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Quale mechanics as a metaphysical weltanschauung of quantum mechanics

Abstract. *The term Quale Mechanics is proposed here as describing the qualitative aspects of Quantum Mechanics that are susceptible of metaphysical considerations. The aim of Quale Mechanics is to distill the quantum discourse to its pillars in order to construct its proper – philosophical in nature – quale discourse. The framework of the discussion is initiated by revisiting the platonic approach of the manner in which knowledge is perceived/processed, and then by discussing the four sapiential stages before arriving at concept of the eide. The sensible-suprasensible dichotomy is exposed by contrasting aistheta to the eide. A discussion on the historical development and the foundation of the pillars of Quantum Mechanics is followed. This includes Planck's solution for the black-body radiation problem with the introduction of quanta – in conflict with Newtonian physics – followed by Einstein's explanation of the photoelectric effect and the implications involving the dual nature of light (particle vs. wave) and two generalizations of the quantum character of matter: the planetary model of the atom by Bohr, and the dual particle-wave character of electron demonstrated by de Broglie. The subsequent distillation of these semi-classical concepts into more abstract mathematical concepts by Heisenberg, Born, Dirac and Pauli are then reviewed – with Heisenberg's uncertainty principle and with the concept of wavefunction as landmarks that unmistakably departs from the classical deterministic view of matter. A representative illustration of these achievements is given by the Casimir effect – with implications for gravity and an illustration of how vacuum can in fact not be considered to be truly void. Quantum Mechanics, as the most*



accurate mathematical framework which can be employed in order to describe and predict the natural phenomena occurring at the atom-size dimensions of reality, may thus be considered as the root from which the concept of Quale Mechanics is emerged in order to construct the parallel between the metaphysical existence and the quantum physical wavefunction collapse. It is concluded that, within its underlying, Quantum Mechanics is a (hopefully fruitful) reiteration of the Ancient Greek Weltanschauung.

Keywords: quantum; existence; wavefunction collapse; weltanschauung

Introduction.

The challenges offered by science to personal beliefs (whether religious, political or of other types) are generally accepted to entail deep rooting into the subjects' *Weltanschauungs* (Boudry, Blancke, & Pigliucci, 2015; Hansson, 2017; Matute, Yarritu, & Vadillo, 2011; Shermer, 2011; Smith & MacDonald, 2017; Wallis, 1985; Shermer, 1997) As such, scientific reasoning may be (or is often) perceived as a challenge to the *Weltanschauung* itself rather than to any specific technical aspect/belief. The attitudes towards pseudoscientific topics such as vaccination, conspiracy theories, or pseudotherapies (e.g., homeopathy) illustrate such situations (Boudry, Blancke, & Pigliucci, 2015; Matute, Yarritu, & Vadillo, 2011; Schoijet, 2009; Shermer, 2011; Shermer, 1997; Silaghi-Dumitrescu, 2021a) Advocates of science in such contexts can be perceived as threats to a pre-existing *Weltanschauung* and thus be asked to provide a substitute – rather than simply demonstrate/convince that e.g. vaccines do not cause autism. It is at that point, and due to this challenge, that the subjects may demand of science to provide its own comprehensible view of the world – a *Weltanschauung* – or at least to manifestly support a preexistent one. The remarkable specialization tendencies in science do, however, mean that the same scientist that can demonstrate how vaccines are not connected to autism... will at most be qualified to look up the term *Weltanschauung* in a dictionary – but certainly not to do anything more than that. Such an ontological shortcoming from the part of scientists can not necessarily be seen as a sinful attitude, but rather as a natural byproduct of the hyper objectivity required by a healthy development of Science. Nevertheless, the problem remains that science may then be perceived as a cause for demolishing old worldviews but not so much as able to provide replacements thereof. Indeed, after the exciting and acceptable role of science in saving and/or improving billions of lives via vaccines, medicines, mechanization/automation, education etc. has unfolded, the realization of a missing sense of purpose can ensue and can foster resentment precisely against science – as previous *Weltanschauungs*, mostly religious and orthogonal to science, are manifestly outdated or unable to adapt to the new realities. As an illustration, some of the formerly communist (and notably secular and science-oriented) countries are prominently seen to collapse towards dire obscurantism (Silaghi-Dumitrescu, 2021a; Silaghi-Dumitrescu, 2018). It is also in these countries that the social collapse prior to the regime change from communism/socialism to democracy has entailed a manifest collapse of most branches of society – including the manner in which science is performed (Korotayev, Romanov, & Medvedev, 2019; Silaghi-Dumitrescu & Sabau, 2014). It is manifestly in such environments (though not

only there) that the questions are often asked: “What good are scientists nowadays? Are they not doing irrelevant and routine work (if any) that does not help our wellbeing and, in fact, only hurts our wellbeing by denying us the good-old (non-scientific) Weltanschauungs?” (Hansson, 2017; Florian, 2006; Silaghi-Dumitrescu, 2021b; Silaghi-Dumitrescu, 2021c). The level of distrust towards scientific endeavors is spectacularly illustrated by the degree of public acceptance of academic imposture in the form of plagiarized PhD theses of national leaders (presidents, prime-ministers, etc.); in one illustrative case, in one ex-communist country if one finds plagiarism in a PhD thesis older than a year, it is now unconstitutional to take any step towards retracting the respective PhD title (Abbott, 2012b, 2012a; Schiermeier, 2012; Strauss, 2014; Van Kline, 2022).

Science can thus be accused of adopting the role of substitute for the previous age-long religious-dominated Weltanschauungs. References to the Nietzschean deicide can be easily (though commonplace-superficially) invoked as reason for the science’s downfall into dogmatic paradigms – a manifestation which would of course be precisely opposed to science’s intended purpose. In its unsuccessful adaptation to the societal (laic) reality, this beheading may be argued to have caused voids within the collective unconscious that ultimately lead to a contamination of the scientific endeavor with the need to replace the now *headless serpent* with dogmatic belief in order to sustain the otherwise collapsing collective psyche. As natural things tend to avoid large gradients, this process would have preferred to avoid the drastic shifts within the collective psyche that are caused by a magnitude of the order of the Nietzschean-type deicide. Such gradients, for instance, can be tamed by employing philosophy-based Weltanschauungs so that their underlying transitions become smoother. Regardless of which Weltanschauung should be employed, the dramatic aspect of the current scientific status is represented by the general lack of adoption of any such worldview, lack which in turn provides favorable grounds for the adoption of dogmatic scientific reasoning in an unconscious manner to the point that, via the same unconscious regime, becomes the dogmatic part of oneself. Premise ultimately leading to a, safe to state, profane view of the world. In the words of C. G. Jung uttered almost a century ago (Jung, 1960, p. 467):

