence and Energy: An Exploration in Orthodox Theology and Physics

Stoyan Tanev

Abstract

This essay provides a parallel study of the meaning of the term “energy” in Orthodox theology (particularly in such figures as John Damascene, Maximus the Confessor, and Gregory Palamas) and physics (particularly in the work of Niels Bohr and Albert Einstein, as well as Max Planck and Max Born) by exploring the way this term is used in these two quite different fields of scholarly endeavor. It does not provide clear-cut definitions and does not pretend to have produced an exhaustive synthesis. Its intention, rather, is to continue building bridges between Orthodox theology and physics on the foundation of existing works and established knowledge. The essay starts with a discussion of the methodological grounds for the parallel exploration of the concept of energy in theology and physics by means of Bernard Lonergan’s “analogical isomorphism,” whose approach allows for bringing forth the similarities of the relationships between essence and energy in both cases and not of the concepts themselves. The author’s comparative analysis brings a number of common themes to the surface, and concludes by sum-

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1 This essay is a modified version of a paper presented at the Colloquium “The Theology of the Divine Energies” at the University of Sherbrooke on 5 April 2008 in Montreal.

2 I am grateful to a number of people for their support in the research that went into this paper including Fr. Maxym Lysack; Professor George Dragas; Archbishop Lazar (Puhalo); Dr. Jean-Claude Larchet; Dr. Ivan Christov; Dr. Alexander Omarchevski; Dr. John Hadjinicolau; Dr. David Bradshaw; and Dr. Roumen Borissov. The continuous support from Professor Georgi Kapriev needs to be particularly acknowledged: our several conversations have been a source of illuminating insights.
marizing the fourteen observations emerging from, and still needing further refinement in, the science-theology dialogue.

I. Introduction: Why Physics? Why Theology?

Although the term “energy” is fundamentally important in both physics and Orthodox theology, it is not confined to the contexts of physics and theology alone. The concept plays a significant role in biology, has some relevance in psychology and, more recently, became very popular within the context of the various kinds of new age spiritualities. It would be fair to say that, while enjoying a growing popularity in ordinary language, the concept of energy is often used in unclear and inappropriate contexts and circumstances.

The concept of energy has a fundamental place in physics – a place that was acquired in the nineteenth century when its emergence provided a new and unifying framework bringing together all known phenomena within the dominating mechanical view of nature and embracing heat, light, and electricity, together with mechanics, in a single conceptual structure. This new framework led to the development of the concepts of the physical field, electromagnetic ether, conservation and dissipation of energy which, in the beginning of the twentieth century, opened the way to the formulation of the theories of relativity, quantum mechanics and gravitation. The evolution of these theories still governs our knowledge about the structure of matter, about the world and the cosmos. Yet, the obvious relevance and pervasive use of the concept of energy in physics did not stop Richard Feynman from writing: “It is

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4 Richard Feynman (1918–1988), recipient of the Nobel Prize in Physics in 1965 for his contributions in quantum electrodynamics, produced a series of lectures that would eventually become the famous Feynman Lectures on Physics.
important to realize that in physics today, we have no knowledge of what energy ‘is.’”

For its part, Orthodox theology has at its centre the distinction between the essence and energies, and this affects the whole body of Christian doctrine. In the words of Christos Yannaras,

the theology of the Church interprets the reality of existence, the appearance and disclosure of being, starting from these two fundamental distinctions: It distinguishes essence or nature from the person or hypostasis, as it distinguishes the energies both from the nature and from the hypostasis. In these three basic categories, nature-hypostasis-energies, theology summarizes the mode of existence of God, the world, and man.

In a similar way John Romanides points out that: “The teaching of the Church Fathers on God’s relation to the world can be understood if one knows: a) the difference between ‘created’ and ‘uncreated;’ [and] b) the distinction between ‘essence’ (ousia) and ‘energy’ (energeia) in God.” This distinction between essence and energy in Orthodox theology has been the subject of multiple theological and philosophical controversies from the fourth century up to the present day.

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believe that some of the epistemological insights of Orthodox theology will be found very illuminating by physicists, providing the possibility for a reversal of the predominant pattern of science-theology interactions, a pattern that could be characterized by the unidirectional (and unsuccessful) scientific attempts to provide an explanation of the mysteries of faith.

The second aspect of the question is theological and evangelical in nature. It is associated with the answer to a simple question: “In the end, who cares about any existing parallels between the meanings of energy in physics and theology?” I am certain that many believers will find such study irrelevant and useless – a life in Christ based on a personal relationship with the living God does not need additional reasons. Others among them, however, may find such an encounter rewarding because it was God Himself who created us with the possibility of knowing Him in creation and knowing more about some of the common heuristic structures underlying our knowledge of God and the world, about which many questions have been unanswered for centuries. In this, I agree with David Bradshaw, Jean-Claude Larchet and the circle of scholars from the Bulgarian school of Byzantine philosophy that the way to resolve the existing theological disputes and provide clarity about the relevance of the distinction between essence and energy is to give a comprehensive history from its biblical and philosophical roots up through and beyond Saint Gregory Palamas. I believe also that it is important to unfold this historical inquiry within the context of a broader contemporary theological, philosophical, scientific, and cultural discourse. I hope this essay will contribute to such an unfolding.


11 Christos Yannaras, Elements of Faith, 38.
12 David Bradshaw, Aristotle East and West.
14 A group of scholars that emerged at the University of Sofia, Bulgaria, including Georgi Kapriev, Tzotcho Boiadjiev, Ivan Christov, Kalin Yanakiev, Oleg Georgiev and others.
II. The Possible Grounds for a Parallel Study of Energy in Orthodox Theology and Physics

Anthropological and Cosmological Implications of the Incarnation

The first ground is rooted in the anthropological and cosmological implications of the event of the Incarnation. It was articulated for the first time in the fourth century by Saint Athanasius of Alexandria and, more recently, in the scientific theology of Thomas F. Torrance and by his former student George Dragas in his lecture on the anthropic principle delivered at Aristotle University of Thessaloniki in 2005. Thomas Torrance points out that theology should operate within the context of a triadic relation between God incarnate, man and world, since it is this world unfolding its mysteries to human scientific questioning becoming the medium of God’s revelation and of man’s responsible knowledge of him. This implies a connection between theological concepts and physical concepts, spiritual and natural concepts, between theological science and natural science. Scientific concepts are related to natural order of the universe. Theological concepts look through the rational structures of the universe to the Creator, i.e., they indicate but do not exhaust or describe the reality to which they refer.

In a very similar vein, the Greek Orthodox priest George Dragas emphasizes the patristic understanding of the relationship between God, man, and the world.}

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15 Thomas F. Torrance (1913–2007) is one of the most important Reformed theologians of his era who has been influential by his works on theological method, the relationship between theology and science, and in the “paleo-orthodox” movement of the late twentieth and early twenty-first centuries, which sees the consensual understanding of the faith among the Church Fathers as the basis of biblical interpretation and the foundation of the Church in the present time.


the Incarnation and Inhomination of God the Creator, which constitutes the basic chapter of Theology, makes the cosmos the context of the revelation of God and of God’s renewing action upon it whereby it is brought back to its natural evolution towards its final fulfillment. … The basis of the universe is the uncreated energy of God and the will of God which transcends nothingness – the empty space that lacks existence and on which the limited existence of the created universe is established and floats. This is confirmed by the stunning event of the Incarnation of the Creator Word, whereby not only God communicates with man, but also this communication enters into the creaturely space of human existence and is expressed mystically with human terms, human thought, language and symbolism.\(^{18}\)

Another contemporary Orthodox theologian, Archbishop Lazar Puhalo, has articulated the fundamental difference in the levels of knowledge that are found in modern physics and theology.\(^{19}\) Science “studies the nature of the ‘creature,’ but does not pertain to worship.”\(^{20}\) Theology, on the other hand, is an ascent in the realm of grace, toward a knowledge which is a gift from God. “God is so far removed from the creature that we dare not even represent Him except as He appeared in the flesh in the person of our Lord Jesus Christ.” By becoming one of us in the person of Jesus Christ, God provided the key to the understanding of the universe and of Himself. Scripture clearly tells us that we can know the Creator from the things that were created by Him, and it is the same God who has created the universe and who is the author of our theology. This unity of divine authorship makes modern physics something that is not to be feared by theologians.

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\(^{18}\) Ibid.

\(^{19}\) Archbishop Lazar Puhalo, *The Evidence of Things not Seen – Orthodox Christianity and Modern Physics* (Dewdney: Synaxis Press, 2004), 27.

\(^{20}\) Ibid.
The Universal Nature of the Distinction between Essence and Energy

The second ground is based on the belief in the universality of the distinction between essence and energy that can be found in the works of the Byzantine Church Fathers. I will use a few citations from patristic literature to illustrate my point. The first one is from the trial of Saint Maximus the Confessor, which took place in Constantinople in June 654. On the question “Is it all together necessary to speak of wills and energies on the subject of Christ?” he answered:

All together necessary if we want to worship in truth, for no being exists without natural activity. Indeed, the holy Fathers say plainly that it is impossible for any nature at all to be or to be known apart from its essential activity. And if there is no such thing as a nature to be or to be known without its characteristic activity, how is it possible for Christ to be or to be known as truly God and man by nature without the divine and human activities?21

The second citation is from Saint John of Damascus and defines energy as “the natural force and activity of each essence” or the activity innate in every essence: “For no essence can be devoid of natural energy. Natural energy again is the force in each essence by which its nature is made manifest.”22

The next two citations are from the Triads of Saint Gregory Palamas written during the time of his debates with Barlaam the Calabrian.23

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21 The Trial of Maximus, in Maximus the Confessor, Selected Writings (New York: Paulist Press, 1985), 23.
As Basil the Great says, “The guarantee of the existence of every essence is its natural energy which leads the mind to the nature.” And according to St Gregory of Nyssa and all the other Fathers, the natural energy is the power which manifests every essence, and only nonbeing is deprived of this power; for the being which participates in an essence will also surely participate in the power which naturally manifests that essence.\textsuperscript{24}

Thus we see that for these Byzantine Fathers, the distinction between essence and energy applies to both God and created beings. The universality of the essence-energy distinction provides a basis for the development of the methodological background for the parallel exploration of the concept of energy in Orthodox theology and physics.

\textit{Methodological Remarks}

The methodological framework adopted here is based on the so-called conceptual or analogical isomorphism method that was previously used, for example, by the Canadian theologian Bernard Lonergan\textsuperscript{25} within the context of a parallel analysis of Thomist and scientific thought. Analogical isomorphism presupposes two sets of terms from two different systems of thought. It neither affirms nor denies similarity between the terms of one set and those of the other set, but it does assert that the network of relations in one set of terms is similar to the networks of relations in the other set. If the first set involves the terms $A$ and $B$, and the second set $P$ and $Q$, the set $(A, B)$ is said to be isomorphic to the set $(P, Q)$ if the relation of $A$ to $B$ is similar to the relation of $P$ to $Q$. Both sets are to be considered at once aiming at bringing to light an isomorphism or analogy of proportion that concentrates on the structural similarity of the two sets of terms moving away from

\textsuperscript{24} Gregory Palamas, \textit{The Triads}, II.ii.7, p.95.

the specific meanings of the terms within each of the sets. Finally, as Lonergan suggests, if this analogy is grasped, it may appear that the conceptual differences between the terms are less significant than what they seem to be when considered alone and the structure of the two sets is ignored.

Lonergan’s approach could be used as a methodological background for our study if we identify the (A, B) set of terms with the concepts of essence and energy in Orthodox theology and the (P, Q) set of terms with the concept of essence and energy in physics. It is, however, necessary to address a key issue raised by the problem of analogy which concerns not only the manner in which the terms are used but the nature of the underlying ontology controlling their use. It is the ontological foundation of the terms that governs whether they are being used in their legitimately proper functions and warrants. The issue seems to be automatically taken care of since the term “essence,” which is the initial term of both sets (A, B) and (P, Q), is inherently ontological in nature. The methodological fit of Lonergan’s approach here is further justified by the fact that the term energy, i.e., the second term in both sets (A, B) and (P, Q), plays a clearly epistemological role, thus providing the proper setting for the development of the relationship between any ontological and epistemological considerations.

