

Dynamic Universe – natural science and philosophy in unison

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Abstract. In a coherent conception of reality, physics and metaphysics should both come together to create a comprehensible worldview. This was the case in the Newtonian picture of reality which turned out to be limited at the beginning of the 20th century. The quest for a new synthesis, a more reliable picture of reality incorporating current theories and observations, has not been fulfilled in spite of a hundred years of interpretive discussions. The claim of this paper is that the missed unison can be found in Tuomo Suntola's Dynamic Universe (DU). This exceptional theory covers the domains of the theory of relativity and quantum phenomena and fairly exceeds their level in philosophical virtues. DU is studied here from the perspective of natural philosophy concentrating on the basic principles of the theory, and the prominent metaphysical features that in addition to the mathematical structure can be found in a proper physical theory. Relying on the zero-energy principle, DU opens up a new kind of holistic framework where the Newtonian furnishings for reality are left behind. By transforming the Newtonian clockwork into a pendulating, spherically closed 4D-sphere, DU discloses a seamless connection between mass, space, motion, and energy. In this representation all the seemingly separated objects are parts of a single totality and ultimately constructed of waves. Their interrelations can be universally formulated as their state of motion does not depend on the time or the site of observation. In addition to its importance for physics, the framework provides justified answers to many age-old disputes in natural philosophy starting from the basic substance of being, the origin and reference of movement, and the possibility of empty space – the most basic questions pondered by giants like Democritus, Plato, Aristotle, Descartes, Leibniz, and Newton. Most importantly, in DU mental properties can be neatly incorporated into the physical world, and conscious activity of human beings can be befitted into the overall evolutionary scheme.

1. Introduction

In the history of Western culture, natural philosophy bloomed in ancient Greece and at the turn of the modern era when modern natural science had its beginnings. Empirical science was for several centuries believed to provide the most reliable 'window into reality', until the beginning of the 20th century, when theories in physics extended into an abstract non-representational level. Their intangible content has remained a challenge for experts and vague for general public. Once again there is a call for natural philosophy to make nature comprehensible.

A shared conception of the world is important for people to navigate among the phenomena they encounter in daily life. Every civilization has had their cosmogonical myths containing information



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about the creation, fate, and constitution of the world. By making things understandable, such basic frames and categories endow security and belongingness to a bigger scheme of things. They inform people about their lot in the world, advise how to explain phenomena in a suitable way, and act in a sensible manner. It is difficult for individuals in any culture to question long-lasting presuppositions, which are taken as self-evident as long as affairs proceed smoothly in accordance with the given paradigm or disciplinary matrix. Cultural paradigms, like scientific theories, are apt to be recognized as temporary constructions only when they fail in explaining new facts in an orderly manner [1] [2].

The particle-mechanistic worldview that was created during the 17th century was based on Newtonian physics. The mechanical conception of the world wielded its influence extensively both inside and outside the realm of physics for more than two hundred years. It provided a well-functioning perspective into nature, and a suitable methodology for a more detailed study. The principles of Newtonian thinking are still widely used, and believed to be true, even though Newton himself regarded simple mechanistic philosophy as inadequate to explain the active living phenomena in nature [3][4]. In addition to a given mathematical structure, a proper physical framework contains a metaphysical basis, a sensible conceptual interpretation that spells out the nature of things and relations the theory is dealing with. The uttermost metaphysical and methodological principles that were adopted along with Newtonian physics were mechanistic description of reality, atomism, determinism, reductionism, and the detached observer. There was no reason to doubt or discard their truth until Newtonian physics failed to explain some phenomena, which led into its modification and complementation by the theory of relativity and quantum mechanics, which distorted the Newtonian picture of reality.

In the current confusing situation where the long-held efficacious Newtonian worldview has outgrown its original scope along with its modification and complementation by the theory of relativity and quantum mechanics, there still remains an opportunity for a more satisfactory conception of reality. Ontological and epistemological evaluation belonging to the field of natural philosophy has once again turned out essential when interpreting the abstract theories of modern physics. Yet, the quest for a new synthesis, a more reliable picture of reality, has not been fulfilled in spite of a hundred years of lively discussion. Given that the reality itself is an unbroken whole, it is also to be expected that the theory that manages to correctly describe it is unified, and brings together physics and metaphysics to create a unified worldview. Accordingly, it is quite clear that we cannot be fully satisfied with current situation where the theories of relativity and quantum physics are incompatible, and their ontological foundations are ambiguous.