“The conception we form of the world is our picture of what we call world. And it is in accordance with this picture that we orient ourselves and adapt to reality. As I have said, this does not happen consciously. Nearly always a forceful decision is needed to tear the mind away from the pressing concerns of the moment and to direct it to the general problem of attitude. If we do not do this, we naturally remain unconscious of our attitude, and in that case we have no Weltanschauung, but merely an unconscious attitude. If no account is taken of our motives and intentions they remain unconscious; that is, everything seems very simple, as though it just happened like that. But in reality complicated processes are at work in the background, using motives and intentions whose subtlety leaves nothing to be desired. For this reason there are many scientists who avoid having a Weltanschauung because this is supposed not to be scientific. It has obviously not dawned on these people what they are really doing. For what actually happens

is this: by deliberately leaving themselves in the dark as to their guiding ideas they cling to a lower, more primitive level of consciousness than would correspond to their true capacities. Criticism and scepticism are not always a sign of intelligence – often they are just the reverse, especially when used by someone as a cloak to hide his lack of Weltanschauung. Very often it is a moral rather than an intellectual deficiency. For you cannot see the world without seeing yourself, and as a man sees the world, so he sees himself, and for this considerable courage is needed. Hence it is always fatal to have no Weltanschauung”.

Quale Mechanics is introduced here as an example of such a philosophical oriented Weltanschauung. The nomenclature is chosen as such in order to designate and to emphasize the *qualitative* nature and aspects of the formally established quantum discourse. The aim of Quale Mechanics is to distill the quantum discourse to its pillars in order to construct its proper – philosophical in nature – quale discourse. The reasoning behind its effort in achieving this shadow resonates with David Bohm's suggestion (Bohm, 1980, p. XVI) for the use of the intuitive language in complementary to the logical one as means to achieve a harmonious functioning of the mind - a state of mind that would also be of benefit for the development of new theoretical ideas.¹

We embark, thus, by threading within the next two sections ancient Greek metaphysics and fundamental elements of Quantum Mechanics, alongside crucial aspects of its development, in order to prepare the mood for the quale discourse initiated in the fourth section. In doing so we have made use of Peters' dictionary (Peters, 1967) for the ancient Greek related discussion; Hund (1974), Longair (2013), Piela (2014) and Atkins and Friedman (2011) were consulted when discussing the axiomatic system and the historical development of Quantum Mechanics. In order to better distinguish the Heideggerian *Being* from *being*, the latter was chosen to be expressed as *entity*. The English citations from (Blaga, 2013) are provided as personal translation from Romanian.

The four sapiential stages.

Knowledge can be revealed in different forms – and depending on the sharpness of the thought employed in order to open the abyss of truth, knowledge can be perceived at various levels of depth. According to Plato, there are four stages at which this perception of knowledge can occur (cf. Figure 1.a). The shallowest of them is termed εἰκασία (eikasia), representing a state which can be perceived only through images and reflections. The term itself derives from the word εἰκών (eikon), which can be translated to *image*, *face* or *reflection* (the same word represents the etymological root of the modern English word “icon”). As a first step involving the act of perceiving knowledge, it deals with images and their generation. The rather superficial character

¹ Our suggestion is that at each stage the proper order of operation of the mind requires an overall grasp of what is generally known not only in formal, logical, mathematical terms, but also intuitively, in images, feelings, poetic usage of language, etc. This kind of overall way of thinking is not only a fertile source of new theoretical ideas: it is needed for the human mind to function in a generally harmonious way, which could in turn help to make possible an orderly and stable society. (...) however, this requires a continual flow and development of our general notions of reality (Bohm, 1980, p. XVI).

of this step is best emphasized in Plato's words when he states that "the visible Universe is an εἰκών of the intelligible one, which comprise the εἶδη (eide = ideas)", and that "time is an image of eternity". The second step deals with the sensorial perception of the image and it is associated with the view developed from this process. This stage of perceiving is referred to as πίστις (pistis), a term which can be translated to *belief, faith, conviction* (the etymology of the word "piety" can be traced to the Latin equivalent of πίστις, *pietas*). These two steps differ from the next two the same way believing differs from comprehending (Heisenberg, 1979, p. 32). Consequently, the third step represents understanding and is termed διάνοια (dianoia). It also refers to *discursive thinking* and, in general, represents the type of knowledge that can be achieved with the help of sciences. Lastly, the fourth step is επιστήμη (episteme), which represents the true nature of things. This type of knowledge is in opposition to that of δόξα (doxa), which represents *opinions*, and, furthermore, Plato distinguishes επιστήμη from πρακτική (praktike = the science of action) and ποιητική (poietike = the productive science, art, poetry) as being of a pure theoretical nature. He puts the latter two terms at the same level with διάνοια, while he places the first one, δόξα, between the act of knowing the true things, i.e. επιστήμη, and ignorance, to which he refers the act of knowing about untrue things. Thus, the act of achieving an epistemic type of knowledge implies mining through the previous three levels of perception. Although at the dianoic level of knowledge a three-fold degeneracy occurs (cf. Figure 1.a), Plato's reasoning emphasizes the need of passing through διάνοια in order to reach επιστήμη, avoiding, thus, the other two, πρακτική and ποιητική. In other words, a symmetry breaking is required in order to remove the dianoic degeneracy such that the epistemic level of knowledge can be achieved, a symmetry breaking that quite resembles the Jahn-Teller effect of fame in modern physical chemistry. If in the latter (Jahn-Teller) case the geometry of a molecule is distorted along one of its symmetry axis such that a more energetically favorable state is achieved (cf. Figure 1.b), in the former, the 3rd level of knowledge is distorted along the "διάνοια axis" (cf. Figure 1.c) such that a deeper kind of knowledge (i.e. επιστήμη) can be achieved (cf. Figure 1.d).

The subtle difference between διάνοια and επιστήμη is exemplified in an enlightening manner by Werner Heisenberg in (Heisenberg, 1979, p. 32) where he notes:

*"Consider a man, whom we believe we know well, suddenly committing some misdeed which is at first quite incomprehensible. Those who know all the details of the case can then explain the reasons for his action. Thus we are in a position to deal with all the arguments, one after the other, and eventually, after a thorough investigation of these arguments we may understand the wrong he committed. This understanding corresponds to διάνοια. Or alternatively we may suddenly realize that this man **had** to act as he did. This sort of recognition can be described Plato's επιστήμη."*

Interestingly by the manner in which the outcome is revealed, the *sudden* epistemic recognition of the truth, which Heisenberg details in his example, resembles the *spontaneous* breaking of symmetry that implies the Jahn-Teller effect. Thus, in a ludic fashion, it can be asserted that the epistemic Jahn-Teller metaphor discussed above shares soil with Heisenberg's philosophic view. Regarding the role of modern

science, Heisenberg stresses that the physical explanation of Nature is a discussion aimed to distinguish *διάνοια* from *επιστήμη*. Regardless if the latter stage is achieved or not, it emphasizes the exclusion of the first two steps of knowledge from the domain in which scientific reasoning should manifest itself.