The main purpose of employing the method of analogical isomorphism is to build on existing works and established knowledge in examining the occasions upon which the con-
cept of energy is used, together with the characteristic ways the concept behaves on those occasions. The expected outcome of such approach is the identification of specific common themes, issues, or patterns of use emerging from the examination of relationships between essence and energy in Orthodox theology and physics. This approach could be compared to the grounded theory approach in the social sciences research – a general method of comparative analysis allowing for the emergence of categories, concepts and relationships between them, from data (most often found in a textual representation of multiple case narratives) by, literally, ignoring all existing conceptual and theoretical pre-assumptions in order to assure that the emergence of the concepts and relationships will not be contaminated by these pre-assumptions. The grounded theory approach is mostly appropriate in situations where there is not enough knowledge about the subject under study which, as I believe, is our present situation.

III. The Concept of Energy in Classical Physics

The discussion of the concept of energy usually starts with an emphasis on mechanics, but it is all embracing. According to Eugene Hecht “it influences our thinking about every branch of physics, indeed, about every aspect of our existence. Yet, there is no completely satisfactory definition of energy. Even so,” he continues, “we will quantify its various manifestations as we struggle to define it.” In its most popular meaning, the concept was used at least since the late 1500s and

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30 I should point out that there are previous works that have addressed this topic although in different and less systematic ways. Cf. George Murphy, “Energy and the Creation of the World,” Zygon 29 (1994); Daniel Rogich, “Divine Energy: Quantum Mechanics, Psychotherapy and World Religions,” in Becoming Uncreated – the Journey to Human Authenticity (Minneapolis: Light & Life Publishing, 1997).
was associated with the capacity of physical objects and systems to do work. In 1638, Galileo employed the term *energia* though he never defined it. It was only in the 1850s that the idea had taken on a scientific meaning – a meaning that is not altogether satisfactorily defined. “In very general terms, energy describes the state of a system in relation to the action of four forces”\(^{32}\) – gravitational, electromagnetic, strong\(^{33}\) and weak.\(^{34}\) It is therefore a relational concept, a concept which is inherently associated with the description of motion, and change and the interaction between physical objects and systems in general.

*Energy and Change*

Energy is a property of all matter and is observed indirectly through changes in physical objects’ speed, mass, position, and so forth. The change in the energy of a system, which is all we can ever measure in an experiment, is a measure of the physical change in that system. Force is the agent of change, whereas energy is the measure of change. Because a system can change through the action of different forces in different ways, there are several distinct manifestations of energy.

By observing the changing behavior of matter, we “infer” the presence of one form or another of energy. Still, energy is not an entity in and of itself – there is no such thing as pure energy. Energy is always the energy of something. The concept of energy provides a means of quantitatively accounting for physical change. When a material system manifests an observable change due to some interaction, we associate an amount of energy with the extent of that change. Inter-

\(^{32}\) Ibid, 223.

\(^{33}\) The strong nuclear force is the force responsible for the structural integrity of atomic nuclei.

\(^{34}\) The weak nuclear force is responsible for the decay of certain particles in the atomic nucleus. Its most familiar effect is the beta decay of neutrons in atomic nuclei which is associated with the phenomenon of radioactivity. The word “weak” derives from the fact that the field strength is some $10^{13}$ times less than that of the strong force.
action is crucial; if matter did not interact, the concept of energy would be superfluous.\textsuperscript{35}

\textit{Kinetic and Potential Energy}

It is interesting to point out that the concept of energy is associated with the concept of work. This association makes a lot of sense given the semantic meaning of the word \textit{energeia} in Greek, which comes from \textit{energos: en} – “at” + \textit{ergon} – “work.” In mechanics, work is defined by the product of force and distance, and happens to be equal to the change of energy resulting from the application of that force to a body as that body moves through a distance in space. This type of energy is naturally associated with motion and is called \textit{kinetic energy}, a term introduced by Lord Kelvin (William Thomson) in 1849. It was defined as the square of the velocity $v$ of an object multiplied by its mass $m$ divided by two: $\frac{mv^2}{2}$. If, however, the force acting upon the body is naturally present after its displacement and the body is kept motionless but potentially susceptible to the force action, the potential for generating the kinetic energy is still there because of the presence of the force. This type of energy is known as \textit{potential energy} and exists by virtue of the position of the body in relation to a naturally present force. Such is the situation when the gravitational force causes the free fall of objects which are left on their own without any support at some height above the surface of the earth. In summary, kinetic energy is associated with the capacity to do work by virtue of motion; potential energy is associated with the capacity to do work by virtue of position.

Historically the concept of kinetic energy was introduced first. The introduction of potential energy provided continuity to the idea of energy in general since its change was associated with the work done on a body against a naturally present external force. Its relevance to the development of physics was found to be critically important:

\textsuperscript{35} Ibid, 223.
The concept of kinetic energy, as it stands, is a derivative concept since it is directly definable in terms of observables, namely mass and velocity. To this extent its usefulness is limited, and it affords no deeper understanding of the nature of mechanical systems; its logical distance from observation is too slight. But the value and significance of the concept are immeasurably increased, both for mechanics and as it turns out for physical science as a whole, by the introduction of the additional concept of potential energy. This move at one stroke places energy among the most important of physical concepts. The new notion of energy thus created represents a considerable conceptual sophistication of the old one; its logical distance from observation is now very much greater, and the concept casts its net more widely.  

*Energy Conservation Law and Symmetry*

R.B. Lindsay defines the concept of energy through the concept of change, but points out that the basis of its usage today is the idea of *invariance*, which means constancy in the midst of change. Lindsay alludes to the energy conservation law – the empirical fact that, whenever an amount of energy is transferred from one entity to another, the total amount of energy always remains unchanged. This shows that “the importance of energy springs not just from its variety of form, but form its conservation: the total amount of energy in the cosmos remains always the same, since the loss of one kind of energy is always being compensated by the gain of another kind of energy.” It is important to note that the conservation of energy applies to systems and not to individual bodies.

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Conservation laws are commonly considered as the deepest and most significant types of scientific laws because they give insights into the symmetry of the physical systems but, more importantly, into the symmetries of space and time (space-time). More involved mathematical manipulations of the classical physics laws of motion reveal that energy conservation stems from the “smooth” nature of time, i.e. from the fact that “it spreads smoothly from the past into the future with no squashed bits or stretched bits.”\(^{39}\) What this really means is that the energy conservation law could be mathematically derived from the invariance of the physical laws to forward and backward time changes. So deep is the relationship between conservation laws and the symmetry of space-time that the conservation laws survive even when classical physics laws of motion fail and there is a need to move into the realm of relativity and quantum mechanics. This relationship shows that the stability and the sustainability of the physical world are deeply rooted into the symmetry principles of its most fundamental inner structure.\(^{40}\)

**Energy and Fields**

The relevance of the concept of potential energy is inherently associated with the emergence of the field concept. To clarify what a field is, we could use an example from electrostatics – the part of physics dealing with electrical charges, fields and their interactions. The concept of electrical charge is fundamental and can not be described in simpler, more basic concepts. In the words of Eugene Hecht: “We know it by what it does and not by what it is – if you like, it is what it does, and that’s that.”\(^{41}\) A charged particle such as the electron interacts with other charged particles by creating a web of interaction around itself that extends out into space. We say that one charge creates an electric field in space and when another


\(^{40}\) Ibid.

charge is immersed in that field, it interacts directly with it. The field that surrounds an electrical charge is part of it and becomes the media or mediator of the interaction with the other charge.

Why do we need the field concept? The answer is: to deal with the explanation of “action at a distance,” and the principle of “locality” – the expectation that effects must be co-located with their causes, both in space and in time. One electron causes another, second, electron located at some distance away, to experience a certain force. This force seems to have no cause located any nearer to the second electron than the distance to the first one. It seems, therefore, that there is no visible local cause for the force experienced by the second electron. The introduction of the field concept by Michael Faraday enabled electric interactions to satisfy spatiotemporal locality and explain the action at a distance, i.e., that the electric force acting on a charged body at a given moment in time is caused by the electrical field at its location. The field is invisible but it becomes visible by its effects. Its energy is manifested by the work done by the electrical field force for moving the charge away at a given distance. Even this simple exposition of the field theory clearly shows in what sense the concepts of energy and field are interrelated. Energy “becomes the basic ‘substance’ of field physics, as matter was the basic ‘substance’ of Newtonian physics. Energy is not a way of characterizing particles, but a way of characterizing processes in the field.”

“It is so because the field is characterized by the presence of energy. … A field is nothing more than a spatial distribution of energy which varies with time. Energy has thus been freed from its dependence upon physical vehicles such as particles; it has achieved the status of independent scientific existence.”

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43 Ibid., 98.
Are Fields and their Energies Real?

It is interesting to discover that in physics the existence of the physical reality behind the concept of energy might be questioned:

The reality of the field is self-consciously inculcated in our elementary teaching, often with considerable difficulty for the student. This view is usually credited to Faraday and is considered the most fundamental concept of all modern electrical theory. Yet in spite of this I believe that a critical examination will show that the ascription of physical reality to the electric field is entirely without justification. I cannot find a single physical phenomenon or a single physical operation by which evidence of the existence of the field may be obtained independent of the operations which entered into the definition. The only physical evidence we ever have of the existence of a field is obtained by going there with an electric charge and observing the action on the charge…, which is precisely the operation of the definition…. The electromagnetic field itself is an invention and is never subject to direct observation. What we observe are material bodies with or without charges (including eventually in this category electrons), their positions, motions, and the forces to which they are subject.  

Such reflection, however, does not seem to fall within the scope of interest of the majority of physicists whose reasoning functions under the premises of “operationism” – the view that the meaning of every scientific term must be specifiable by identifying a definite testing operation that provides a criterion for its application. This means that for most physicists “the whole of physics is about operations, chiefly measurements

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and computations, rather than about nature." This approach is clearly visible in the continuation of Richard Feynman’s comment from the beginning of this essay: “It is important to realize that in physics today, we have no knowledge of what energy ‘is.’” For Feynman every specific meaning of the energy concept should be based on a specific formula, on a carefully defined measurement and on some calculation procedures. Such an approach to the definition of a concept is called operational. The operationist attitude to scientific concepts has a long history and, as we see, tends to put aside questions of whether the object of the definition really exists or not.

**Electrodynamics and Realism**

The ambiguity of the question about the real existence of the electric field seems to appear due to the fact that we were silently focusing on static fields, i.e., the electric fields of electrical charges that do not move in time and space. Electrodynamics deals with dynamic, i.e. changing in time, electric and magnetic fields. When an electrical charge undergoes some acceleration, a portion of its field “detaches” itself and travels off at the speed of light, carrying with it energy. This is what we call electromagnetic wave radiation. It is impossible to question the reality of electromagnetic waves. “Its existence invites (if not compels) us to regard the fields as independent dynamical entities in their own right, every bit as ‘real’ as atoms or baseballs. … But it takes a charge to produce an electromagnetic field and a charge to detect one.” Thus, the dynamic nature of the electromagnetic fields helps in resolving the ontological ambiguities associated with the reality of their existence.