The claim of this paper is that Tuomo Suntola's Dynamic Universe (DU) [5] provides the desired unification. The extensive theory, based on zero-energy principle, is easily comprehensible, and on the second thought almost self-evident. It provides a fresh metaphysical context, where the mathematical abundance typical for contemporary standard theories of physics can be reduced to take in more physics, i.e., intelligible explanations of phenomena, rather than just plain maths whose ontological interpretation is ambiguous. DU is a unified theory of the phenomena that the theories of relativity and quantum physics are dealing with. In addition to incorporating precise structure and dynamics for the entire physical reality, DU settles several age-old disputes in natural philosophy. It straightens the current quandaries related to the nature of space, time, and the basic substance of being. It puts an end to the question of whether matter and space are atomic by tracking down the nature of mass and the cause of inertia. Finally, DU holds a solution to the mind-body problem. Like physical theories until now it leaves open the place of mental phenomena in the world. However, it is not difficult to reconcile mentality to the causal closure of the physical world in the context of DU. Existence and behaviour of conscious creatures nicely conforms to the overall evolutionary scheme: actualization of potentiality. All these features contribute in a notable manner to the most basic questions in natural philosophy pondered by giants like Democritus, Plato, Aristotle, Descartes, Leibniz, and Newton.

The recipe for success in DU is composed of principles that are reliable and well-known in physics: the zero-energy principle in spherically closed space with 4 metric dimensions. By allowing a metric fourth dimension, the zero-energy hypothesis in DU discloses a new kind of seamless connection

between mass, space, motion, and energy. The universe presents itself as a pendulating whole that naturally evolves into the phenomena and cascades of structures in space we observe. The particle-mechanistic worldview developed in the 17th century where separate objects reside in space, is transformed into Leibnizian holism where all objects are related and compose an unbroken whole. The whole determines the energetic conditions for everything that exists and possibly might exist. Natural laws are seen to generate an all-embracing substantial entirety that lawfully organizes itself into a multilayered unbroken whole. The magnificent universe innately contains everything that ever exists. It is a flexible process that resides both inside and around everybody.

In this paper DU is studied from the perspective of natural philosophy and the goal to seamlessly unify mathematics and understandability. The focus is on DU's basic ontological principles behind its mathematical structure. Throughout the paper is manifested the author's belief that the relevance of philosophy of science should be better appreciated in physics, especially philosophical notions concerning the history of science, paradigm shifts or the progress of science, and the evaluation of theories.

2. Historical viewpoints

The history of ideas and conceptual questions has not been central in physics. Yet they cannot be overlooked when dealing with the conception of reality that is based on comprehensive results in various fields. The tentative nature of a worldview as a slowly transforming cultural construction is not commonly considered. Nevertheless the fact that the particle-mechanistic way of thinking has been a norm for several centuries does not make it the one and only reasonable way of thinking about reality and the circumstances in the material world. Many great philosophers have found the atomistic idea of everything consisting of *fundamentally separate* particles moving in an empty space unfounded. In other words, the Cartesian-Newtonian particle-mechanistic worldview certainly claimed victory over the Leibnizian holistic worldview, but the present confusion in theoretical physics gives strong reasons to suppose that the holistic worldview will eventually outlive the particle-mechanistic worldview.

2.1. Matter and its division

The modern conception of reality was sealed in 1689, when Isaac Newton published his monumental work *Philosophiæ Naturalis Principia Mathematica* [6]. Newton's work united Kepler's planetary laws and Galilei's research on motion. It was an achievement whose contemporary parallel would be a theory that unifies the theories of relativity and quantum mechanics. Newton completed the paradigmatic change in the conception of reality that Copernicus had started when challenging the Ptolemaic Earth-centered view of the universe. He formulated precise mathematical expressions to initially vague terms or concepts such as 'force', 'motion', 'mass' and 'inertia'. To provide a proper basis for the mathematical description of the motions of material bodies, he also gave new meanings to space and time, postulating them to be infinite and independent of matter. The world of matter began to be understood as an immense clockwork that was controlled by exact eternal laws. [7]

Newton's laws described in detail how separate bodies move in empty space under the influence of gravitational force. Every piece of matter in the universe attracted every other body with force proportional to the square of the distance between them. Newton, however, was not able to give an answer to the nature of this force. The idea that gravitational attraction could operate across empty space was against the dominant (Cartesian) mechanical theory that required direct contact between interacting bodies. Among others, the philosopher Leibniz fiercely criticized Newton's gravitational theory for requiring "occult forces" which remained beyond both rational explanation and human cognition. Newton absolutely rejected the charge that gravity was an occult quality. For him, it was not a hypothesis, it was an empirically established fact whose cause would be revealed in due time. [3]

Leibniz himself related the inertia of bodies to their weight and Descartes related it to their size. Newton distinguished between weight and mass, because the latter did not vary with motion, and related inertia to a body's mass and motion. Classical mechanics adopted Newtonian mass as a kind of

constant, 'the quantity of matter in a body'. It was an 'intrinsic' property of a body which did not depend on the body's velocity. Newton's account of mass in his third law is, however, notoriously unsatisfactory. His definition of mass as the product of a body's density and volume is quite useless, since the density of a body is commonly defined in terms of its mass and volume [8]. Ernst Mach who equated the 'relative masses' of bodies with the 'negative inverse ratio of their mutually induced accelerations' was the first to propose the definition which has been widely adopted even if the constancy of this ratio is not actually a matter of definition [9] [10]. The origin of gravitation and inertia that affects all bodies remained a mystery in Newtonian physics and it has not been decisively solved by the theory of relativity either. In the wider framework disclosed by DU, a thorough solution is finally given.