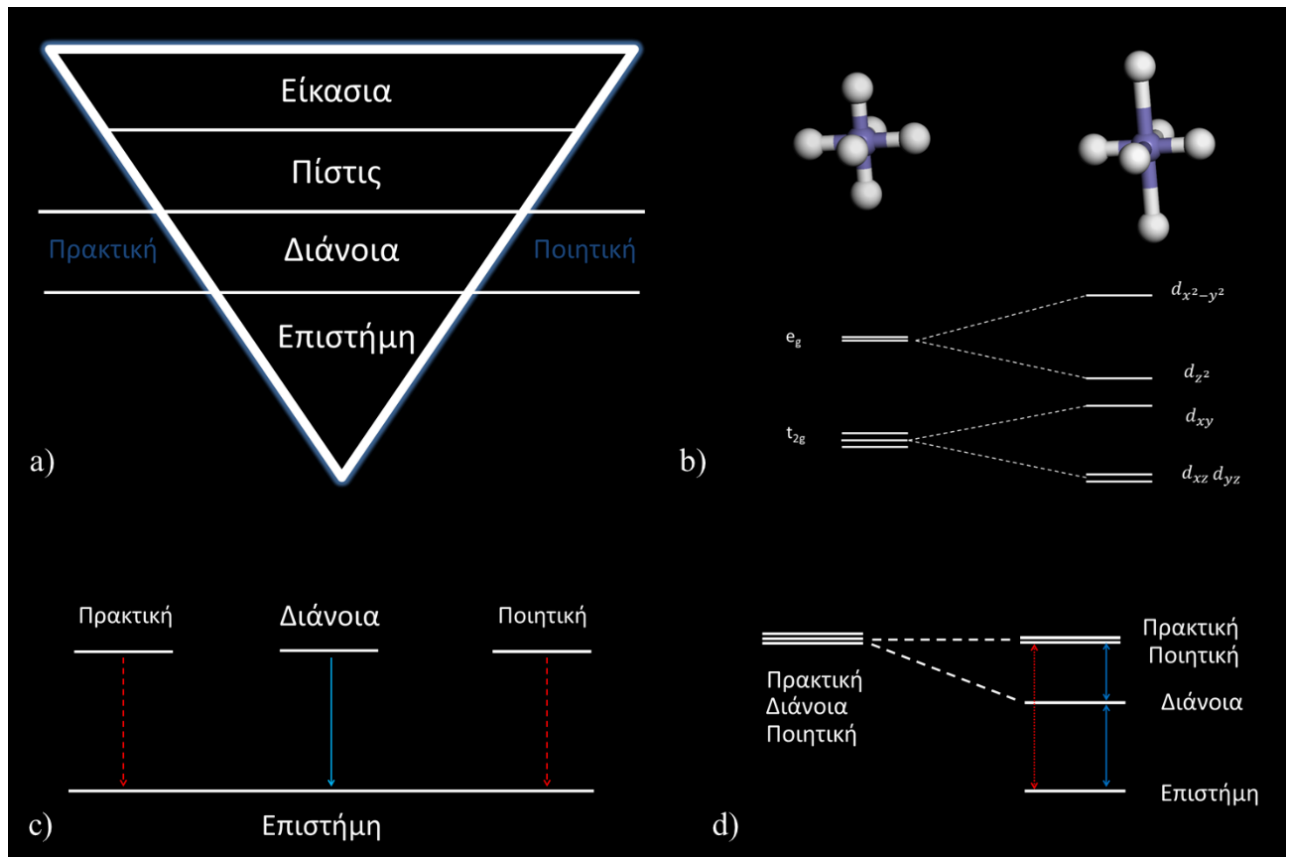


Figure 1. a) The Praktike-Dianoia-Poietike triple degeneracy; b) The Jahn-Teller effect depicted for a metal atom adopting an octahedral geometry; c) Forbidden and allowed transitions; d) The breaking of symmetry within the Praktike-Dianoia-Poietike degeneracy. Allowed transitions are depicted in blue while the forbidden one in red (Author's figure).

The *eide*.

Returning to the deepest level of perception of things, Plato believes that in order to reach the epistemic level of knowledge, the true nature of things needs to be known. In his view, the *εἶδη* (*eide*) constitutes the true nature of things that, like in the above-mentioned example regarding the intelligible Universe, are hindered behind appearance. The concept of *εἶδη*, of the indivisible and eternal entities that lay within the kernel of things, was developed in contrast with the pre-Socratic philosophy which, bearing Heraclitus as exponent, viewed change and fluctuation as the essence of Nature (cf. the famous Heraclitian aphorism *Πάντα ῥέει* = Everything flows). Consequently in this line of thought, as everything changes there is no true nature of things, the only constant in Nature being change itself. This fluctuation restricts the achievement of the epistemic level of knowledge and constrains the view of the world within the borders of illusion and temporal truths that are susceptible to fade as time prolongs. In this

framework, the highest act of knowing is represented by a πίστις → διάνοια transition. Plato rejected this framework as the fundamental view of the world and concluded that, in order to achieve the true form of knowledge (i.e. επιστήμη), the core of reality should not be subject to change. Interestingly, he refutes the somehow similar atomistic views of Democritus for being materialistic and in a suggestive metaphor he compares its followers to the Titans, while the Olympians are represented by the seekers of επιστήμη by means of transcending to a suprasensible picture of reality through the use of the είδη. Indeed a godly clash that dislocated the highest act of knowing from a πίστις → διάνοια transition to a διάνοια → επιστήμη transition...

The είδη represent the essence of things, the *ideas* that are the fundament of every object. They are of suprasensible nature, meaning that they cannot be grasped through sensorial means. Nevertheless, they can be reached through various rational processes, such as recollection (ανάμνησις) and different forms of dialectics (διαλεκτική). For instance, one of the first dialectical processes consisted in a regression from a hypothesis towards an unhypothesized principle, αρχή. Later, the dialectical process involved a collection/reunion (συναγωγή) followed by a primer division (διαίρεσις) which continues via a second, specific division (διαφορά) downwards the ultimate, indivisible είδος. Examples of eide are found in each class of things such as mathematics, in natural and artificial objects, in relations or even ethics, beauty, goodness. Some of the είδη play a more important role. For instance, for Plato the greatest kinds of είδη are the *Being*, the *Same*, the *Different*, the *Movement* and the *Rest*. By their nature, the είδη are transcendent and form the class of objects by which epistemic knowledge can be revealed. Their collection forms the τόπος νοητός, the intelligible place, are represented as the first concentric circle in Figure 2.