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46 Ibid., 42.
A Classical Epistemology

Before moving to quantum physics we should stop for a moment and see how to characterize the epistemology of classical physics at the end of the nineteenth and the beginning of the twentieth century. But why talk about epistemology here? One of my underlying assumptions is that, in order to escape the trap of operationism, a discussion of the concept of energy in theology and physics should be developed within an epistemological context. A second underlying assumption is that the epistemic power of a science is dependent on its ontological presuppositions, i.e., on the foundational insights about the nature of the realities it is dealing with. This second assumption is found to be methodologically important since it reflects the proper positioning of the two terms – essence and energy – as the two poles of the analogical isomorphic analytical approach. ⁴⁹

There is no doubt that one of the main features of classical physics was the development of a refined mathematical language. ⁵⁰

The enormous success of classical physics soon convinced more secular Enlightenment thinkers, however, that metaphysics had nothing to do with the conduct of physics, and that any appeal to God in efforts to understand the essences of physical reality in physical theory was ad hoc and unnecessary. The divorce between subjective constructions of reality in ordinary language and constructions of physical reality in mathematical theory was allegedly made final by the positivists in the nineteenth century. This small group of physicists and mathematicians decreed that

⁴⁹ Bernard Lonergan, “Isomorphism of Thomist and Scientific Thought.”
⁵⁰ Here and in the following discussions of classical and quantum epistemology I will be closely following the logic of the insights found in Robert Nadeau and Menas Kafatos, The Non-Local Universe. I am grateful to Archbishop Lazar Puhalo for pointing out to me this work of Nadeau and Kafatos.
the full and certain truth about physical reality resides only in the mathematical description, that concepts exist in this description only as quantities, and that any concerns about the nature or source of physical phenomena in ordinary language do not lie within the domain of science.\textsuperscript{51}

The result was the emergence of the belief that the real is, in its essence, geometrical, rigorously describable, exactly measurable and, therefore, predictable and manageable. The truths of classical physics were considered as literally “revealed” truths, fully given for exploration and able to be visually studied in completeness, independently of the specific inner nature of their corresponding realities. This metaphysical presupposition became in the history of science what we could call today the “hidden ontology of classical epistemology” – a kind of universal ontology leading to the universality of the scientific method and to the “epistemological arrogance” of the rationalism of the eighteenth and nineteenth centuries which may still be commonly found today in modern physics.

\textbf{IV. The Concept of Energy in Modern Physics}

\textit{1. Energy in Quantum Physics}

Max Plank and the Quantum of Energy and Action

The idea of the quantum of energy was introduced as a kind of energetic atomism, in which energy could not be divided into arbitrarily small amounts but existed as discrete, tiny packets.\textsuperscript{52} In its origins, the introduction of the concept of energy quantization was driven by deeply practical reasons. In 1900 it allowed the German physicist Max Planck to create an adequate mathematical model of a troubling problem – the so-called black-body radiation, i.e., the radiation that is emitted

\textsuperscript{51} Ibid.

\textsuperscript{52} For an insightful description see Peter Dear, \textit{The Intelligibility of Nature – How Science Makes Sense of the World} (University of Chicago Press, 2006), 142.
by a specific type of heated bodies. Planck worked with careful experimental measurements of the actual energy distribution trying to develop a correct theoretical model to describe it. Eventually, he found out that he could do that only if he assumed that the emitted energy could change only in jumps, from one energy level to the next. This assumption in Planck’s model violated the usual way of thinking about energy – as a quantity that could vary smoothly, increasing or decreasing gradually, rather than being confined to stepwise change. Some people consider Planck’s assumption as a “desperate” but the only possible move enabling him to fit the empirical data on black-body radiation. Planck called these discrete energy changes “quanta” of energy. He assumed that their necessity in the theory would soon be explained, and that the explanation would not require energy itself to exist only in bundles of specific sizes. He, however, was not able to come up with such an explanation himself.

The Universal Meaning of the Energy Quantum Concept

Very soon other physicists began to see the more universal meaning in Planck’s idea. In a paper of 1905 on the so-called photoelectric effect, Albert Einstein argued that light itself should not be understood simply as wave motion but should also be understood in terms of light quanta – massless packets of energy that were later to be called “photons.” The energy of a single photon $E$ was found to be proportional to the light’s frequency $\nu$ by means of a universal constant $\hbar$: $E = \hbar \nu$. The constant $\hbar$ was first derived by Planck and, therefore, known as Planck’s constant or the “quantum of action.” Soon after the emergence of the photon, the idea of the quantum nature of energy was extensively infiltrated into microphysics.

In 1913, the Danish physicist Niels Bohr opened up a critically important new arena for the use of the concept – atomic spectra. It was the exploration of this arena that led to the emergence of quantum physics. Bohr adopted Planck’s quantum to study the internal structure of atoms in a way that was “in obvious contrast to the ordinary ideas of electrodynamics but appears to be necessary in order to account for experimen-
tal facts.” He started with the commonly accepted “solar system” model of the atom wherein negatively charged electrons orbit around the central positively charged nucleus like planets.

The size of an electron’s orbit corresponded to the orbit’s energy, and Bohr postulated that the only orbits permitted to such electrons were those whose energy corresponded to discrete, quantized levels— not just any amount of energy, or orbit, was allowed by his model. There were levels, or steps, of orbital energy that the electrons could occupy; Bohr called them “stationary states.” The only changes in orbital levels that an electron could undergo were ones in which it shifted, in a discrete jump, from one stationary state to another.

Assuming the discrete nature of these changes allowed Bohr to interpret some experimental results that had been known for nearly thirty years. These results concerned the radiation emitted by hydrogen atoms when excited by heat. When the radiation was separated out according to frequency by a spectroscope, the spectrum showed a series of discrete bright lines that was uniquely related to the specific internal structure of the atom. Even though quantum theory was still at its initial stages, there was a major epistemological breakthrough that was associated with Niels Bohr’s achievement—the demonstration that the behavior of light quanta and their energetic manifestations could be identified with the composition of atoms and the structure of matter in general. The dynamic structure of matter is manifested or known by the particular mode by which the smallest quantities of energy are presented to the observer. Or, in the poetical theological language of Christos Yannaras, “that means that the hypostasis of matter itself is energy, that matter contains the constituents of light, that light is the ideal matter.”

53 See Ibid., 144.
54 Ibid.
55 Christos Yannaras, Elements of Faith, 39.
The Classical Epistemology of Albert Einstein

The mathematical description of physical reality that Planck, Einstein, Bohr and others developed over the first thirty years of the twentieth century undermined or displaced virtually every major assumption about the nature of physical reality in classical physics. And the vision of reality in what came to be called the new physics immediately challenged the predominant epistemology without providing a clearly articulated new alternative.  

Albert Einstein has contributed enormously to the opening of the new era in physics starting with his special theory of relativity. However, his underlying epistemology itself ended up being classical. The motivation behind his special theory of relativity was in fact a larger unification of physical theory that would serve to eliminate mathematical inconsistencies in some of its currently existing fundamentals. The fact that frames of reference in physical experiments are relative was known since Galileo. What Einstein did was to extend the so-called Galilean relativity principle from mechanics to electromagnetic theory by abandoning the Newtonian idea for the existence of an absolute reference frame. It was this abandonment that led to the radical shift in physics from the realm of the visualizable into the realm of the mathematically describable but unvisualizable. It is when we try to image the four-dimensional reality of space-time in relativity theory that we have our first encounter with modern physics. It is not difficult to imagine the dramatic nature of this encounter. However, all subsequent attempts to forcefully visualize the unvisualizable have led to reductionism, to an idolization of the mathematical formalisms, and to an objectification of the physical models rather than of physical reality itself.

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56 In this section I am following again the insights provided by Robert Nadeau and Menas Kafatos, *The Non-Local Universe.*
57 Ibid., 23.
58 On the problem of visualization in modern physics within the context of Orthodox theology see Puhalo, *The Evidence of Things not Seen,* 34.
In 1915–16, Einstein extended the principle of relativity to account for the more general case of accelerated frames of reference and developed his general theory of relativity. Here, again, visualization may only help in understanding what is implied by this theory, but it does not disclose what is really meant by it. A visual analogy is useful only to the extent that it helps in accepting that the reality of space-time and the fundamental physical phenomena in it are unvisualizable. Yet here, as in the special theory of relativity, there is no ambiguity in its mathematical description. Most physicists have made a firm commitment to Einstein’s classical epistemology. Its fundamental precept is based on the assumption of one-to-one correspondence between every element in the theory and every aspect of the physical reality described by that theory.

A Quantum or Non-Classical Epistemology

Quantum physics began challenging this epistemology in the beginning of the 1920s in a twenty-three-year debate between Einstein and Bohr. It was just in the last few years of the twentieth century that modern physics experiments demonstrated that the fundamental issues in the famous Einstein-Bohr debate seem to have been resolved in Bohr’s favor. The outcome of this debate was the disclosure of a profound new relationship between parts and whole that 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 “see” reality-in-itself, is no longer acceptable. Modern physics experiments have made it perfectly clear that these classical assumptions are no longer valid.59

59 Ibid.
The Principle of Uncertainty & the Move from Visible to Invisible

It took more than two decades before it became possible to formulate a theory that was in a sense similar in functioning to Newtonian mechanics. Quantum mechanics was introduced in 1925–26 by Heisenberg and Schrödinger in two mathematically equivalent but epistemologically different versions. Heisenberg’s version was presented in virtually non-classical terms and led to the formulation of the so-called uncertainty principle. When applied to a particle, Heisenberg’s famous uncertainty means that having more precision in the particle’s position leads to less precision in its velocity, and vice versa. There are no states in which a particle has both a definite position and a definite velocity and the amount of uncertainty can never be reduced below the limit set by the principle. The radical nature of this principle is based on the fact that it makes a quantum physicist blind and wordless by somehow hiding or blurring the visual attributes of the particle.

The first insight that would open the door to an improved understanding of this situation came from Max Born in 1926, and it was not well received by the majority of physicists at the time. Born realized that it is not the exact position and velocity of a particle but the “probability” of finding the particle within a particular region and with a possible range of velocities that allows us to predict precisely where that particle will be found. 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 aspect of measurement of all quantum mechanical events, which does not allow predicting where a particle will be observed no matter what improvements are made in both theory and experiments. While there is a mathematically simple quantum recipe to describe this situation, the reality it describes is totally unvisualizable.
The Principle of Complementarity and the Breakdown of Classical Logic

It is quite significant that the point at which mathematical theory meets the realm of the unvisualizable 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.\textsuperscript{60} Since physical reality in quantum physics is described on the most fundamental level in terms of exchange of quanta, Bohr realized that the fact that a quantum exists as both wave and particle was enormously significant. This mutual exclusivity was the basis for him to define the principle of complementarity – a single quantum mechanical 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 stating 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. We realize that 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 “quantum” logic and epistemology. Therefore, the principle of complementarity in quantum mechanics does not conform to classical logic.\textsuperscript{61} The “total reality” of a quantum system is antinomic in nature and Bohr was among the first to realize that a proper understanding of the relationship between these two aspects of a single reality requires the use of a new logical framework.

What makes this logical framework new is that, in addition to representing profound oppositions that preclude one another in a given situation, both aspects are necessary to achieve a complete understanding of the entire situation. It not only applies to the measurability or knowability of

\textsuperscript{60} Ibid.

some property of a physical entity but, more importantly, it applies to the limitations of the manifestation of this property in the physical world. Thus, physical reality is determined and defined by the energetic manifestations of its properties which are limited by the trade-offs between the two aspects of its antinomic wave-particle nature. The emergence of complementarity in a quantum system occurs when one considers the specific circumstances under which one attempts to measure 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.”

The Debate between Albert Einstein and Niels Bohr

The famous debate between Bohr and Einstein began at the fifth Solvay Congress in 1927 and continued intermittently until Einstein’s death in 1955. The argument took the form of thought experiments in which Einstein would try to demonstrate that it was theoretically possible to measure, or at least determine precise values for, two complementary constructs in quantum physics, like position and velocity, simultaneously. Bohr would then respond with a careful analysis of the conditions and results in Einstein’s thought experiments and demonstrate that there were fundamental ambiguities he had failed to resolve.