Einstein modified the notions of space and time, and disclosed an intimate relation between mass and energy; the theory of relativity however preserved the accustomed idea of separate bodies, which Galileo had adopted from ancient atomism [11]. Leucippus and Democritus in the 5th century B.C. assumed that physical bodies are formed out of tiny particles, and all real happenings can be reduced to these particles moving in empty space. Natural science quite wholeheartedly adopted the mechanistic and reductionist conception of matter which became an essential part of the Newtonian world-view. The assumption that all natural events can, in principle, be analyzed by reducing them into their parts represented a new view of the mutual relationship between the whole and its constituents. While the alchemy and occultism of the Middle Ages were largely holistic, atomistic methodology was generally regarded as a huge intellectual breakthrough in the historical development of science. [12]

In the history of science, Descartes has often been associated with the revival of ancient Atomism; but he did not in fact hold an atomist view of matter, even though he committed to the mechanical theory that required direct contact between interacting bodies [13]. The great philosophers of antiquity, Plato and Aristotle, were also firmly against atomism. When advocating the importance of form they considered Democritus' mechanical idea of "dead matter" too narrow to cope with phenomena related to living systems. Their idea of matter rather resembles the undifferentiated *apeiron* proposed earlier by Anaximander. Plato made a distinction between an eternal world of ideas and the changing sense-world that could appear in various forms, depending on the ideas that influenced the unformed matter; every being appearing on the sublunar world was a combination of matter and form [14]. For his disciple Aristotle, the basis of material being was *materia prima*, an indestructible substratum which was common to all elements. This material without qualities could not exist as such. Existence and coming into being was a matter of the substratum instantiating any of two basic opposites, such as wet-dry and hot-cold. Aristotle believed that matter could be divided potentially infinitely, i.e., that the division could continue step by step without a limit. According to him, the atomists' presumption that there were limits to the division of matter was in contradiction to the transformation of particles. An entity transforming from a state in which it has relatively less form into a shape in which it has more form, was a matter of potentiality becoming actuality. A substance with a particular form always had the potentiality of becoming to have a particular form: when a substance is actual, it has a certain form. [15] [16]

2.2. Modern notion of continuity based on fields and waves

The explanatory value of particles diminished in physics along with the introduction of the concept of fields as continuous entities filling up their space. Michael Faraday in 1849 was the first to use the term 'field' which James Clerk Maxwell adopted in his electromagnetic theory. He discovered that waves in these fields propagated at a finite speed. Einstein employed field equations in general theory of relativity in 1915, and Paul Dirac introduced quantum fields where particles are considered to be quanta in these fields. Quantum physics completely ruined the particle-mechanistic paradigm of classical physics, the atomistic idea that all real happenings could be reduced to eternal particles moving in space or in space-time. Waves came into the forefront in physical explanations.

When trying to understand the new situation in physics at the beginning of the twentieth century, the Copenhagen founding fathers of quantum theory tracked the difficulties in interpretation down to the increasingly abstract nature of the theory. Everything that measurement could reveal from the investigated system was supposed to be contained in the wave or state function, but the nature of this mathematical construction remained unclear as it did not appear to have any distinct counterpart in observable reality. At the same time, as the significance of mathematics increased, the concept of matter became more abstract. Elementary particles such as protons, electrons and photons were not eternal and unchanging. Rest mass changed into energy in collisions, and kinetic energy became mass in pair formation. The structure of regular particles appeared to be specified on the basis of conservation laws and fundamental symmetries in nature. The Copenhagen group along with Werner Heisenberg concluded that the increased immateriality (*entstofflichung*) of elementary particles meant that the concept of ‘dead matter’ customary in our worldview was to be replaced by a kind of interplay of forms. Niels Bohr considered that the first step in this direction had already been taken by the theory of relativity in its equivalence between mass and energy. Bohr [17] emphasized contextuality and criticised atomism in very much the same way as Plato and Aristotle: “The discovery of the elementary quantum of action revealed a feature of wholeness inherent in atomic processes which goes far beyond the ancient idea of the limited divisibility of matter.”

In his popular book *Physics and Philosophy* [18], Werner Heisenberg indicated that the description of the world was going through the same type of change that took place in Antiquity when the atomist teachings of Leucippus and Democritus were replaced by the ways of thinking employed by Pythagoras and Plato, in which form was a more important factor than matter. Even though the final shape of a situation could not yet be recognized, Heisenberg felt able to express his belief that Plato’s philosophical concepts were more suitable for addressing reality than proposals made by the antique Materialists. Moreover, the Aristotelian terms ‘form’ and ‘content’ or ‘form’ and ‘substance’ were given new meaning, since the elementary particles of modern physics were neither eternal nor unchanging particles of matter, but abstractions in the same way as Plato’s regular elements consisting of triangles. In Heisenberg’s view, elementary particles were different forms in which energy could be manifested. The result of their collision was not an object but a form which energy could take and which we then observed as being a material object. Energy was not just the force which kept everything moving, it was like fire in the philosophy of Heraclitus – the fundamental substance out of which the world is made [19].