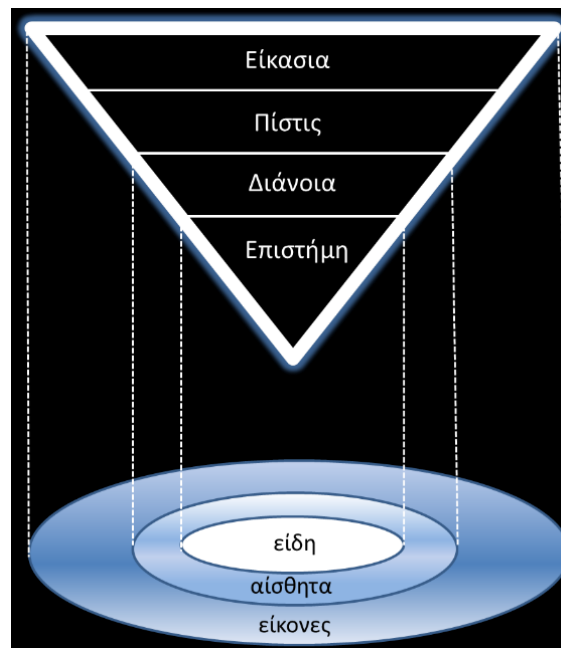


Figure 2. The classes of objects characteristic for different types of knowledge and their corresponding topos: τόπος νοητός in white; κόσμος and its illusory extension in blue (Author's figure).

Αἴσθησις (aisthesis) represents the sensible nature of things and the objects by which it can be perceived are referred to as *αἰσθητά* (aistheta). They are the source of sensation which, in itself, was regarded as the transition of a sensible entity from its potency (*δύναμις*) to its act (*ἐνέργεια*). Thus, the sensibles, *αἰσθητά*, are objects that are capable of being perceived. They cannot lead to an epistemic level of knowledge but are limited to a dianoic level of knowledge (cf. Figure 3) and therefore can only express opinions. They can still, however, retrieve a deeper level of knowledge than the *εἰκόνες* (eikones) which represent the images, reflections and shadows of things that are therefore restricted to *εἰκασία* and *πίστις* levels of truth. The topos of the sensibles (second concentric circle in Figure 3) bears a name that, through its modern meaning, also emphasizes the alteration that the ancient Greek concepts suffered through the ages: *κόσμος* (cosmos).

The transition from *εἶδος* to *αἴσθησις* is achieved through the intermediate class of the *μέταξύ* (metaxy) which, like the eide, are also eternal. The process itself was referred to as *μέθεξις* (methexis) which means *participation*. The difference between the eide and metaxy consists in the plurality nature which the later adopt. Such metaxy objects are represented by the objects of mathematics and geometry. For instance, the ideal numbers (*αριθμοὶ εἰδητικὴ*) are of such character and can modulate the transition between the world of the suprasensible and material world. In some aspects, this picture is not that different from our today's scientific method, which starts from empirical investigations of material objects and then bathes in mathematics in order to build models that can offer prediction. At this stage, more often than not, the similarity ends. The process is no longer descended towards the eide, but rather, in a boomerang manner, is redirected back towards the material world. Perhaps this is one of the crucial differences between us and the Elders. Often enough we restrain our mathematical endeavors to the practical aspects of reality and to its predictability. Blinded by the tempting shine of practical predictions, we ignore the underlying mysteries of the suprasensible world; we too often *shut up and calculate*.

Elements of Quantum Mechanics.

By the end of the 19th century, the Newtonian Mechanics had reached an undisputed status as governing ontological tool by which humankind could ultimately grasp the true nature of the physical reality and, therefore, nature itself. Indeed, the endeavor pursued by Newton's intellectual descendants such as Lagrange and Hamilton (who upgraded Newton's Mechanics) or Maxwell (who managed to provide a unitary description of the magnetic and electrical forces and therefore unite them under a common electromagnetic interaction) had managed to unveil the vast majority of mysteries hidden beneath the known-at-that-time aspects of Nature. There were, however, still some exotic phenomena such as the spectra of the black-body radiation and the emissions of atoms that were still not fully understood but were believed to be soon comprehensible by the virtue of Newtonian Mechanics. This atmosphere within the scientific world is perhaps best emphasized by the advice that Planck had received with regards to the study of physics: to abandon it as there is nothing left to be discovered beside these soon to be solved exotic issues (Lightman, 2009).

Planck can be regarded as still holding ground within the realm of Newtonian Mechanics, yet managing to provide a pivotal foot ground in the darkness lying ahead towards the suprasensible nature of what will later become Quantum Mechanics. Indeed, as it is often recalled, Planck's solution for the black-body radiation problem was the first shot in the dark; a shot that by hitting its target submitted the foundation of Classical Mechanics into a crisis. It was so because, in developing his explanation, Planck had hypothesized that the oscillating atoms constituting the walls of the black-body can transfer light only in discrete quantities of an elementary unit of light – a quanta. This was against Newtonian dogma that saw no reason for which this process should not be done in incremental amounts of light. Thus, while Newtonian Mechanics suggested a continuous range of energy by which the black-body radiation could be emitted, Planck's shot in the dark implied the opposite, that it can be emitted only in amounts of energy which were an integer multiple of an elementary energy.

It was in 1901 that Planck published his results, and the general impression under which they were received was skeptical. Planck's shot in the dark seemed as a fortunate accident and was regarded as a provisional result that was expected to be corrected and sustained within the Newtonian dogma. Planck himself tried to reconcile the two antagonistic approaches but it was too late. The shot in the dark he had taken provoked an avalanche. In 1905, Einstein further employed Planck's quanta hypothesis in order to explain the photoelectric effect. In doing so, Einstein brought confusion with regards to an aspect that was thought to be clearly understood, that is, the undulatory nature of light. Historically, Newton managed to establish the field of Optics by considering light as being of corpuscular nature. This was later shown to be incorrect by Huygens who, by treating light as an undulatory phenomenon, managed not only to reproduce the results of Newton's Optics, but also could provide explanations where the former failed: namely in the process of the diffraction of light. Thus the particle-like behavior of light, which was thought of as a particular description embodied in the general undulatory theory provided by Huygens, was revived by Einstein in his reasoning behind the photoelectric effect. The fundamental mystery that laid behind this effect consisted in the nature of the dependence that the ejected electrons displayed when removed from a light-ionized material. Namely, the number of such electrons (accountable by the intensity of the current that they were developing when connected to an electric circuit) was dependent on the frequency of the incident ionizing light and independent of its intensity. This was contrary to what one might expect from the undulatory behavior of light. Indeed, if light was to be of wave-like nature, the number of ejected electrons ought to be dependent on its intensity. This is so because the intensity of light is directly linked to the amount of energy it possesses and thus to the amount of energy available to kick electrons out of their hosting material. The dependence on frequency, however, implied that only some specific amounts of energy can yield electron ejections. Einstein managed to explain this frequency dependence by employing Planck's quanta of light as elementary particles constituting light itself. Thus, light appeared to behave in some situations as a wave and in others as particle. This aspect became known as the wave-particle duality of light.