Einstein eventually accepted the idea that the uncertainty or indeterminacy principle is a fact of nature and the essential point of subsequent disagreement in the debate became whether quantum theory was a complete theory. Einstein’s position can be expressed by his famous statement that “God does not play dice with us.” According to him, if our current

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63 Insightful discussions of the nature of the debate between Einstein and Bohr can be found in R. Nadeau and M. Kafatos, in The Non-local Universe, and in Peter Dear, The Intelligibility of Nature, 162.
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 improve with time. In other words, our ignorance about these hidden variables makes quantum reality appear probabilistic, unpredictable, and unknowable in classical terms. Therefore, the knowledge of these hidden variables would supposedly make the description of quantum systems completely deterministic, i.e., although quantum indeterminacy may be a property of a quantum system in practice, it need not 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. This is how the dialogue eventually revolved around the issues of non-locality and realism.

Bohr agreed that our existing theories may and will improve with time but believed that this improvement will not remove 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 their properties. 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 of the quantum objects themselves. The assignment of such properties is unacceptable in view of the impossibility of any sharp separation between the behavior of atomic objects and the interaction with the measuring instruments which 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 ter-

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64 In the realm of quantum physics we will be always talking about the energetic manifestations of the inner nature of quantum objects not directly
minological adjustment. All terms now apply to certain physically complex and non-localized entities, each involving the whole experimental arrangement, rather than to single and localized-in-space physical entities. In other words, there is no God-like perspective from which we can know physical reality absolutely in itself. We are forced to recognize that our knowledge of the physical system is in principle local and, therefore, incomplete. Recent modern physics experiments by the groups of A. Aspect in 1981 and N. Gisin in 1998 have clearly confirmed this view.  

Quantum vs. Classical Language

Bohr grounded the language of quantum theory in the wave-particle model of matter. Wave-language is process-like; particle-language is object-and-event-like. Two particles cannot be in the same place at the same time, whereas two waves can. Physical description can use one or other language, but clearly not both at once. There seems to be no logical continuity between the languages of macrophysics and micro-physics, and it cannot be simply assumed that the categories of classical discourses will be the same as those of quantum discourse. In Bohr’s interpretation, the apparatus of quantum mechanics is viewed as a mathematical device for the description of a reality that cannot be directly measured or observed. It expresses the relationship between the quantum system, which is inaccessible to the observer, and the measuring device, which conforms to classical physics. The challenge is in viewing quantum reality with one set of assumptions, those of quantum physics, and the results of experiments with another set of assumptions, those of

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67 Ibid.
classical physics. This implies a categorical distinction between the micro and macro worlds.

Bohr confronts and resolves the epistemological implications of the quantum observation problem in entirely realistic terms. Some scientists have assumed that since Bohr’s analysis of the conditions for observation precludes exact correspondence between every element of the physical theory and the physical reality, he is implying that this reality does not objectively exist or that we are not anymore objective observers of this reality. These conclusions are possible only if we equate physical reality with our ability to know it in an absolute sense. According to Bohr, we just reach a limit to our ability to know. Knowledge here can never be complete in the classical sense because we are unable to simultaneously apply the mutually exclusive constructs that constitute the complete description. This, however, does not make the quantum objects less real. In this sense the limits of knowledge and the unknowable itself have become an inherent part of our knowing process:

This (non-classical) thinking and these theories radically redefine the nature of knowledge by making the unknowable an irreducible part of knowledge, insofar as the ultimate objects under investigation by non-classical theories are seen as being beyond any knowledge or even conception, while, at the same time, affecting what is knowable.\(^68\)

Quantum vs. Classical Energy

One of the most obvious and important differences between classical and quantum physics is that the exchange and transformation of energy is not regarded as a continuous process. In classical physics the use of the energy concept is process-driven and descriptive in nature. It presupposed continuity and had to be abandoned when moving into the

realm of quantum physics.\textsuperscript{69} But concepts such as conservation of energy, which do not require following the actual process of change, are naturally still valid in quantum theory. In other words, the radical newness of quantum theory is associated with the way it describes the states of systems and has nothing to say of the processes by which states of affairs are realized. This does not mean that nothing ever happens; it simply means that continuous processes escape the conceptual apparatus of quantum theory. In quantum physics the concept of energy is associated with a deeper split between visible manifestations and the invisible realities. This is due to two reasons. First, in addition to the invisible nature of the quantum objects, there is also another radically different scale of dimensions – the sub-atomic. Second, quantum objects are not only invisible but also unimaginable – the fundamental concepts of quantum physics are not accessible to human imagination. This second reason leads to the need of interpretation. This “new” physics deals again with the energetic manifestations of physical realities, which are invoked or actualized in acts of observation performed in a way suitable to the dynamics of their inner nature, i.e. to observe the activity of a quantum object, you must disturb it.\textsuperscript{70} Although impersonal (i.e., there is no such thing as quantum object will), its energy is hypostatic in the sense of the Byzantine Church Fathers because it is always the energy of a (some)thing representing a particular instance of all things having the same essence and nature. The unimaginability, however, of this thing makes the need of the interpretation of its energetic manifestations unavoidable. Such an interpretation could happen only within the framework of activities of a given scientific community driven by its historically developed ontological and epistemological presuppositions. In contrast to classical physics, physical description at the quantum level operates by means of two languages – the classical or the macro-language and the quantum or the micro-one. One must use one or other language, but clearly not both at once. This implies a categorical

\textsuperscript{69} David Theobald, \textit{The Concept of Energy}, 117.
distinction between the micro- and macro-descriptions which is based on the necessity of using classical terminology and concepts but also requiring an appropriate discontinuous quantum mechanical “correction” and conceptual “upgrade.” Such logical discontinuity leads to the necessity of a new logical framework in accordance with the particular antinomic nature of quantum objects. Last but not least, quantum physics operates with a completely new understanding of the relationship between whole and parts which is due to the non-local nature of quantum objects. All these quantum “features” lead to the need of a more subtle understanding of the relationship between the quantum nature or essence of microphysical entities and their energy or energetic manifestations.

2. Energy in Relativity and Cosmology

Next let us consider Einstein’s role in extending our understanding of energy by providing three major insights showing that: i) mass is a form of energy, ii) there is a close relationship between mass and energy, on the one hand, and the geometry of space-time and gravitation, on the other, iii) energy can exist in what can be called “vacuum” – the state of space with no matter present.71

Special Theory of Relativity and $E = mc^2$

The special relativity of Einstein came out of the study of electricity and magnetism. It arose from a description of the world based on the concept of field. As we have seen, fields are physical realities filling all space and mediating the interaction between physical particles such electrons, protons and neutrons. This was a world different from Newton’s world that was based on particles exerting forces on one another through empty space. The insights of special relativity, however, go far beyond electromagnetism since its essence is rooted in a symmetry principle – that the laws of physics should take the

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same form after an increase of the velocity of all objects by the same constant value. What Einstein really did was to change Newton’s laws of classical physics of motion so that they obey the symmetry principle found in electromagnetism.\textsuperscript{72}

The first of Einstein’s insights about the concept of energy was the association of mass with energy: “One more consequence of the electrodynamical paper has also occurred to me. The principle of relativity, together with Maxwell’s equations, requires that mass be a direct measure of energy contained in a body; light transfers mass. … The argument is amusing and attractive; but I can’t tell whether the Lord isn’t laughing about it and playing a trick on me.”\textsuperscript{73} Einstein obviously talks about his famous equation $E = mc^2$ which holds for isolated bodies at rest. For moving bodies, the correct mass-energy equation becomes $E = \gamma mc^2$ and includes an additional factor $\gamma = 1/(1 - v^2/c^2)^{1/2}$ which depends on the velocity of the body $v$. Einstein’s result implied that the mass of any body was equivalent to its energy at rest and did not assume a special role of the equation in electromagnetism. In the world of isolated elementary particles “there are two significant forms of energy: the mass energy and the kinetic energy of motion. The mass energy of a particle is its energy of being.”\textsuperscript{74} Energy of being is proportional to mass. “Twice as much mass means twice as much energy, and no mass means no energy. … So mass represents a highly concentrated form of energy.”\textsuperscript{75} It took many years before Einstein could assume in 1932 that his equation was experimentally confirmed\textsuperscript{76} and it is now well known that $E = mc^2$ is correct.\textsuperscript{77}

\textsuperscript{72} Ibid. David Gross points out that this practically revolutionized the way we view symmetry and credits Einstein as the driver of this revolution. This point goes back to the fact that symmetries imply conservation laws such as the energy conservation law discussed earlier.

\textsuperscript{73} From a letter to Conrad Habicht in 1905, quoted in Ibid., 299, fn. 97.

\textsuperscript{74} Kenneth Word, \textit{The Quantum World}, 18.

\textsuperscript{75} Ibid., 19.

\textsuperscript{76} In 1932 Ernest Walton and John Cockcroft split the Lithium atom by accelerated protons and demonstrated that the kinetic energy gained by the two newly created Helium atom nuclei was equal to the mass that was lost during the experiment.

\textsuperscript{77} It is also known that the equation has significant consequences that could be seen in: i) the nuclear processes that sustain the burning of the sun;
Energy, Gravitation and the Geometry of Space-Time

The second of Einstein’s insights about energy is related to his theory of gravitation. After the development of the special theory of relativity, Einstein started looking for a way to include gravity into the new framework and, in the end, produced a field-based theory of gravity – general relativity. The fact that general relativity is a field theory should be of no surprise. One of the main insights from the special theory of relativity was the postulate that the velocity of light, c, is constant but, even more important, limited. Therefore, the influence of one particle to another cannot be transmitted faster than that. Newton’s law of the gravitational force did not obey that rule and was not consistent with special relativity theory. General relativity arose as an update of Newton’s gravitation theory by fixing this inconsistency with the help of a field-based approach. Using the relativistic principles, Einstein showed how energy creates a gravitational field playing the role that was previously occupied by mass alone.78

Matter, Dark Matter and Dark Energy

The third of Einstein’s insights about energy is related to cosmology. In 1917, based on his two initial insights, Einstein derived the set of equations describing the metric of the space-time of the universe as a whole. He thought that the universe had a constant density in time and space but eventually found out that there is no solution with those properties. To get the constant density solution Einstein added to the equations for gravity a new term called the “cosmological

77 Ibid.

ii) the radioactivity, the reversed process of chemical element creation (it happened during the early stages of the evolution of the universe when particles and antiparticles were constantly created and destroyed as mass and energy were inter-converted – a process that happens today at particle accelerators); iii) nuclear power and (hopefully not) in nuclear bombs; iv) the explanation of the origin of most (more than 95%) of the mass of known matter which is due to the mass of protons and neutrons. See Lisa Randall, “Energy in Einstein’s Universe,” 303.
term” or the “cosmological constant.” The solution he found corresponded to a closed static universe – a big sphere with finite radius that stayed constant over time. This solution happened to be unstable. In addition, in 1929 Edwin Hubble provided convincing evidence that the universe is in fact expanding, leading Einstein to admit that the introduction of the cosmological term was his “greatest mistake” or “blunder.” Nevertheless, the possibility he identified, of adding a new term to the equations of general relativity to describe the universe, did not go away and became a matter of serious study in the following seventy years. Cosmological observations remained consistent with a cosmological constant equal to zero until about 1998, when convincing measurements began to indicate that there is indeed an accelerating cosmic expansion that could be explained by the presence of a cosmological term with a \( \Lambda \) having a very small positive value. Subsequent observations provided additional support for this and Einstein’s introduction of the term in 1917, although introduced for the wrong reasons, was found to be prophetic.