Max Born [20] also emphasised mathematical forms or structures: in his opinion, particles were not something that could “in a Kantian manner be thought of as having substance”. Schrödinger, who considered waves to be more important than particles, also joined this discussion. He thought of the accurately specified masses and charges of particles as nothing more than gestalt-elements specified by wave equations. Individual particles were of no significance, since they were not identifiable as individuals. The same particle could never be observed twice, nor could a specific electron, even in principle, be considered to be labelled without resulting in errors in calculation. On the other hand, it was easy to leave a permanent trace in wave structures which could be observed more than once. [21]

However, on the basis of quantum theory it was not possible to carry out wave description completely. The multi-dimensional wave packets that describe the studied systems depended on the chosen group of observables in the experiment, and soon dissipated because of the different velocities of the component waves. Physics had to be content with wave-particle dualism which left the nature of quantum entities unclear, and consequently the conception of reality vague. The deep interpretative questions raised by the Copenhageans were not settled but faded into oblivion until recently when ‘the second spring’ of quantum physics arrived. New technologies in fast-developing fields of quantum simulation and quantum information processing depend on manipulating coherent quantum states. Researchers are utilizing the most unexpected and inexplicable quantum features like superposition and entanglement when creating innovative new constructions and realizations like supersensitive detection or artificial photosynthesis. Physicists today often maintain that a wave function has to be something “real”. It is considered a mundane object that does not differ much from an itinerary. [22].

However, there is no commonly accepted ontological explanation of what this unobservable entity, that does not fit into the context of classical (meta)physics, is or where it comes from.

2.3. *Advancement in natural philosophy*

Physics as an independent branch of knowledge gradually deviated from natural philosophy. The idea that nature is governed by mathematics superseded the old methodology that was more dependent on metaphysical explanation. Experimental natural science generates reliable mathematical descriptions of perceptions, but a comprehensive picture of reality also requires intelligible metaphysical explanations. Physics and metaphysics cannot be unequivocally separated [10]. All science presupposes some unfalsifiable metaphysical system of beliefs about the nature of the world, such as that there are physical objects and that there are causal relations. The positivist ideology cannot break free from metaphysics just by accepting some chosen metaphysical commitments to be empirical facts. From the viewpoint of natural philosophy, comprehensive theories combining mathematics and openly stated metaphysical postulates are like sharpened tools that may reach intricacies in nature unattainable by other means, i.e., by mathematics alone. Their interpretation and translation into a common language may expose fresh answers into age-old questions in natural philosophy and lead into a better understanding of reality. Modern natural philosophy should combine ‘physics’ and ‘philosophy’ to formulate a comprehensive framework – a perspective that is built around a metaphysical core and exactified by mathematics.

Many of the fundamental questions now under evaluation were discussed already by the pre-Socratic natural philosophers. Their quest found a long-lasting consensus in Aristotle’s physics and metaphysics [15]. As Heisenberg noticed, quantum phenomena would also be much easier to understand in Aristotle’s world, where abstract forms and potentialities may emerge to the material level. The same fundamental questions need to be answered again whenever established presuppositions at cultural turning points lose their plausibility. According to Kuhn [2] metaphysical considerations are prominent when new paradigms are coming into existence. Natural philosophy bloomed in ancient Greece and at the turn of the modern era when modern natural science had its beginnings. Along with the decline of the Newtonian framework, work in this fundamental field is once again stimulated. There is a demand for a more trustworthy map to navigate in the world.

In their attempt to understand the nature of reality, natural philosophers have since antiquity tried to move from plain phenomena or perceptions to deep understanding of the phenomena and perceptions. The Milesian school that bloomed in the 6th century BC is known for initiating the search for natural causes and explanations. The early philosophers looked for a single fundamental substance or principle out of which everything was formed, something that ruled all occurrence and could explain the colourful variety of the myriad phenomena that we observe. Heraclitus saw that the diversity of reality could not be reduced to anything material as the material world was not permanent. There was a continuous change going on everywhere. Nobody could step into the same flow twice as today’s river consists of different water than yesterday’s river. Heraclitus understood that in addition to Being, also the question of Becoming demands a solution.

Pythagoras emphasized the power of numbers and mathematics. In the Pythagorean doctrine, mathematics and numbers took a position similar to that of basic matter for the Milesians. The ultimate basis was an ideal principle of form, proportions and measures that could not be sensed as water in the philosophy of Thales. Forms and numbers represented a deeper order, a harmony hidden behind visible phenomena.

The Eleatic approach to fundamental truth followed Parmenides who trusted that logic proved that one could not become many, static things could not begin to move, and something that already existed could not change into something which it was not. Multiplicity, movement and change had to be virtual and subjective. Senses were a poor witness compared to logic which revealed true being to be one and unchanging. Atomists with their idea of eternal atoms moving and mingling with each other in empty space attempted to unite the idea of primary substance to Parmenides’ argument which rejected change and multiplicity. [1]

At the turn of the modern era special stress was put on empirical truth, i.e., on what could actually be observed or measured. When Galilei combined the atomist outlook to the strict mathematical method inherited from Pythagoras and Plato he especially asked for factual relationships, i.e., how change actually takes place. Metaphysics disappeared under the empiricist practice. Aristotelian terms related to substances, their unseen essences and potentialities were discarded from explanation. The new method proved unprecedentedly successful, and the particle-mechanistic worldview was for centuries believed to correspond to reality, at least on the material level.