The charge distribution within atoms was eventually clarified in 1911 when Rutherford, by scattering radiation upon atoms, managed to prove that atoms concentrate their positive charge in a point-like center, which is surrounded by a uniformly distributed negative charge. The positively charged nucleus was thus shown to be composed of protons and to be minute in comparison to the entire atomic volume, while the electrons formed the negatively charged medium that surrounded it and accounted for the vast majority of the atomic volume. In 1913 Bohr rationalized Rutherford's discovery in terms of stationary orbits that the electrons would adopt in their trajectories around the nucleus (stationary – with regard to the electromagnetic exchange that an electron ought to have with the surrounding medium when adopting these favorable orbits). From classical electrodynamics it was expected that an electron orbiting a nucleus would emit electromagnetic radiation due to being under a constant influence of the electrostatic force (and thus subject to acceleration; classical electrodynamics implies that an electric charge in accelerated movement would emit electromagnetic radiation). The loss of energy due to the radiating process would be responsible for a decrease of the electron's kinetic energy which would cause an imbalance in the favor of the centripetal electrostatic force. Ultimately, the electron would be doomed to collapse unto the nucleus. Bohr hypothesized that there ought to be some special orbits within which this radiative process would cease to exist (i.e. stationary states) and managed to explain the emission spectra of the hydrogen atom in terms of transitions between these stationary states. For instance, transitioning from a lower-energy stationary orbit to a higher-energy one, energy in the form of electromagnetic radiation would need to be added. Oppositely, an electron would output electromagnetic radiation when descending from a high-energy orbit to a lower-lying one. For all other infinite possible trajectories that an electron might adopt when orbiting the nucleus, the classical electromagnetic dogma would still hold as the electron would lose energy by emitting radiation but now, in its descend, would be caught in the safety-net of its proximal stationary orbit. Thus the planetary model of the atom was established and another anomaly was explained in terms of discrete phenomena (i.e. fixed values corresponding to interorbital transitions) as opposed to the continuous, incremental approaches adopted in classical physics. Furthermore, Bohr also showed that the stationary orbits that he hypothesized contained an amount of angular momentum which was an integer multiple of the constant that Planck had devised in his discrete description of the black-body radiation spectrum. It was the same Planck's constant that Einstein also used in explaining the photoelectric effect and that was now appearing in the motion adopted by the electron in the favorable, stationary trajectories inside atoms.

The wave-particle dual character of light was extended by de Broglie in 1924 to particles. It was in his PhD thesis where he showed that, under convenient circumstances, the electrons should behave like waves and diffract similarly to how light normally does. The same constant of Planck's appeared again. This time, however, it became clearer what it really is: the embodiment of the wave-particle duality itself, as it showed that for any given object, the amount of wave-like character

that the object possess (provided by its wavelength measure λ) and the amount of its particle-like character (provided by its momentum p) is constant:

$$\hbar = \lambda \cdot p. \quad (1)$$

The first mathematical formulation of Quantum Mechanics was established in 1925 by Heisenberg. The approach he adopted marks the end of the chimeric quantum-classical era (marked as the period of the Old Quantum Theory) and the dawn of the pure Olympian era of the Quantum Theory (also referred to as the New Quantum Theory). Heisenberg abandoned the concept of electron trajectories and relied solely on the observable quantities that were available from experiments. These were the energies of what Bohr called stationary states and Heisenberg associated them to virtual oscillators that were within the atom. He then coupled these virtual oscillators in terms of the transition energies known from atomic emission spectra. The revolutionary approach consisted in working with quantities which were associated with two states and not with one. For instance, when concerned with the trajectory of an electron within a stationary orbit, one might be interested in quantities such as velocity, position or momentum in terms of the energy associated with the respective stationary orbit. In other words, in quantities associated with a state. Heisenberg neglected these quantities and treated the known experimental data in terms of energies that coupled virtual oscillators corresponding to Bohr's stationary orbits, i.e. quantities associated with two states. In doing so, he stumbled upon a new quantum multiplication rule which, also to his dismay, was non-commutative in nature. Soon after he urged Heisenberg to publish his new approach, Born recognized that the non-commutative character of this new multiplication rule was similar to the non-commutative nature of some less familiar, exotic mathematical objects that he had encountered at some point earlier in his life: matrices. By this time, however, Heisenberg departed to Copenhagen, at Bohr's institute. Thus, Born had to ask his other prominent assistant, Pauli, to help him formulate in terms of matrices Heisenberg's approach. Convinced that the path of matrices will be just a mathematical complication, Pauli refused. He expressed this by warning Born that he will spoil Heisenberg with his mathematical endeavors. Nevertheless, Born was not disheartened and managed to spark the interest of one of his other pupils, Jordan. Together, in the same year (1925), they published the first formulation of quantum mechanics in terms of matrices. Heisenberg joined Jordan and Born, and together published, still in 1925, the paper that marked the birth of Matrix Mechanics. It was still 1925 and now Pauli redeemed himself by adopting and finally mastering the new matrix formulation. In doing so, he managed to discover two new fundamental quantum concepts: the two-valued nature of the electron with respect to a non-classical coordinate (which in the following year was observed experimentally and denoted as the *spin* of the electron) and the Exclusion Principle.

The following year, 1926, further marked the development of Quantum Theory. Firstly, Schrödinger adopted de Broglie's wave description of electrons and conceived in terms of wavefunctions a new approach to the quantum phenomena. His work on this subject marked the birth of Wave Mechanics. Then Born, again quick in reactions, provided within the same year the interpretation of Schrödinger's wavefunction as the

amplitude that when squared retrieves the probability of finding in a certain location the quantum object that it describes. Subsequently, Heisenberg formulated the Uncertainty Principle, which states that some quantum quantities cannot be simultaneously precisely known. Such quantities became referred to as complementary objects and could be identified by possessing mathematical descriptors which did not commute with each other. If the descriptors of two quantities commuted, then both quantities could simultaneously be known with precision. For instance, the position x and momentum p of a particle cannot be simultaneously known. Similarly, there is an uncertainty between the adopted energy in an interval of time:

$$\begin{cases} \Delta x \Delta p \geq \frac{\hbar}{2} \\ \Delta E \Delta t \geq \frac{\hbar}{2} \end{cases} \quad (2)$$

From 1926 to 1928, Dirac had managed to synthesize the newly developed quantum theories and then further provided his own crucial contributions to their development. He firstly demonstrated the equivalency between the matrix and the wavefunction formulations of Quantum Theory (together with the work of Jordan which became known as the Dirac-Jordan Transformation Theory; the equivalency, however, was also demonstrated independently by Schrödinger). He then managed to provide a connection, in terms of Poisson brackets, between Quantum Theory and the classical Hamiltonian Dynamics. His attempt to reconcile Quantum Theory with the Theory of Relativity led him to develop what was afterwards known as the Dirac equation. The relativistic treatment employed on Quantum Theory yielded, via this equation, in a natural way the concept of spin and also predicted the existence of antimatter.