The \( \Lambda \) or the cosmic density was recently estimated by measuring its effects on the curvature of space through the distortion such curvature causes in images of distant galaxies. It is a powerful new technique measuring some of the properties of the cosmic microwave background radiation (CMB). Using this technique, by 2001 several groups made several important conclusions. First, the universe is made up of 30% matter. Second, only 5% of the 30% is the matter as we know it – the kind of matter we study in biology, chemistry, engineering and geology, and the kind of matter we are made from. The remaining 25% is a special type of (dark) matter – it is not uniformly distributed in space and its density is not constant in time. Observations suggest that it is based

79 Ibid., 304.
81 Ibid.
82 Frank Wilczek, The Lightness of Being, 108.
on a special (probably new) particle but it is not clear what this particle is. The new Large Hadron Collider (LHC) in Geneva is expected to help in identifying the source of dark matter. Third, there is a 70% missing component which is not matter and which is considered as being contributed by the so-called dark energy. It appears to be very uniformly distributed in space and time and has been observed only through its gravitational influence on the motion of normal matter. The dark energy concept is directly associated with Einstein’s cosmological term – although there are slight differences in the interpretation, which may refer to the same physical phenomenon. The current guesses are that it is some sort of force field which permeates the vacuum but there is no currently known theory of physics that could explain it. On the other hand, “the dark-matter problem, …, is ripe for solution” and there are promising ideas that could explain what dark matter is.

Einstein’s Contributions to the Concept of Energy

Some physicists believe that, with the addition of his cosmological term, Einstein in fact had identified a new form of energy that is associated with space-time itself – it is not carried by matter and not the result of the known forces, i.e. a kind of vacuum energy. This is the first time in physics when a new form of energy is identified together with a claim that there is maybe nothing carrying it. There are two other logical possibilities. Either we are now seeing the effects of some new substance that was not previously seen before, or there is something wrong with our theoretical worldview. Nobody knows. What we clearly know, however, is that Einstein’s work on energy was extraordinarily influential in providing

83 Ibid., 105.
85 Ibid., 196.
86 Andrew Taylor, “The Dark Universe,” in Alain Connes et al., On Space and Time, 41.
the fundamental insights for our current understanding of this concept.

Having thus detailed the understanding of energy in modern physics, let us turn now to the usages and understandings of the term in Orthodox theology. In both cases, as noted at the outset, it is important to proceed by way of an expository delineation, carefully setting forth the understandings of the term in context and without forcing comparisons. Only once this demonstration of Orthodoxy’s use of “energy” is complete do we venture some tentative overall conclusions about this interdisciplinary discussion between theology and physics.

V. The Concept of Energy in Orthodox Theology

1. Introduction


The Byzantine Church Fathers traditionally consider the meaning of “essence” and “nature” as equivalent.\(^87\) “Nature” is defined as what is common for all individual things or beings which exist through it and in which this nature is. More importantly, the essence of all things remains unknowable and it is only through its natural energies that we know that an essence or nature is. Every nature is defined by the principle (logos) of its essential energies.\(^88\) This basic premise of Byzantine theology is inherently related to the concept of hypostasis.\(^89\) The term hypostasis specifies a

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\(^88\) Ibid., 132.

unique essence together with its particular properties. The particular properties constitute what distinguishes one specific hypostasis from other hypostases of the same nature. The hypostasis could be conceived as the unique way of possessing or assuming a nature or essence and manifests the “who” of the essence.

Saint Maximus the Confessor also defines a hypostasis as an actually subsisting subject. He specifically emphasizes the impossibility to reduce the hypostatic order to the natural (essential) one. Every actually subsisting being, be it living or inanimate, has a hypostasis which contains its essence and manifests its natural energies. The hypostasis does not possess the natural energy but only manifests it according to its specific mode of existence and hypostatic properties. The specific manner and the intensity of this manifestation depend on the way the hypostasis exists and not on the principle of the existence of its nature. The hypostatic characteristics shape and provide the particular mode of the manifestation of the energies. In this sense, it is incorrect to talk about the manifestation of the natural energies of a particular being out of the context of its hypostatic existence – the energies are always the energies of a hypostasis, i.e., these are the energies of something or of someone, i.e., of a person. The Byzantine Fathers, therefore, “used the term hypostasis and person and individual for the same thing,” but also distinguished between the hypostases of animate and inanimate, rational and irrational beings. For them the essential differences actualized in the hypostases “are one thing in inanimate substances and

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91 J.-C. Larchet, La divinisation de l’homme, 133.

92 Opuscules XVI, 214 (=Migne PG 91, 205BC).

93 See Kapriev, Byzantine Philosophy; and Tchalakov, I. and Kapriev, G., “The Limits of Causal Action.”

94 The Cappadocian Fathers were the first to identify hypostasis with person – person is the hypostasis of being and it is the personal existence that makes being a reality (see Christos Yannaras, Elements of Faith, 33).

95 John of Damascus, Philosophical Chapters, in Writings, ch. 42, p.66.
another in animate, one thing in rational and another in irrational, and, similarly, one thing in mortal and another in immortal."  

Every nature corresponds to its essential principle (logos) but can operate in different ways or modes (tropoi) and manifest its energies accordingly in a way that is driven by the person. The specific mode of operation is defined by person’s proper choice and will. One of the fundamental differences between the hypostasis of inanimate irrational beings and the divine and human persons is the presence of a will. God as person appears as a willing subject, and manifests Himself through His energies in the way He wants. The divine essence is eternal and has one will and energy. Since the divine energy and will belong to an eternal nature, they are also eternal and uncreated. The energy presupposes the will, and the will has its definition and limits in the energy which proceeds from the will. The will and the energy are not of the hypostases, but are carried by them, in exactly the same way as they are carriers of their nature. The situation is crucially different in the case of the natural energetic manifestations of irrational inanimate things which happen during their interactions with other things or beings according to the inner logic of their proper nature, i.e., unwillingly. In both cases, however, in terms of its existence, the energy is always en-hypostatic: it is manifested through a hypostasis and always exists in a particular hypostasis. As we shall see later, the universal meaning of the triad essence/nature-energy-hypostasis pro-

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96 Ibid., 68.
99 “One should note that will is one thing and wishing another, and that the thing willed is one, the principle willing another, and the one willing still another. Whereas will is the simple faculty itself of willing, wishing is the will in regard to something, and the thing willed is the object of the will, or that which we will.” John of Damascus, *Orthodox Faith*, II.22, in *Writings*, 251.
100 *Opuscules* I, 111 (=Migne PG 91, 33B-36A); *The Disputation with Pyrrhus of our Father among the Saints Maximus the Confessor (= Disputation with Pyrrhus)*, trans. J.P. Farrell (=Migne PG 91, 348A, 352B), as referenced in Kapriev, *Byzantine Philosophy*. 
vides the epistemological ground on which the concepts of energy in theology and in physics could be considered in parallel.

Is There a Definition of Energy in Orthodox Theology?

It is worth pointing out that in Orthodox theology there are comprehensive definitions of the concept of energy. It is probably Saint John of Damascus who is the one who defined it most straightforwardly:

energy is the natural force and activity of each essence: or again, natural energy is the activity innate in every essence: and so, clearly, things that have the same essence have also the same energy, and things that have different natures have also different energies. For no essence can be devoid of natural energy. … Natural energy again is the force in each essence by which its nature is made manifest. And again: natural energy is the primal, eternally-moving force of the intelligent soul: that is, the eternally-moving word of the soul, which ever springs naturally from it. And yet again: natural energy is the force and activity of each essence which only that which is not lacks. 101

We can already see one of the major trends in the definition – the universality of the distinction between essence and energy. The Damascene makes a careful distinction between four related terms:

But observe that energy and capacity for energy, and the product of energy, and the agent of energy, are all different. Energy is the efficient and essential activity of nature: the capacity for energy is the nature from which proceeds energy: the product of energy is that which is effected by energy: and the agent of energy is the person or subsistence which uses the energy.

Further, sometimes energy is used in the sense of the product of energy, and the product of energy in that of energy, just as the terms creation and creature are sometimes transposed. For we say “all creation,” meaning creatures.\textsuperscript{102}

This last paragraph was used as the criterion of Orthodoxy at the Council of Constantinople in 1351 where the Orthodoxy of Palamas was confirmed. This is an opportunity to focus now on a number of aspects of the theology of Palamas within the context of what has been said so far.\textsuperscript{103}

\section*{2. Palamas and the Distinction between Essence and Energy}

The distinction between essence and energy is a key for the understanding of the theology of Palamas – it is the essence that is manifested through the energies and not vice versa. This is the fundamental epistemological premise of his theology – a premise that he applied also to all beings.

With respect to the fact of its existence but not as to what it is, the substance is known from the energy, not the energy from the substance. And so, according to the theologians, God is known with respect to the fact of his existence not from his substance but from his providence. In this the energy is distinct from the substance, because the energy is what reveals, whereas the substance is that which is thereby revealed with respect to the fact of existence.\textsuperscript{104}

Palamas did not define in great details the character of the distinction between essence and energy. For him the distinction is not just conceptual, but it is not real, either, in the sense of the scholastic terminology, where \textit{distinctio realis} means a

\begin{footnotesize}
\begin{enumerate}
\item Ibid., III.XV, “Concerning the Energies in our Lord Jesus Christ.”
\item In this section I am following very closely the insights found in an excellent study by Georgi Kapriev, \textit{Philosophie in Byzanz}.
\item Saint Gregory Palamas, \textit{The One Hundred and Fifty Chapters (= Capita 150)}, trans. Robert E. Synkewicz, Ch. 141, 247.
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difference in substance. Energy is not an independent substance. The word reality (originating from the Latin word *res*) presupposes a difference in substance and it is difficult to express it in Greek. The Greek *pragma* means “something existing,” but not necessarily an independent substance or essence. It belongs to the same group as the concept *praxis* and also means “something actual.” In this sense Palamas usually calls the energies “things.” He talks about an “actual distinction” (*pragmatike diakrisis*), opposing it, on the one hand, to the “actual division” that would remove the divine unity and simplicity and, on the other hand, to a simple mental distinction (*diakrisis kat’ epinoian*).  

The reality of the distinction between essence and energy in Palamas is directly associated with his theological point of departure – the real possibility for the knowledge of God and the deification of man. This real distinction is unavoidable in connection with the doctrine of deification and divine knowledge, since deification and divine knowledge imply participation of man in the uncreated life of God and God’s essence remains transcendent and totally unparticipable. For Palamas the energy differs from the essence but is not separated from it. The essence refers to the immanent, self-identical being of God, while the energy means that God does something and He does it willingly. The energy does not denote something other in God than His essence but is the same divine being as active *ad extra*. This activity *ad extra* includes God’s works such as creating, sustaining, providing, deifying etc. “When the activity is spoken ‘objectively’ as a divine work (*ergon*) or being, … we are not to imagine a something existing between the divine essence and creatures. The terms work and being denote … the reality of God’s activity as a powerful presence.”

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106 Torstein Tollefson, *The Christocentric Cosmology of St Maximus the Confessor* (Oxford University Press, 2008), 140.  
109 Ibid.
activity or energies in relation to His creatures and God, as He is in Himself, should be distinguished from God as He related to something other than Himself. The articulation of this actualization of the divine energies echoes Maximus the Confessor: “For I do not say that in these things providence is one thing and judgment another. But I know them as potentially one and the same, but having a differing and many-formed activity in relation to us.”

One of the main arguments of Palamas for the distinction between essence and energy is the plural nature of the energies:

As it has been made clear above by Basil the Great, the theologians treat the uncreated energy of God as multiple in that it is indivisibly divided. Since therefore the divine and divinizing illumination and grace is not the substance but the energy of God, for this reason it is treated not only in the singular but also in the plural. It is bestowed proportionately upon those who participate and, according to the capacity of those who receive it, it instills the divinizing radiance to a greater or lesser degree.