During the transition from the 19th to the 20th century, new empirical data was discovered which required new theories that challenged the uttermost metaphysical principles adopted along with Newtonian physics: atomism, determinism, and the detached observer. Especially the difficulties related to the interpretation of quantum phenomena disclosed the need for deep ontological and epistemological re-evaluations. Natural philosophy entered its third “golden age”. However, this debate has not yielded a consensus. As the metaphysical problems have not yet been solved despite almost one hundred years of discussions, the scope of the currently occurring change appears to be parallel that of the earlier revolutions. [1]

There are no mathematical problems in dealing with quantum phenomena. The problem is just that the phenomena cannot be explained within the prevailing mechanistic-deterministic framework in a comprehensible manner. The success of mathematics does not mean that the quest for an understandable ontological interpretation is futile. Abstract mathematical structures as such are not enough for complete physics, or natural philosophy. To comprehensively describe reality, an operationally satisfactory mathematical theory that conforms to observations, should be complemented by a univocal ontological interpretation.

Since the time of the Copenhageans in the first half of the 20th century, a variety of further interpretations explicating the unexpected quantum facts has emerged. Each of them holds different presuppositions and implies different kinds of surprising changes to the world view, such as active information or branching universes [1]. There is no obvious choice between conflicting ontological views; the very existence of several imaginative conceptions can rather be seen just as a manifestation of a deeper methodological and ontological problem – the failure of the central ideas of mechanism and materialism assuming that all causes could be reduced to properties and exterior relations between separate things.

Many researchers have found it easier to explain or interpret quantum phenomena in the context of eastern philosophies where mind and mental influences are not disconnected from material reality. Especially, the notorious ‘measurement problem’ evoked the concept of consciousness to be included in the vocabulary of physicists. The idea of a detached observer was already criticized by Bohr who repeatedly stated the epistemological problems to be similar to those which thinkers such as Buddha and Lao-Tze encountered when attempting to balance our position as both observers and actors in the great drama of existence [23] [24]. People are immersed in the world which they strive to understand to the best of their ability.

When aiming to provide a proper ontology for mathematics-driven theories, contemplation about the nature of the basic substance or substances is of fundamental importance. Related to quantum phenomena, it has often been suggested that the basic substance may not be strictly material, physical or concrete but something psychophysical, i.e., something that supports material as well as mental phenomena. This is a customary assumption in Eastern philosophies, and has become gradually a viable option also in western philosophy, as Cartesian dualism has been practically rejected and it becomes more and more evident that emergent materialism suffers from deep problems [25]. When in principle allowing some kind of panpsychism, empirical science has advanced to a level when the very ideas – the ideas of dualism and materialism that originally legitimated its field of study, but blurred proper comprehension of mental phenomena – can justifiably be surpassed.

An ontological approach was significant in the profound re-evaluations that happened in antiquity and at the turn of the modern era. Contrary to the contemporary increasingly abstract theories which are often considered to be just operational tools rather than realist portrayals corresponding to reality,

Tuomo Suntola's 4-dimensional zero-energy model, the Dynamic Universe, has remarkable ontological content. Ontological starting points have sometimes been criticised in philosophy for the problematic presuppositions associated with the whole endeavour [26]. Whenever there is an attempt to understand the world as the differentiation of some primary substance or element, it is necessary to postulate this substance as being the basis for all appearing things. One can then ask how a clear conception of this maybe non-visible primary substance can be formed simply by thought. Secondly, it is necessary to present a credible explanation of why and in which way this homogeneous primary substance differentiates exactly into the world that we observe. The Dynamic Universe starts from an original innovative idea opening a new view into the universe, and successfully meets the second criterion, by applying the basic idea.

Formulation of a plausible world view is a creative task that in addition to rigorous study demands original thought. A proper ontological solution must reveal the primary causes and fundamental physical processes behind observed phenomena. Obviously, an appropriate mathematical model that captures the whole spectrum of observations is indispensable, but a natural philosopher cannot be content with plain mathematics in the absence of understanding. Epicycles in Ptolemaic celestial mechanics are a grand example of elusive mathematical self-deception. These mathematical complications turned out to be unreal, along with acceptance of the Copernican heliocentric system. Simpler mathematics sufficed to take in more physics when the Earth was no longer assumed to be in the centre but revolved around the Sun. The discovery of Copernicus was a prerequisite for further progress in understanding the universe. Without his constructive metaphysical thought it was not possible to get rid of the blinding spell of the Ptolemaic theory which merely gave mathematical descriptions of immediate observations of people on the surface of Earth. Instead continuing the age-old process of fitting and fixing the complicated geocentric model according to new observations, it was possible to find reasonable further causes and interconnections in the wider heliocentric scheme.