At this point the ingredients for the foundation of a rigorous theory describing the quantum phenomena were set. The accomplished theory became known as Quantum Mechanics which, like other fundamental theories, is axiomatic in nature. The set of axioms adopted within Quantum Mechanics were based on the earlier results of the matrix and wave formulations and is comprised of six axioms.

The first axiom implies that each quantum state is characterized by a wavefunction, Ψ , which upon squaring retrieves the probability density associated with that state. All available information regarding the particular state is embedded within the wavefunction. For instance, if one might be interested in the position of particle within a certain state, the square of the wavefunction describing that state would map the space adopted by that state in terms of a probability of finding the particle in each point of the space occupied by the state. This axiom descends from Schrödinger's Wave Mechanics and Bohr's interpretation of the wavefunction.

The second axiom states that observable quantities are represented by mathematical operators that act upon the wavefunction. From a mathematical standpoint, these operations are done in a specific abstract space known as the Hilbert space. This axiom incorporates the essence of the earlier matrix formulation.

The third axiom assures that the evolution in time of a quantum state is described by the time-dependent Schrödinger equation:

$$i\hbar \frac{\partial \Psi}{\partial t} = \hat{H}\Psi, \quad (3)$$

where Ψ is the wavefunction describing the quantum state and $\hat{H}$ is the Hamiltonian operator.

The fourth axiom states that the result of a single experiment retrieves only one eigenvalue of the operator associated with the quantity sought by the experiment.

An eigenvalue problem implies that the outcome of an operator acting on a function will be the same function times a constant. If the function is represented by a wavefunction Ψ and the operator is generally noted as $\hat{O}$, then the eigenvalue problem can be written as:

$$\hat{O}\Psi = \omega_i\Psi, \quad (4)$$

where ω_i represents the entire set of constants that are solutions to the eigenvalue problem. The constants themselves are named eigenvalues and their set, referred to as spectrum, are specific for each operator. For instance, if the wavefunction describes the hydrogen atom, a Hamiltonian operator acting upon it will retrieve the (eigen)energies of the system: the energy of the 1s orbital, of 2s, 2p and so on. Thus, the fourth axiom implies that when trying to measure an electronic state within the H atom, for instance, one would obtain one of its available eigenstates (not two, not more). Both this and previous axioms are assumed from Schrödinger's wave-mechanical considerations.

The fifth axiom implies the existence of a spin degree of freedom for each quantum particle. This comes from experimental evidence. Like mentioned earlier, the relativistic treatment of quantum mechanics, however, retrieves the spin concept in a natural way.

The sixth axiom states that a wavefunction describing a set of bosons (=particles that possess an integer spin number) has to be symmetric while a wavefunction describing a set of fermions (=particles possessing a half-integer spin number) has to be antisymmetric. This implies that when exchanging the positions of two bosons, the wavefunction describing them remains the same:

$$\Psi_{1\leftrightarrow 2}^{bosons} = \Psi_{2\leftrightarrow 1}^{bosons}, \quad (5)$$

while for fermionic particles it changes sign:

$$\Psi_{1\leftrightarrow 2}^{fermions} = -\Psi_{2\leftrightarrow 1}^{fermions}, \quad (6)$$

This last axiom comes from experimental considerations which also provided the basis of Pauli's spin statistics.

Quantum phenomena are not restricted to discrete phenomena. In fact, the specific quantum discreteness appears only in bounded systems while for non-bounded ones particles can adopt a continuous range of states similar to the way they do in Classical Mechanics. For instance, an electron bounded to a nucleus will adopt a discrete range of energetic levels, while as a free-particle, such as in scattering experiments, the same electron can adopt a continuous range of energy states. In Quantum Mechanics the *Natura non facit saltus* classical dogma becomes *Natura ligatum facit saltus et natura liberum non facit saltus*.

An example encapsulating quantum phenomena can be given in the form of the Casimir effect. When two metal rods are placed in vacuum very close to each other (cf. the black bars in Figure 3), they experience an attractive interaction which, although small in magnitude, turns out to be far greater than if caused by gravitational attraction alone. The reason why they attract has been interpreted in a few ways – but among these is a pure quantum mechanical effect. Thus, in fact, the bars are not attracted to each other, but are being pushed to each other. This Casimir effect may thus be seen as an interplay of continuous and discrete states of matter embedded in Heisenberg's Uncertainty Principle. Due to the latter, vacuum may be interpreted to not be empty after all. Due to the complementary nature of energy and time, as shown in Equation 2, the uncertainty of one measure is coupled to the other. Thus for brief amounts of time, when Δt becomes very small, a significant fluctuation of energy, ΔE , may appear. The way in which this increase of energy manifests itself is by spontaneously generating pairs of particles and antiparticles that will exist for limited amount of time, Δt of Equation 2, after which they will annihilate themselves by recombining. The reaction between a particle and its antiparticle converts the full amount energy stored inside them in the form of mass, into pure energy in the form of photons. For instance, when an electron collides with a positron, two isoenergetic photons are released, each bearing a 0.51 MeV energy corresponding to the electron mass converted into energy via Einstein's $E = mc^2$. For a minute amount of time Δt corresponding via Equation 2 to the 1.02 MeV amount of ΔE , a pair of electron and positron will appear. Out of nowhere 1.02 MeV of energy is borrowed for the positron-electron generation, which will be repaid when the 1.02 MeV resulting from their annihilation returns back to nowhere. These transactions are allowed only during the Δt amount of time corresponding to the required particle-antiparticle energy. Due to the recurring generation-annihilation processes, the ground state energy of vacuum is higher than zero. Its inherent fluctuations cause a continuous range of energetic states that can be adopted. In the case of the Casimir rods, these positron-electron generation and annihilation processes occur in the vacuum outside rods as well in the vacuum between the two rods (cf. upper half of Figure 3). There is, however, a dramatic difference between the ways these processes manifest themselves outside the rods and between the rods. Confined within the region between the rods, the generated particles behave like textbook examples of particle-in-the-box systems and, similar to electrons confined in atoms, can only adopt a discrete set of energies. For the regions outside the

rods, particles are no longer confined as they are limited only in one direction by a rod. Consequently, they can adopt a continuous range of energies (lower half of Figure 3). Now, for each discrete energy state resulting between the rods, there will be an associated pressure exerted upon the rods. The pressure results from the occasional collisions between the particles corresponding to the discrete states and the walls of the rods. For each such discrete state between the rods, there will be an isoenergetic state outside the rods which will balance the rods by manifesting an equal amount of pressure from outside the rods. Furthermore, within the outside region there will be a continuous range of states between those corresponding to the discrete levels present between the rods. Consequently, the pressures associated with these non-discrete values of energies will not be balanced by corresponding pressures between the rods simply because the energies required by such pressures cannot be developed in a confined space (i.e. a bounded system). Thus, the overall pressure appearing outside the rods will exceed the one appearing between the rods and therefore will push the rods towards each other. The Casimir concept can be further elaborated to interpret gravitation itself, as done by Sernelius (2009).