Ontology vs. Epistemology

The ontology underlying Palamas’s theological epistemology is the ontology of divine-human communion which is centered on the realism and experiential nature of the knowledge of the personal God. This ontology finds its source in the Incarnation and leads to an understanding of theology which is “antinomic” and rooted in the very being of God as simultaneously transcendent and immanent, revealed and hidden,


\[111\] Saint Gregory Palamas, Capita 150, Ch. 69, 163.
visible and invisible, knowable and unknowable. For Kallistos Ware, by “antinomy” in theology we mean:

the affirmation of two contrasting or opposed truths, which can not be reconciled on the level of discursive reason although a reconciliation is possible on the higher level of contemplative experience. Because God lies “beyond” the world in a unique sense, He cannot be precisely conceived by human reason or exactly described by human language. But if there are no exact descriptions of God, there are many “pointers.” In order to reach out towards that which is inconceivable, the Christian tradition speaks in “antinomic” fashion – as Newman put it, “saying and unsaying to a positive effect.” If we rest satisfied with a strictly “logical” and “rational” theology – meaning by this the logic and reason of fallen man – then we risk making idols out of finite, human concepts. Antinomy helps us to shatter these idols and to point, beyond logic and discursive reason, to the living reality of the infinite and uncreated God.

The relationship between ontology and epistemology found in the theology of Palamas is different from the one that could be found in modern theological discourse where epistemology seems to be preceding ontology and is usually seeking to determine whether or not the so-called ontological questions are relevant. Palamas’s ontological presuppositions are also different from the ones found in the “classical physics epistemology” where all realities are considered as literally “revealed,” fully given for exploration and able to be studied in completeness, independently of their inner nature. His epistemology, however, shows some trends very

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114 Aristotle Papanikolaou, Being with God, 9.
similar to the non-classical or “quantum” epistemology which is antinomic insofar as it could be described by the complementarity between waves and particles, between whole and its parts, between invisible properties and their visible energetic manifestations. The antinomic nature of the divine realities is directly expressed in Palamas’s comments on the divine energies:115

God also possesses that which is not substance. Yet it is not the case that because it is not a substance it is an accident. For that which not only does not pass away but also admits or effects no increase or diminution whatever could not possibly be numbered among accidents. But it is not true that because this is neither an accident nor substance it belongs among totally non-existent things; rather, it exists and exists truly…. Since each of the hypostatic properties and each hypostasis is neither a substance nor an accident in God, are they each on this account ranked among non-existent things? Certainly not! Thus, in the same way, the divine energy of God is neither a substance nor an accident nor is it classed among non-existent things.

The Debate between Barlaam the Calabrian and Gregory Palamas116

The question about the use of normative or Aristotelian logic in the realm of the divine realities was the major issue at the initial stage of the controversy between St. Gregory

115 Saint Gregory Palamas, The One Hundred and Fifty Chapters, 135, p. 241.
116 Before moving forward, I need to point out that the initial stage of the controversy between Gregory Palamas and Baralaam seems to be quite understudied. Until recently, the major sources of information and interpretation of this debate available in English and French were John Meyendorff’s original study (A Study of Gregory Palamas [London: The Faith Press, 1964] and Byzantine Hesychasm: Historical, Theological and Social Problems [London: Variorum Press, 1974]) and Robert E. Sinkewicz (“The Doctrine of Knowledge of God in the Early Writings of Barlaam the Calabrian,” Medieval Studies 44 [1982]).
Palamas and Barlaam the Calabrian. Barlaam was the Byzantine representative in the discussions between Constantinople and Rome on the issue of the *filioque*. The anti-Latin Treatises which Barlaam wrote in 1335 to explain the Orthodox point of view have as their object the refutation of the use of Aristotelian logistic proofs by scholastics in defending the *filioque*. Barlaam’s objective was to refute them by their own methods, by showing that their syllogisms prove to be fallacious. His point was that the truth-value of the *filioque* can not be demonstrated with syllogistic arguments such as expressed in Aristotle’s *Posterior Analytics*. The fundamental movement of Barlaam’s commentary in his preliminary debate with Gregory Palamas was an exposition of the epistemological ground of logical science, aimed at demonstrating the inappropriateness of its use in theology.

The interest for us here is to be found in the fact that in this debate Palamas introduces the main concepts constituting his theology – being, existence, nature, essence and energies – and uses them both theologically and in a broader philosophical context. In fact, it is during this initial stage of the controversy with Barlaam that the Athonite monk and future metropolitan of Thessaloniki will articulate for the first time the core of his teaching on the essence and energies of God. It must be also noted that the articulation of the meaning of the above concepts and the doctrine itself emerged within an entirely epistemological context driven by the specifics of a discussion about the nature of human knowledge of God.

The particular use of the concepts provides us with the unique opportunity to explore the type of transformations they needed to undergo in order for them to function within the realm of the ontological intuitions of Byzantine theology.

The polemic of Palamas against Barlaam follows two main directions. First, Palamas in his own turn was trying to refute Barlaam in what he believed to be his strength by accusing him of ignorance of Aristotelian logic. The second direction

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118 Ibid., 221.
119 Ivan Christov, “Being and Existence in the Discussion on the Method between Saint Gregory Palamas and Barlaam.”
focuses on another articulation of the ontological foundations of Aristotelian logic leading to a radical transformation of the nature of the syllogistic proof. The distinction between essence/being and existence provides the ontological foundation for the development of a different teaching on the use of syllogistic proofs. It is not the divine essence anymore that is the subject of syllogistic proofs but those aspects of the divine being that are open for participation – the act of being, the divine life, wisdom and providence.\textsuperscript{120} The ground for participation is that part of the essence which is open towards everything existing and which represents the pre-eternal essence and source of all being. Due to its existential finitude Palamas calls it nature.\textsuperscript{121} This nature is the source of the energies making possible the knowledge and experience of God and opening the possibility for a theological syllogistics. The causality in theological syllogisms pertains to the things around God, i.e., it is based on the divine energies. This is why their premises and terms are positioned not according to human understanding but according to their own (divine) nature.

This is the way Palamas addresses Barlaam’s major arguments against the possibility of using apodictic syllogisms in theology. Theological proofs are not about singulars but about the one singular who is the source of everything that is general. Due to the same reason, one can not really speak of a purely quantitative subordination or positioning of the syllogistic terms since they all express the divine energies and can be characterized by the same “general” uniqueness. In addition, the cause of the theological conclusions is nothing external to God and one can not speak of anything that is ontologically and temporally prior to the divine nature.\textsuperscript{122}

The ontological presuppositions of Palamas are not an innovation. In the articulation of distinction between essence and existence and between essence and energies, he is following St. Maximus the Confessor with his distinction

\textsuperscript{120} Ibid.
\textsuperscript{121} Ibid.
\textsuperscript{122} Ibid.
between the *logos* of essence and the *tropos* of existence.\(^{123}\) The fact that this did not clearly come out of the temporal development of the discussions may be only due to the dominating role of Aristotelian syllogistic terminology. It provides, however, the background for the understanding of Palamas’s ontological presuppositions, epistemology, and overall logic during the debate.

3. *Maximus the Confessor: Essence, Energy and the Logoi of Creation*

The fundamental relationship between essence and energy is linked in Maximus the Confessor with the distinction *logos*-tropos which constitutes one of the major axes of his theological system.\(^{124}\) The *logos*-tropos relationship was widely used before him for the articulation of the distinction between the essence and the hypostases of the Trinity.\(^{125}\) Maximus, however, applies it more universally and moves it out of the purely Trinitarian context. This universality is considered as one of the main characteristics of his Christian philosophy.\(^{126}\)

The doctrine of the *logoi* (“reasons”) of creation is at the theological foundation of the Maximus’s teaching on the knowledge of God. The *logos* of a thing is its formative cause, the principle of its beginning and purpose in terms of its being.\(^{127}\) Every created reality has its associated *logos* corresponding to the inner law of its nature.\(^{128}\) The *logos* is the

\(^{123}\) As we have already seen, some scholars may argue that in his articulation of the distinction between being and existence Palamas is actually following Aristotle himself. Cf. Husain Kassim, *Aristotle and Aristotelianism in Medieval Muslim, Jewish and Christian Philosophy* (Lanham: Austin & Winfield Publishers, 2000), ch. 2, “Existence and Essence.”

\(^{124}\) In this section I am following very closely the analysis of Georgi Kapriev, *Philosophie in Byzanz*, 56–65.

\(^{125}\) J.-C. Larchet, *La divinisation de l’homme*, 146.

\(^{126}\) Ibid, 144.

\(^{127}\) Ad Thalassium 64, in Maximus the Confessor, *On the Cosmic Mystery of Jesus Christ*, trans. P.M. Blowers and R. L. Wilken (Crestwood, NY: Saint Vladimir’s Seminary Press, 2003), 145 (=Migne PG 90, 709B).

carrier of the definition of the essence. Any change of the *logos* of an essence would destroy its nature and create a new nature corresponding to a new essence. The *logoi* of creation correspond to God’s activity through which He creates, sustains and guides all things towards Himself. The *logoi* pre-exist eternally in unity as models, goals or purposes of all creation in God Himself – the one *Logos*. Without losing their unity in the divine *Logos*, the *logoi* of creation become dynamic and differentiated when they are brought from potentiality into actuality at the creation of the world from nothing. Every created thing bears with it the manifestation or rather manifests its *logos* and without this manifestation its *logos* cannot be made known.129 The *logoi*, therefore, have both ontological and existential dimensions which are inseparable. The ontological dimension of the *logos* of a thing corresponds to its existential cause and nature. The existential dimension corresponds to the divine thought, intention and goal associated with the creation of that thing and directed towards the believer. The many *logoi* of the one *Logos* make the world a meeting place for divine-human dialogue reflecting and manifesting God’s thoughts and personal activity. “By seeking the *logoi* inherent in creation, man communes with the thoughts and intentions of God, which are directed towards him personally.”130 In this way the *Logos/logoi* relationship provides a personal dimension, a common meaning to every created reality. The common meaning of all things is the one Person of the *Logos* of God, i.e. “Jesus Christ is the ‘bridge’ to God on all levels of existence, not only through human nature (which He united to the divine in His hypostasis), but also as the one *Logos* of all the *logoi* which are found in all things.”131

The *tropos* (the way) of existence is the mode of the natural activity. It is the carrier of any variation, modification or

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130 Ibid., 192.

131 Ibid., 196.
innovation on the background of the unchangeable logos. The tropos is the form of the various manifestations of nature, it is the way in which the essence exists and functions. The transition from logos to tropos is a change from the essential to the existential order. The possession of a logos of essence and a tropos of existence is a prerequisite for the existence of every being.

Maximus relates the logos to the essence of a being and the tropos to its hypostasis or person. However, the mode of existence is a concept that is not immediately identified with the hypostasis or with the way of hypostatic existence. For Maximus the term “existence” does not refer only to the hypostasis and the dyad essence-hypostasis has nothing to do with the medieval coincidence between essence and existence that will be later associated with Thomas Aquinas and that was found as an epistemological premise in Barlaam the Calabrian. Maximus does not associate the hypostatic mode of existence directly with the essence. The tropos of existence is the way in which any nature actually exists. It denotes nature in its concrete reality. It is true that the tropos of existence is realized in a hypostasis but this is only because there is no nature without a hypostasis. Nature is available in reality only as enhypostatic, where the hypostasis provides the format in which the way of existence of the enhypostatic nature is actualized. The tropos of existence should be always considered in relation to the personal volitional disposition and it is from the specific personal (hypostatic) will and choice that the variability of each essence or nature is actualized.