Physical understanding related to the basic principles of reality has not advanced much for the last hundred years as unification of the theories of relativity and quantum physics has not succeeded. There are attempts at formulating an all-encompassing ultimate theory of everything in physics but these multidimensional mathematical edifices cannot be validated by empirical tests. They remain beyond tangible comprehension and cannot capture a complete outlook of reality. It seems quite an impossible task to find a perspective from which to join together the theory of relativity where bodies are moving in 4-dimensional space-time whose structure is being modified according to their presence, where time and length are apt to vary depending on an observer's position and state of motion, and quantum mechanics where the unobservable systems follow wave-mechanics in complex, multidimensional Hilbert spaces, but reduce into quite ordinary entities whenever observed in the accustomed 3-dimensional space.

In the light of history, proper unification may not succeed based on pure mathematics. The present trend for mathematical abundance might once again be reduced by a fresh metaphysical context which could disclose some hitherto unnoticed fundamental interrelations by providing a deeper view into the universe. The Dynamic Universe model that is offered by Tuomo Suntola contains the required primary principles. This truly revolutionary theory gives a unified explanation of the domains of the theory of relativity and quantum physics, and unlocks their mathematical complications by introducing a more thorough perspective on the cosmos.

In spite of its obvious merits, this unequalled solution has not been widely acknowledged among professional experts. It may be considered too strange or too good to be true. In addition, Karl Popper noticed that one does not need to admit the problems of one's pet theory, for one can always save it from falsification by adding more metaphysics to it, metaphysics by which the theory can accommodate data that it does not genuinely explain. As we have learned from Kuhn, it is not a painless task to assimilate a completely new theory package which does not conveniently fit into one's previous lines of thought [2]. Then again, it is also quite natural that only new theories, that are incompatible with the earlier ones, can genuinely overcome the problems of the earlier theories. Guidelines for theory evaluation are provided in philosophy of science which explicitly state that a

better theory or a more encompassing theory explains and predicts the same data with a smaller number and quantity of premises, unexplained explainers, or just metaphysics. Avril Styrman in his doctoral dissertation compared DU and relativistic physics, concluding that DU matches perceptions at least as accurately as relativistic physics and is metaphysically more unified and virtuous [27] [28].

3. DU – a transparent framework for a wider conception of reality

The recipe for successful unification in Suntola's theory is composed of principles that are reliable and well-known in physics: the zero-energy principle in spherically closed space with 4 metric dimensions. The Aristotelian-Leibnizian notion of actualization of potentiality is the central philosophical principle combined with these principles. The through-going integration of these principles generates a structure and dynamics for physical reality where time and length maintain their shape and bodies can be constructed out of waves. In addition to its great value for physics, the framework is indispensable for constituting a comprehensible picture of reality. It provides a justified answer to many age-old disputes in natural philosophy starting from the basic substance of being, origin of movement, the possibility of empty space and the character of mass, inertia, energy, and their relations. Most importantly, even if DU like standard theories of physics leaves open the philosophy of mind, its basic mechanism of actualization of potentiality, when extended to cover mental phenomena, provides an explicit mechanism for incorporating mind and mental properties in their entirety into the scheme of natural things.

According to DU, our 3D space is the surface of a 4D sphere that is expanding at the speed of light. The surface of the 4D sphere counts for three metric dimensions, and the radius of the 4D sphere is the fourth metric dimension. The velocity of light is defined as the velocity in which the radius of the sphere is growing. The surface of the 4D sphere is not an empty space but ultimately consists of mass which is the primary and the conserved substance. The foremost movement that takes place along the radius of the 4-dimensional sphere is customarily called 'rest mass' or 'rest energy' of an object in the 3D space. As an implication of the conservation of energy mechanism, an object's momentum in the fourth dimension decreases when its momentum in a space direction increases, and vice versa; the closer the velocity of an object in space is to the velocity of light, the smaller its momentum in the fourth dimension, and vice versa. Consider three cases. (i) An object such as a photon moving at the velocity of light in space has momentum only in the direction of its motion in space. (ii) An object at rest in space has momentum only in the fourth dimension. (iii) An object moving in space at a velocity lower than of light has momentum both in the fourth dimension and in a space direction. The 3D space is naturally structured in a zero-sum process of motion and gravitation into multi-layered cascades of mass structures or nested energy frames that we observe in space, such as the Earth's frame, the Solar System's frame, the Milky Way's frame, and so forth up to the Universe as a whole. In the process, the gain of motion as well as the formation of all accessory structures and properties in any system *in* space is always counterbalanced by the release of the global gravitational potential energy, so that the conservation law of energy is sustained.