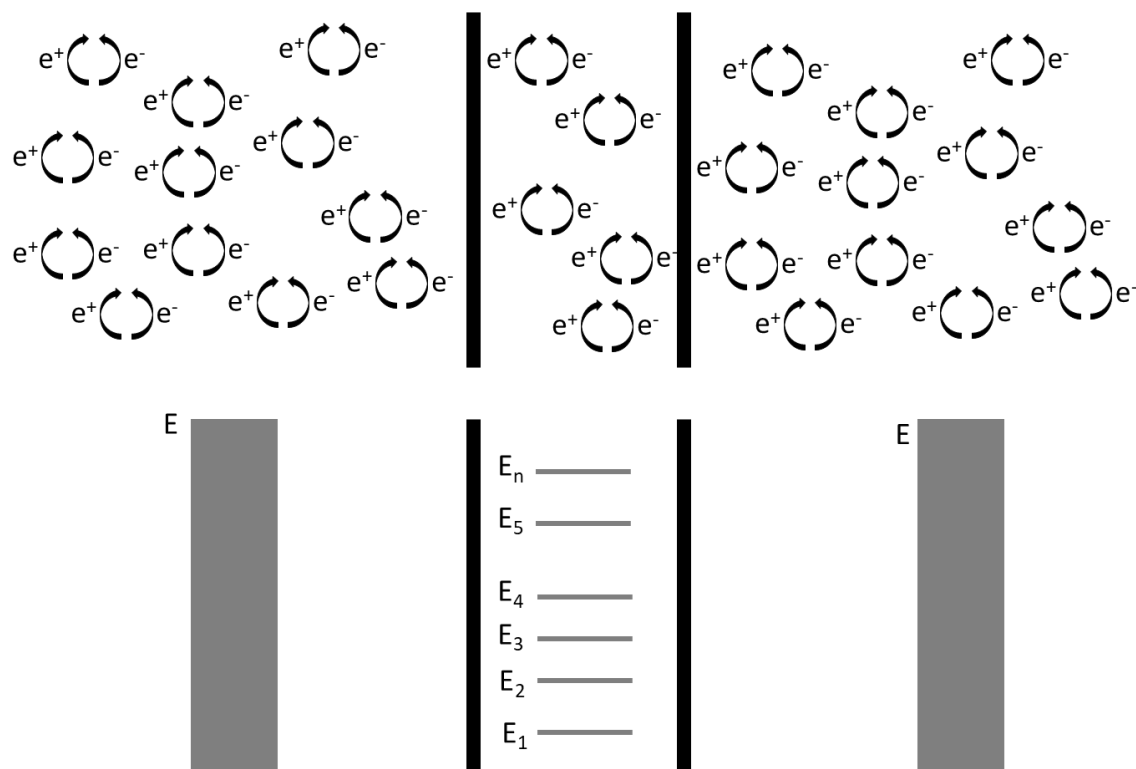


Figure 3. Depiction of the Casimir effect (cf. main text) (Author's figure).

Elements of Quale Mechanics.

By the term *Quale Mechanics* we refer to the qualitative aspects of *Quantum Mechanics* that are susceptible of metaphysical considerations. Quale mechanics can serve as a first hand approximation that can ease the understanding of fundamental quantum mechanical concepts.

Quantum Mechanics (QM) represents the most accurate mathematical framework which can be employed in order to describe and predict the natural phenomena occurring at the atom-size dimensions of reality. It represents the scaffold on which Quantum Theory (QT) resides the weight of its interpretations and the spring from which fields of quantic phenomena branch into technological applications.

A proposed hierarchical structure of Quantum Theory is presented in Figure 4. At the core of this classification lies the mathematical apparatus specific to this theory, coined “Quantum Mechanics”. This mathematical theory starts from an axiomatic system, dubbed the Quantum Mechanical Axiomatic System (QMAS), which is further developed into theorems and statements. Each mathematical proposition constructed within this framework adds to the size of the group. This growth can be pictured as an *encapsulated expansion*, as each new statement will extend the size of the group, but it will not bring any new information that was not hindered within the group’s essence (i.e. the QMAS). Mathematics is the tool that processes the QMAS inherent truth into aspects specific to certain situations.