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133 Ambiguum 42, 1341D.
134 J.-C. Larchet, La divinisation de l’homme, 145.
135 Ibid.
136 Ambiguum 42, 1344D, in On the Cosmic Mystery of Christ, 91; see also n. 16 on p.89.
137 J.-C. Larchet, La divinisation de l’homme, 146.
138 Ibid.
139 Ibid., 147.
The manifestation of the essence is through its natural energy. Without it, neither being nor existence are possible.\textsuperscript{140} It is exactly the \textit{logos} of the essential energy that is the limit and the definition of the entire nature.\textsuperscript{141} In this sense the energy reveals itself in two different aspects. As far as it is immanent, it is identified completely with the movement that is proper to the essence and, therefore, with the essence itself. But, insofar as it is transitive and directed outwards, it goes beyond that movement. These two aspects of the divine energy are related to each other within the perspective of the \textit{logos-tropos} relationship.\textsuperscript{142} The immanent essential energy is beyond any existence (super-existential) and impossible to be expressed and understood. The (other) transitive energy represents the way of divine existence. It is manifested outside of the essence and can be known to some extent. This is the energy that is active in all creation.\textsuperscript{143} In this sense the ‘\textit{logos-tropos}’ relationship represents the ontological bridge opening the possibility for the direct knowledge of God through His uncreated energies.

Divine Energies and the Logoi of Creation

The doctrine of the \textit{logoi} has three distinctive aspects: i) the \textit{logoi} are uncreated realities which are manifested in created things; ii) the \textit{logos} of a thing has multiple ontological and existential dimensions; iii) the \textit{logoi} have a parallel relationship and role with the divine uncreated energies.\textsuperscript{144} The

\textsuperscript{140} Ambigua à Thomas 5, in Saint Maxime le Confesseur, Ambigua (Paris: Les Editions de l’Ancre, 1994), 112.
\textsuperscript{141} Ibid. Ambigua à Thomas 2, 03; Ambigua à Thomas 5, 112.
\textsuperscript{142} Georgi Kapriev, Philosophie in Byzanz, 56–65.
\textsuperscript{143} Chapters on Knowledge 1, 3, in Maximus Confessor, Selected Writings (New York: Paulist, 1985), 129.
last aspect is of particular relevance for us here since the *logoi* and the divine energies are interrelated in an important and complementary way.

The primary purpose of the *logoi* reveals the attributes, thoughts or intentions of God through created things, whereas the primary purpose of the uncreated energies is to bring about direct interpersonal communion. It could be said that the *logoi* reveal God as personal reality indirectly, whereas the uncreated energies reveal Him directly.\(^{145}\)

The *logoi* could be “seen” as uncreated energies only in their created effects. The uncreated energies, however, are not bound to any specific aspect of reality as are the *logoi* of things. The distinction between the *logoi* and the energies can be also seen in the fact that the vision of the *logoi* requires the assistance of grace, i.e., the intentional divine energies assist in the uncovering of the *logoi* which are reflected in and seen though the created things: “The *logoi* in things are nothing but *logoi* from God, reflected in the mirror of things by intentional divine energies. From the *logoi* mirrored in imperfect ways in things, perspectives of ascent through the divine energies to the *logoi* from God are opened.”\(^{146}\) For Maximus, the ultimate goal of the divine economy is the deification of man, and rational creatures are deified insofar as they move and act in accordance with their *logoi*,\(^{147}\) becoming, in this way, their own co-creators.\(^{148}\)

The similarity between the *logoi* and the energies in Maximus does not mean their identification. “In places where Maximus uses both terms he clearly regards them as differing in reference. It would be more faithful to his usage to say that he splits the Cappadocian conception of the divine *energeiai*

\(^{145}\) Kevin Berger, “Towards a Theological Gnoseology,” 222.
\(^{146}\) Ibid., 223, quoting St. Nilus.
\(^{147}\) Ambigua 7, 1085A, in On the Cosmic Mystery of Christ, 61.
\(^{148}\) David Bradshaw, Aristotle East and West, 206; Alexander Golitzin, Et Introibo ad Altare Dei, 86; Jean-Claude Larchet, La divinization de l’homme, 120.
into three: one part relating to creation (the \textit{logoi}), another to God’s eternal attributes (“the things around God”), and the third to the activity an energy of God that can be shared by creatures (for which he tends to reserve the name \textit{energeia}). The point in using the term \textit{logos} rather than \textit{energeia} is to emphasize that God is present in creatures, not only as their creator and sustainer, but as their meaning and purpose.”

In what it concerns Palamas, it should be pointed out that there is a clear difference in context between his theology of the divine energies and the Maximus doctrine of the \textit{logoi} of creation: “Palamas’ theology is in fact a \textit{doctrine of God}, while Maximus’ doctrine of the \textit{logoi} deals with the \textit{world} which is anchored or rooted in God. In other words, Maximus’ theology of the \textit{logoi} deals with \textit{cosmology}, while Palamas’ theology of the divine ‘energies’ deals with theology proper (\textit{theologia}).”

This is the reason why many scholars believe that the Maximian doctrine of the \textit{logoi} could be used as another starting point for the development of a dialogical platform between physics and theology.

4. Divine Energies, Personal Dynamism and Realism

A Theology of Divine Realism

For Palamas, divine energy is not a divine function which exists on account of creatures. Even if creatures did not exist, God would manifest Himself beyond His essence. Indeed, as Vladimir Lossky pointed out,

expressions, such as “manifest Himself” and “beyond” are really inappropriate, for the “beyond” in question only begins to exist with the creation, and “manifestation” is only conceivable when there is some realm foreign to Him who is manifested. In using such defective expressions, such inadequate images, we acknow-

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149 Ibid.
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ledge the absolute, non-relative character of the natural and eternal expansive energy, proper to God.\textsuperscript{151}

The divine energies provide the dynamics of the divine-human personal relationship but “God is infinitely beyond all his operations – both essentially and as a personal reality.”\textsuperscript{152} In his discussion of the Transfiguration, Palamas follows Maximus by pointing out that it was not Christ who was transfigured when He was seen in glory but the disciples, who were momentarily enabled to see Him as He truly and eternally is. “They passed over from flesh to spirit before they had put aside this fleshly life, by the change in the activities of sense that the Spirit worked in them, lifting the veils of the passions from the intellectual power that was in them.”\textsuperscript{153} There are several important messages here: i) the divine energies are both relational (intentionally directed towards us) and non-relative (existing beyond any relation and independently of us); ii) the perception of the divine presence in the world requires divine cooperation, ascetical struggle and liberation from the passions; iii) the personal relationship between God and man could described as synergy; iv) the nature of the divine energies explains both our potential for deification and our inability for it.

Divine Personal Dynamism

It is important to underline the personal dynamic nature of the divine energies. It is exactly the divine personal dynamics that make the invisible God visibly present in the world. In a way similar to the situation in quantum physics, these dynamic personal (hypostatic) presence and manifestations cannot be considered apart from us. We are co-participants to the measure of our personal participation and humble cooperation, which are borne within the specific context and status of our

\textsuperscript{151} Vladimir Lossky, \textit{The Mystical Theology of the Eastern Church} (Crestwood: St Vladimir’s Seminary Press, 1997), 74.

\textsuperscript{152} Kevin Berger, “Towards a Theological Gnoseology,” 221.

\textsuperscript{153} Difficulty 10, 1128A, in Andrew Louth, \textit{Maximus the Confessor}, 109.
own spiritual “devices” and sacramental life. The personal character of divine-human interaction and “energetic cooperation” bears the signs of personal specificity, historicity and spiritual conditioning. The divine energies are “God for us” as persons to the measure of each and every one’s personal response and receptivity, ascetic struggle, humility and love. As Kallistos Ware elaborates:

But God’s energies, which are God himself, fill the whole world, and by grace all may come to participate in them. The God who is “essentially” unknowable is thus “existentially” or “energetically” revealed.

This doctrine of the immanent energies implies an intensively dynamic vision of the relationship between God and world. The whole cosmos is a vast burning bush, permeated but not consumed by the uncreated fire of the divine energies. These energies are “God with us.” They are the power of God at work within man, the life of God in which he shares.154

Divine Energies and Space-Time

God as personal reality can exist on multiple planes, including both eternity and time.155 He experiences His personal relations with us through His uncreated energies on both planes. “The plane of time and the plane of eternity are two modes of existence which are interrelated, and not only can the person exist on both, but the very planes themselves would not be understood outside of the person.”156 In this sense, time came out of His eternity and He is present in it with His eternity opening it to man. Time began simultaneously with the created world. “Creation of the world is not a temporal act.

156 Kevin Berger, “Towards a Theological Gnoseology,” 177.
The world was not created in time, the world is created with time.”

Saint Gregory Palamas, quoting Saint Maximus, also says that one who has been deified becomes “without beginning” and “without end.” He also quotes Saint Basil the Great who says that “one shares in the grace of Christ … shares in his eternal glory” and Saint Gregory of Nyssa who observes that man who participates in grace “transcends his own nature; he who was subject to corruption in his mortality, becomes immune from it in his immortality, eternal from being fixed in time – in a word, a god from a man.”

God created man and the world for eternity. But eternity is won through a movement towards God which comes about in time and implies the need of both space and time. Time is the ladder extended by the eternity of God. It becomes the condition for the dynamic interpersonal relationship and union with the eternal God as well as a road towards eternity. In relation to us the eternal God is placed in a position of anticipation and expectant waiting and there is a remaining distance between us and Him. This distance, however, has a place within the plan of salvation as an expression of divine love.

Space is the form of the relation between God and man, that spiritual “metric” which makes possible the attraction, interaction, and movement between persons, including the movement towards the divine persons of the Trinity. It defines the field of divine action. The Damascene is particularly relevant here:

God is not in place, for He is the place of Himself, filling all things and being above all, and holding together all things. When, however, He is said to be in

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158 Quoted by Dumitru Stâniloae, Orthodox Dogmatic Theology, 154.
159 Ibid.
160 Ibid., 158.
161 Ibid., 171.
place, this place of God clearly specifies where His energy is at work. This is because He pervades all things without mingling, and is in all through His own energy according to the fitness and receptivity of each.  

Therefore, the “places of God are those in whom God’s energy is clearly manifested to us.”  

In other words, “the noetic (i.e., spiritual and not somatic) energy of God embraces and transcends the somatic space-time parameters of the universe and refashions them. … For theology the basis of the universe is the uncreated energy of God and the will of God which transcends nothingness, the empty space that lacks existence and on which the limited existence of the created universe is established and floats.”  

VI. Summary and Conclusions

In accordance with the initial methodological remarks, I will focus now on the identification of the specific common themes, issues, and patterns emerging from the parallel examination of relationships between essence and energy in Orthodox theology and physics. The examination of the ways the concept of energy is used leads to the following conclusions:

1. The meanings of the concept of energy in Orthodox theology and physics intersect at the epistemological level, driven by two ontologies which are both antinomic. The parallels are definitely more visible in relation to quantum physics, the theory of relativity and cosmology than in relation to classical physics,
where the concept plays a more descriptive than epistemological role.

2. They are both used to deal with the articulation of the hypostatic manifestations of these realities which are invoked or actualized within the experiential acts of divine-human and object-instrument interactions. The hypostatic nature of the energetic manifestations in physics is expressed by the fact that energy is always associated with something – a physical entity, such as particles, bodies, objects or fields, or a physical system of such entities. There is a single occasion in physics where there is claim for the existence of new type energy – a kind of vacuum energy or energy of “nothing.” This is the so-called dark energy in cosmology which is believed to be associated with space-time itself and not carried by any matter or rather by any known particle. This belief, however, is just one of the possible alternatives and seems to be more of a speculation.

3. They are both associated with ontological and existential aspects of reality. This claim may be seen as mostly relevant in theology and less obvious in physics. There is, however, a clear relationship between the mass of a particle and its energy at rest \( E = mc^2 \), showing that the physical concept of energy could be associated with the “being” and the existence itself of individual particles.

4. They are both inherently related to the nature of space-time, the first in a physical, the second in a spiritual sense. The spiritual sense both embraces and transcends the physical one, pointing out the divine creative origin, meaning, and purpose of the universe. However, the relationship between the divine energies and the spiritual meaning of space-time does not seem to be articulated enough.

5. They both emerge within the context of a relationship between ontology and epistemology that is expressed in a subtle distinction between essence and energy, between the essential and existential order of being,
providing an epistemological bridge between visible and invisible, hidden and revealed, knowable and unknowable.