In its quest for a coherent picture of the whole reality, DU attains a discovery whose importance is parallel to Copernicus' discovery. In a broader ontological framework many present concepts, such as dilated time, contracted length and dark energy, turn out to be just epicycles. These hypotheses are no longer needed in a more encompassing theory. Being inhabitants of a 3-dimensional world, we are unable to notice the 4th dimension or the fundamental movement happening at the speed of light into the direction that is perpendicular to all directions in space. Yet the 4th dimension and movement in its direction are presented to be real, and in the holistic system they provide a reference to all subsequent frames and movements in space whether seemingly in motion or at rest. It may be against everyday observation, just like the earth moving around the sun was against what was considered possible at Copernicus' time. Copernicus refused to publish his thoughts until the very last days of his life, since among the uninitiated they might only arouse mockery. He could only plead for his theory yielding a simpler and more harmonious mathematical order for the facts. Despite the turmoil of the time and the ban set by religious authorities, this subtle truth was enough to initiate a revolution.

Contrary to the standard theories that are based on local observations and their extrapolation, DU boldly starts from totality which in its entirety cannot be directly seen but is securely discernible by meticulous inventive thought. The result is a more encompassing theory which does not seamlessly fit into the previous lines of thought as it is built on a smaller number of premises. This is an obvious merit according to the criteria established in the philosophy of science. The consistent theory needs remarkably less laws of nature and ad hoc hypotheses for its predictions to fit with the observed results in physics and cosmology. Because of its clear principles and transparent mathematics, the theory can be easily interpreted, like Newton's synthesis at its time. The precise and lucid model includes an obvious ontology which can be spelled out into an unambiguous and understandable interpretation.

When turning the Newtonian clockwork into a pendulating 4D-sphere, DU further clarifies the basic Newtonian terms of force, motion, mass, and inertia. Especially DU's consistent composition profoundly enlightens the nature of mass, its abstract essence, and terms of evolution and division into various kinds of entities. Newtonian mass was a kind of constant, 'the quantity of matter in a body' whose origin remained a mystery. DU gives an explanation of gravitation and inertia by recognizing mass not just as a certain feature in all bodies, but the origin of all existence. Mass is an abstract quality that cannot be seen if it is not energized. As such, it is a hidden basis of everything, the foundation of all existence which becomes tangible when energized. Because of gravitation, mass entails movement and provides potentiality for everything to actualize, for an evolving universe to manifest. It is imperative that force is derived from energy. In Newtonian Mechanics and in contemporary standard physics force is primary and energy is derived.

In DU all the remnants of the particle-mechanistic thinking adopted at the beginning of the modern era are embedded into genuine holism that permeates everywhere and ultimately connects everything. The ideas of atomism, mechanicism and materialism are innately surpassed in this dynamic synthesis that venerates the holistic way of thinking typical in ancient and eastern philosophies. The universe with its laws is seen as a 4-dimensional self-organizing unity, a flexible process where nothing that ever exists is disconnected from this magnificent entirety. This integrated conception is in line with the Copenhageans' conviction that the concept of dead matter in our world-view is being replaced by a kind of interplay of forms. In DU the constraining demand for wave-particle dualism can be given up.

Particles become secondary constructions as DU manages to carry out a ubiquitous wave description by noticing that Planck's constant contains an inbuilt term c (speed of light) which can be removed. The matter wave suggested by de Broglie wave can then be described as a mass wave carrying the momentum of a moving mass object – much in the way de Broglie was looking for. In DU's formalism mass waves propagate at the velocity of light whereas the velocity of structured bodies in space accord with observations. The thorough wave description grants an obvious explanation for many apparent paradoxes in quantum theory starting from Young's double slit experiment. The theory thus completes the aspiration of Erwin Schrödinger [21] and others for a comprehensive wave description. In this kind of context ultimately composed of elusive waves it is easy to admit that the wave structures are "real" mundane objects as physicists today often do, even if the ontological nature of these unobservable entities which do not fit into the context of the Newtonian world view is not really known.

When leaving behind the mechanical idea that things would ultimately be reducible to separate particles existing in empty space, the unbroken whole in DU, based on energy conversions still is a lawful but more flexible system. Through actualization of the underlying potentiality, the theory implements continuous change in the way emphasized by Heraclitus when declaring 'nobody can ever enter the same river twice'. This kind of continuous, unpredictable change entails irreversibility which cannot be captured into a reversible theory. As Newtonian mechanics and the theory of relativity are reversible theories, they are not able to distinguish whether processes are happening forward or backward in time. They are unable to reach the unfolding of things and events that appears to happen in our everyday circumstances. In DU, corresponding to quantum mechanics, the universal laws do not predict the outcome of individual interactions. Causation is no more supposed to be transferred via forces or particles as the laws are determining just the energetic conditions for the allowed processes.

This adjustment enables the universe to be seen as an irreversible self-organizing whole which contains genuine possibilities for emanation of new qualities and things. When energized via motion, mass presents itself in a wavelike mode whose precise form depends on the characteristics of the utilized energy. Energy can be said to make the thing to what they are. It is as the form in Aristotle's depiction of matter which is much more than mere shape of the thing. It incorporates the thing's causal powers and capacities [16]. The waveforms likewise embody the thing's context and carry out interference, causal correlations and modulation in their course allowing various kinds of coincidences and internal tendencies to modify the self-organizing. There is plenty of room for things to change. This pertains to all the cascaded subsystems including the circumstances humans are living in. In DU mental phenomena can in principle be approached in accordance with the guidelines utilized in the emerging field of quantum cognition. The basic notions of quantum theory are supposed to represent features of how nature is organized and are thus useful also in psychology as anticipated already in [1].

In DU's holistic framework any motion or state of rest in space are always associated with the motion of space in the fourth dimension. In spite of the invisibility of the 4th dimension, its metric nature fits better to the categories of human perception than Einsteinian space-time that mixes up the quantities of space and time, collapsing the traditional coordinate system. Energy and mass should also not be equalized although all forms of energy are originally derivable from mass and its movement in 4th dimension. The theory endows mass equivalence for electromagnetic radiation and Coulomb energy that influences all charged particles. According to Maxwell electromagnetism can be described on the basis of kinetic energy and potential energy. In principle, there might also be more subtle forms of energy which could be manifested in special conditions when systems grow more complex.

When looking for a place for spiritual phenomena the greatest philosophers could not accept that everything consisted of separate particles moving in empty space. In DU the abstract forms that Plato and Aristotle highlighted can be described via the interplay of energies. There is once again room for Aristotelian concepts related to essences of substances, their unseen reservoirs of potentialities for actualization. The notion that potentialities aim to get actualized can be extended to mental phenomena. For instance, human beings aim to actualize their potentialities or their goals. Every being appearing on the sublunar as well as the supralunar world turns out to be a combination of substance and structure that is formed in a definite historical process. *Materia prima* cannot exist as such but will appear when energized by any of the two basic opposites. Elementary particles are specific legitimate formations, fitting structures for energy to manifest.

The great rationalists Descartes and Leibniz argued for a full space consisting of continuous substance. The identity of matter and space which was the metaphysical foundation of the Cartesian system, leads to the conclusion that the infinite world consists of the same matter throughout. This fits nicely into the framework of DU. The world is not infinite but it contains everywhere mass which actually determines the whole space. Space and the gravitational potential field need not be separated. Through gravitation also local and global are seamlessly linked together. There is room for mentality and conscious beings to affect the course of evolution. We live in a world where invisible and change is naturally present.

4. Conclusions

The Dynamic Universe is a worthy candidate for constituting a solid basis for a revised conception of reality. The theory covers the present empirical knowledge and gives justified answers to age-old questions in natural philosophy. It hands over a full-fledged framework of explaining reality as actualization of potentiality. There are hints for this idea in perennial doctrines and in texts of great philosophers like Aristotle and Leibniz, but never before has the vision matured into an exact mathematical theory that concords accurately with observations. When looking for a realistic ontological model for reality one cannot be satisfied with the empiricist tenet of accepting a theory that merely describes observations. Aiming straight ahead is a poor compensation for qualitative thought when dealing with reality. The ability of coming up with new viewpoints and inventive generalisations has been paramount for the evolution of human beings. In the midst of present environmental and

social problems it might be vital to realize the throughout unity, historicity and interrelatedness of everything in the world. Instead of laying trust on automatic machine-based progress, a sensible worldview should promote reliance on human impact and subtle reserves.

In DU everything is interconnected, there are no separate objects or beings in the universe – any action, conscious or unconscious, has its consequence to the rest of space. Mental cannot be just an epiphenomenon and humans are not doomed to be powerless automatons living meaningless lives in an indifferent world as once suggested based on the Newtonian physics. Related to mentality, DU concurs with panpsychism and neutral monism in allowing mentality to exist in material things. Yet the position of matter is radically changed. Matter loses its primacy as all of existence results from one intangible source: mass that is being energized. The source provides almost endless reserves of energy for various kinds of things and characteristics to emerge. There is no obvious reason why the fertile global process when maturing more and more complex could not, in addition to the structures exhibiting chemical and electrical properties, also produce animated systems equipped with mentality. Instead of being material physical reality might better be described as psychophysical: it supports material as well as mental phenomena and binds them together. In this kind of framework, the age-old schism between materialism and idealism ends into a synthesis: There is no ontological need for Cartesian dualism. This is in line with recent research on brain plasticity and the Operational Architectonics theory of brain-mind functioning that unifies brain and mind through nested and dynamic hierarchy of electromagnetic brain fields [29].

Mental phenomena and elusive human characteristics such as creativity, conscience, discernment and volition did not have any factual role or purport in the particle-mechanistic frame. Neither could immaterial things be properly explained or reconciled into the worldview. In DU unity is the starting point. Layers and spheres of reality traditionally called spiritual need not be disconnected from the intangible totality emerging from mass. In a monistic all-embracing frame there is no need for the prevailing gap between sciences and humanities. All the conceptions and their advocates with their various features are deeply embedded to the universe they are resulting from.

Every human being like all distinctive individuals in the universe are born into certain historically determined frames that provide, and limit, the resources and possibilities that are available in given circumstances. As essential participants we have power to structure the scheme of things, improve or deteriorate the habitat of our species. Whenever any of us uses the resources at hand to modify something according to his or her intention, a new form may be said to enter to the substance employed. A potentiality becomes actuality. It is an unavoidable ethical challenge for everyone to think of what to actualize.

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