6. In both cases, the invisible and unimaginable nature of the realities leads to the need for interpretation. Such interpretation happens within the framework of the social activities and life of a given community, driven by its historically developed intellectual or sacramental tradition, including its specific ontological and epistemological presuppositions. In both cases the interpretation of the manifestations of invisible realities can lead to the danger of a forceful visualization of these realities since we always tend to interpret within the framework of our visual experience.\textsuperscript{165} This potential relationship between interpretation and visual experience affects our language since the visual is more easily expressed linguistically and our linguistic and visual assumptions are not entirely separate. “Linguistically based assumptions are derived from the presumption of visualizability.”\textsuperscript{166} The struggle against such forceful visualization of invisible, i.e., unseen, realities is common to both Orthodox theology and modern physics. In Orthodox theology it leads to idolatry, which arises from the impulse to linguistically describe and define the unseen, resulting in metaphors and allegories.\textsuperscript{167} Similarly, in physics “whenever we visualize or visually interpret in the quantum level, we distort and perhaps even falsify reality.”\textsuperscript{168}

7. They were both enriched by lively historical debates that need to be further studied and analyzed: between Einstein and Bohr in the twentieth century and between Barlaam and Palamas in the fourteenth; we could also add the debate between the Cappadocian Fathers and Eunomius in the fourth century. Its study

\textsuperscript{165} Archbishop Lazar Puhalo, \textit{The Evidence of Things not Seen}, 38.
\textsuperscript{166} Ibid.
\textsuperscript{167} Ibid., 39.
\textsuperscript{168} Ibid.
within the context considered here will be the subject of future research.

8. They both deal with the limit of our knowing capabilities, making these limits part of knowledge itself. Therefore, they may be both more valuable in explaining why we do not know instead of what exactly we know.

9. They both operate in a mode requiring two different languages driven by the antinomic nature of the realities they are dealing with. The logical discontinuity between these two different languages requires a new logical framework going beyond normative or Aristotelian logic.

10. They are both inherently realist in nature, promoting a subtle realism that could be challenged but, at the same time, is irresistible. The challenges come from the fact that the energetic manifestations and knowledge of both physical and spiritual realities are associated with struggle, continuous efforts and preparation in accordance with the inner principles (logoi) of their nature. Addressing these challenges could be trivial in physics where the need of preparation for a subtle experiment could be obvious. In theology and spirituality, however, these challenges are dominant and seem to be based on a serious negligence of the need for preparation, humility, prayer and divine cooperation.

11. They both deal with a new understanding of parts and whole where the sum of the parts does not constitute the “invisible whole” but the whole is fully present in each of its parts and manifestations.

12. They both need to be considered as referring to dynamic realities, and it is only by taking into account this dynamism that it is possible to escape potential ontological ambiguities and open additional epistemologi-

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169 I know very well that I will never be able to repeat Gisin’s group experiment demonstrating the non-local nature of quantum realities: Cf. W. Tittel et al, “Violations of Bell Inequalities More than 10km Apart,” 3565–3566.
cal opportunities that enable the movement from visible to invisible.

13. The fundamental difference between the two concepts is rooted in the different nature of the realities they are dealing with and can be expressed as the difference between “created” and “uncreated,” “person” and “thing,” “personal” and “impersonal.” The divine realities are the dynamic personal realities of a living and loving God who has a will. God does what He wants and our spiritual efforts and knowledge make sense only within the context of our personal (as in person-to-person) relationship with Him. Physical realities are impersonal (inanimate and irrational) but also hypostatic and dynamic. They need to be disturbed in order to manifest their energies and inner nature.

14. Last but not least, we should stay away from seeing the subtle distinction between essence and energy in both theology and physics within the context of a “forced” positivistic epistemology. In many cases this distinction may be more useful in explaining our inability to know. This, however, does not need to be part of an agnostic attitude to God and the world. It should, rather, be seen as part of a positive attitude pointing out and opening up the possibilities for our God-given knowing capacities.

In conclusion, I should focus on the potential value of this exploratory study, i.e., its relevance for the science-theology dialogue. In a recent illuminating essay Michael Heller has tried to answer the question of whether science and theology can nowadays interact with profit for both sides. His insights will be useful in the articulation my conclusions:

the profit for theology is obvious; the question at stake is to become relevant for men and women in our times. To see the profit for science is less obvious, but we should take into account the fact that much of Western science, such as for instance Newton’s ideas, is im-
bued with things taken ultimately from theology, and it is better to be aware of this than not. To understand science is a part of the understanding of the world.\footnote{170}

Heller also points out the delicate nature of the matter, arguing that that the interface between science and theology must be based on extremely “fine-tuned” principles. This is 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.”\footnote{171} I could not agree more with Michael Heller and believe that one of the aspects of the potential value of the present essay within the context of the science-theology dialogue is exactly methodological. I believe that in exploring the parallels between the uses of two similar terms in two different fields it is important to see first how these terms work in their own natural conceptual environment and then let the differences or parallels in their meaning and use emerge on their own. That is why this essay has focused so much on an actual exposition of the concepts of energy in physics and theology, guided by the analogical isomorphism method, without forcing a speculative interpenetration between them. One simple conclusion from the application of this method could be the fact both physicists and theologians are trying to deal with very similar issues. An example of such an issue is making the limits of our knowledge become part of our knowledge itself. Another example is the articulation of the visible manifestations, properties, and nature of invisible realities.\footnote{172}

A second potential value to this essay is related to the establishment of a common exploratory ground – epistemology. As I have already discussed, the epistemological aspects of the

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\begin{itemize}
  \item \footnote{170}{Michael Heller, “Where Physics Meets Metaphysics,” 246.}
  \item \footnote{171}{Ibid, 241.}
  \item \footnote{172}{For example dark matter and dark energy appear to be perfectly invisible and transparent. They interact with ordinary matter only very feebly, if at all. The only way they have been detected is through their gravitational influence on the orbits of ordinary stars and galaxies, the things we do see. Cf. Frank Wilczek, The Lightness of Being, 203.}
\end{itemize}
concept of energy are clearly articulated in Orthodox theology but not so much in physics, where the concept plays a more descriptive and (through the energy conservation law) more operational role. It is true that these aspects become significantly more relevant in quantum physics but, still, they appear indirectly, in between the lines, rather than in a straightforward manner. Whether theology can inspire a better focus on the epistemological aspects of the concept of energy in physics is an open question. The identification of the common exploratory ground, however, is considered as having value on its own.

A third potential value to this essay is the identification of specific cross-disciplinary insights. Here I do not mean just the value coming from a conceptual cross-fertilization of theology that would help the enrichment of the apophatic language used in the description of the mysteries of faith. What I do mean is the value coming from the opportunity to open an illuminating window to the richness of the theological “space-time insights” themselves.173

Another cross-disciplinary message could be found in the fact that modern quantum physics cannot operate without the proper immersion of the observer into the experiential realm of the dynamic interactive processes of that which is being studied. This view has become part of the philosophy of physics and has affected the way people reason in general. The experiential nature of Orthodox theology is revealed in the life of grace, the life in Christ. We are led to truth by experiencing the Truth and this is accomplished not by learning “dry legalistic facts but by entering into the interactive processes within the whole Body of Christ.”174 Orthodox theology understood and practiced this concept long before the mind of science perceived it. “The connection between the two: the processes of science and the processes of our theology are not identical in essence but in a real sense, they are related in concept.”175

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173 I cannot stop being amazed by the words of Saint John of Damascus: “this place of God clearly specifies where His energy is at work.”
174 This point was clearly articulated by Archbishop Lazar Puhalo, The Evidence of Things not Seen, 33.
175 Ibid., 34.
In what it concerns the theology → physics direction, one of the clearest insights that comes from Byzantine theological history is the affirmation of the hypostatic nature of any energetic manifestations – energy is always the energy of something or someone, and there are no anhypostatic energies flying in the world in the anticipation of being “enhypostasized.” In all its history Orthodox theology has firmly rejected all attempts at introducing anhypostatic presences and manifestations. The theological message that could be formulated here is related to a possible warning in association with some of the current interpretations of dark energy in the universe, which some consider to be the energy of nothing (or energy of the absolute vacuum). Theology will not explain what the source of dark energy in physics is. It can, however, keep pointing out that there must be one, promoting at the same time a kind of terminological hygiene that would resists the introduction and use of terms such as “energy of nothing,” “God particle” and even “dark energy” which, as we have seen, has nothing to do with darkness.

The last potential value to this essay is the identification of the major differences in the use of the concepts that could potentially, due to methodological negligence and excessive ambition, create paper bridges between science and theology. There are two important points here. The first point is about the ultimate goals of physics and theology that are at stake here. We can easily understand that physics ultimately deals with the beauty and the comprehensibility of the world around us and our place in it. It is an expression of our honest appreciation of the fundamental context of human existence. Physics, however, does not deal with questions concerning the purpose and meaning of life. Hoping that physics will provide answers to these questions means to look for answers to questions physics has never asked. Theology is “the science” dealing with the purpose and ultimate goal of human life,

177 Dark energy is “a term that has caught on broadly, but is just a mask to hide our ignorance of what is going on”: J. Craig Wheeler, *Cosmic Catastrophes – Supernovae, Gamma-ray Bursts, and Adventures in Hyperspace*, 2nd ed. (Cambridge University Press, 2007), 282.
human authenticity, and eschatological destiny. This is why the authenticity of our theological worldviews is so important – it is ultimately a question about life and death, it is about life eternal which, according to the Scripture, is to know God Himself. The difference in the two contexts is crucial and should be always kept in mind.

The second point is about the difference between personal and impersonal. The concept of energy in physics deals with the articulation of our experiences with physical objects and systems. It describes the manifestations of the inner nature of invisible physical realities. To actualize these manifestations we need to bring them up by interacting with the object or system under study and, ultimately, disturbing them in a way that will lead to a specific natural response. The concept of energy in theology is associated with the nature, personal manifestations, and will of a living, loving God. The divine energies impregnate the language describing our personal relationship with God. “God descends into the world – and unveils not only his countenance to man but actually appears to him. Revelation is comprehended by faith and faith is vision and perception. God appears to man and man beholds God. The truths of faith are truths of experience, truths of a face.”

We cannot, however, consider our relationship with God except within the context of a humble attitude, ascetic discipline, and a prayerful spiritual life. We are seeing God’s love and find it because He first found us and opened Himself to us. We pray and glorify Him, but His loving answers to our prayers may be “yes,” “no” and “not yet.”

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Резюме

Цей нарис пропонує паралельне дослідження значення терміну “енергія” у православному богослов'ї та фізиці як науці. Базований на авторитетних текстах і загальноприйнятих принципах, цей нарис вказує на емпіричні та епістемологічні аспекти віри і науки а також аналізує їхні методологічні основи. Ідеться зокрема про богословські поняття Бернарда Лонергана, Варлаама Калабрійського та Григорія Палами а також досліди з фізики Нільса Бора та Альберта Ейнштейна. Огляд творів згаданих авторів породжує цілий ряд спільних тем: взаємозв’язок між невидимою дійсністю та її видимими проявами; протиставлення між реалістичним та антиреалістичним баченням Бога та світу; різниця між класичною та квантовою на противагу божественної та гуманістичній епістемології; взаємовідносниця між цілим та його складовими частинами в межах божественної та квантової дійсності; істотна природа усіх енергетичних проявів; небезпека ігнорування епістемологічних аспектів енергії за рахунок підходу який зосереджується на здебільша на дії; необхідність виходу поза межі законів класичної логіки та прийняття нових логічних систем; необхідність застосування антиномічної термінології для змалювання взаємодоповнюючих аспектів дійсності і нарешті необхідність давати собі раду з обмеження наших знань вбачаючи в ній тонкий реалізм, що відзеркалює природу божественної та квантової дійнос- тей.