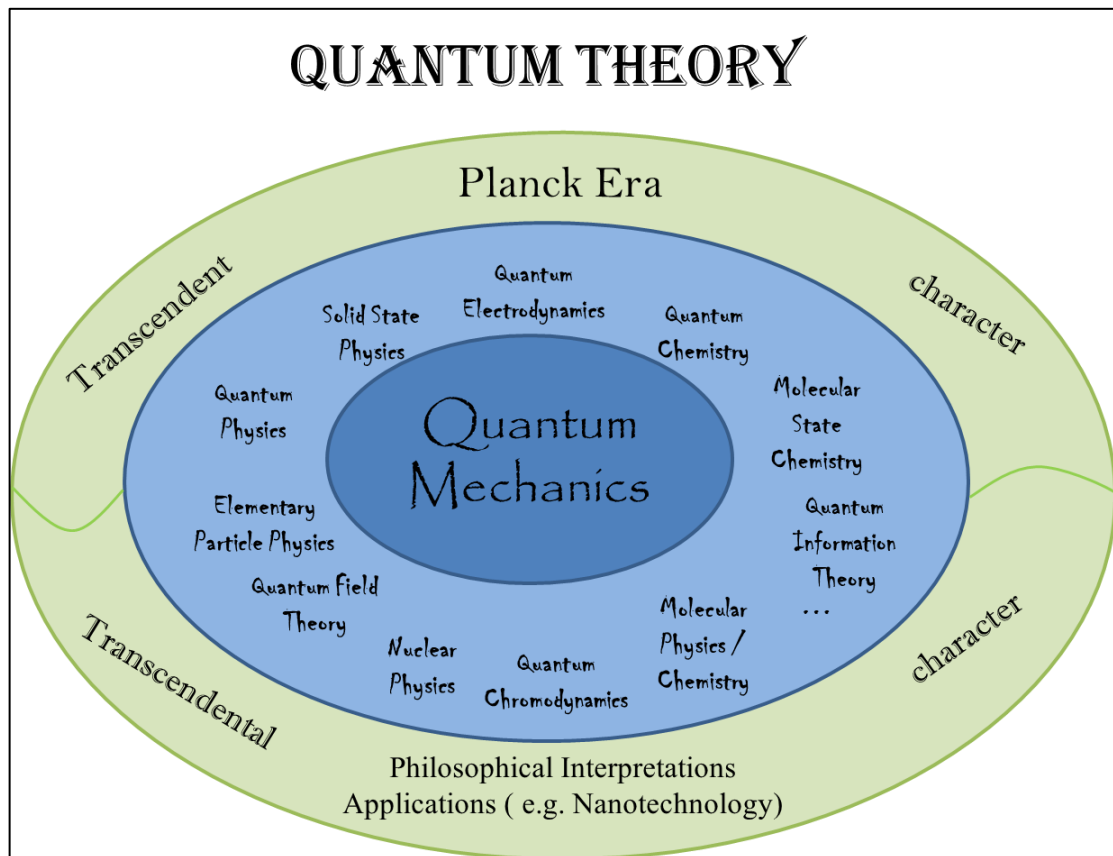


Figure 4. A hierarchical structure of Quantum Theory at the core of which lies the mathematical apparatus in the form of Quantum Mechanics. The second layer represents the further sprung quantum based scientific domains. The third layer denotes the two orientations the theory has: facing towards human perception and comfort are, respectively, its philosophical interpretation and its applications; facing toward its transcendent truth is the Planck Era of the Universe (Author's figure).

Quantum Theory is a generalization of Quantum Mechanics, not in a mathematical sense (because Quantum Mechanics is regarded as a closed system), but in the sense that the former is a global group in which the latter is part as a subgroup. For the QM case it can be asserted that an epistemological level of knowledge can be achieved because any complex “why” type of a question can be mathematically traced to its fundamental axioms. From the QM point of view there is no other truth laying beyond its axiomatic system and, although it can always be extended, it can be as closed (mathematical) system because all further-to-be-generated truth can be derived from previous generated truth and so on, further down to the zero-level unquestionable set of truths: to the QMAS. Within QM there is no other type of truth that is not *genetically* related to the QMAS.

On the other hand, the global Quantum Theory group also comprises that part of intellectual activity that casts the “why” question on the very essence of Quantum Mechanics (i.e. QMAS), namely the philosophical aspect of the “Interpretation of QM” subgroup. Applying the philosophical drill on the QMAS leads to its transcendence into a domain in which it can no longer be expected that an epistemological level of knowledge can be achieved. There is a two-folded reason why it can be stated that this has not been achieved, which may be presented in a Kantian manner as follows:

- from a transcendental point of view, i.e. from the point of view starting from the QMAS and heading towards the human preceptor (the observer), it has not been answered which of the QM interpretations (Copenhagen, Bohm – de Broglie etc.) is correct. As a matter of fact, recently it has been shown that neither of interpretations known to date can be correct (Frauchiger & Renner, 2018);
- from a transcendental point of view, i.e. from the point view departing on the opposing side from the QMAS towards a deeper essence of truth, it can be stated that all effects (including the QMAS itself) in the Universe can be traced back, cause by cause, to a cause that will eventually had to be taken place prior the Planck time, in a time in which all human-conceived theories are no longer valid.

From a philosophical perspective, the Planck Era of the Universe can be regarded as the matrix of *mystery* and the primeval source of what Lucian Blaga refers to as “*luciferian knowledge*” (Blaga, 2013). Through this term, the philosopher considers that type of knowing by which “*through the initial act, it (i.e the luciferian knowledge) considers its object cleaved in two, in one part which reveals itself and in one which conceals itself. The object of luciferian knowledge is always a mystery, a mystery which through its signs, on the one hand, reveals itself and on the other conceals itself*” (Blaga, 2013, p. 253).

In Blaga’s philosophical system, the *luciferian knowledge* is complemented by the *paradisiac knowledge*. The terminology used by Blaga is strictly restricted to its etymological sense. Namely *luciferian* is used with its original sense, that of *bringer of light* (the etymology of the word is found in the Latin words *lux*, meaning light, and *fero*, meaning carrier, bearer). On the other hand, the *paradisiac* term borrows its mythological sense and reflects the *illo tempore* condition “when” everything was in good order, everything in equilibrium and furthermore everything was *known*. Perhaps an example can elucidate the meaning and usage of these two terms. Let us consider a

celestial object that can be visible on a night sky. We assume that no astronomical instruments are at our disposal so that, in observing the celestial object, we rely solely on our eyesight. In this configuration, the celestial body can be regarded as a mysterious object subject to a luciferian type of knowledge in the sense that the light arriving from it offers positivistic aspects regarding its location and brightness, but simultaneously the same arrived light is the factor that obscures the object's essence. Thus, although some aspects of its being are revealed, its nature remains hindered to us and we cannot know exactly if the celestial body is, for instance, a star or planet Venus. In Blagian words, the sign by which the celestial object manifests itself simultaneously reveals and conceals its characteristic aspects. This line of thought can be extended as the technological and theoretical instruments required for understanding the celestial body evolve. For instance, it might be shown that the object is in fact a star and now the mystery is further descended to the question "how does it produce the light by which it is seen?" Upon understanding that the respective light is produced by nuclear fusion, the mystery is shrunk to the question "why does nuclear fusion produce light?". This can be understood from the perspective of the Special Theory of Relativity (STR), which provides the equivalency between matter and energy together with the law that governs their transformation (i.e., $E=mc^2$). From STR's perspective, the now acquired information is of an epistemological level because this transformation law can be decomposed to STR's axiomatic system. For instance, one such axiom would be that light travels at constant speed in all relative reference systems. Within the STR framework the question "why does light travel at a constant speed regardless of reference system?" is an invalid question because its domain of applicability lies outside that of STR. Thus, from STR's perspective, the knowledge has reached an *επιστήμη* level that corresponds to a paradisiac type of knowledge as all that can be known, within STR's boundaries, is known. Pushing the question outside the STR domain would require a further (more profound?) theory in which, now, the STR-epistemic knowledge would be degraded to, at best, a *διάνοια* level.

Now we are left with the impression that the pursuit of knowledge itself could be painted via encircled cycles which, by concentrically collapsing within themselves, provide the transition towards more fundamental stages. This picture in itself implies a fundamental axiom that governs all axiomatic systems of each theoretical stage: that within each stage there are at least two levels of knowledge, one corresponding to *επιστήμη* and one to *διάνοια*. Perhaps at one point, a stage in which all available knowledge is of *επιστήμη* nature and thus, this axiom among axiom might also lose its domain of applicability. Nevertheless, each of the aforementioned steps employed in the transition between the stages of acquired knowledge, from simply observing the celestial body all the way to the axioms of Special Relativity, correspond to what Blaga refers to as the *crisis of the object*. The act of questioning the *paradisiac* pillars of the theory triggers a crisis that, by deepening the foundation of the *paradisiac* theory into mystery, becomes the basis of the new *luciferian* knowledge.

Converged to the Planck Era is also the metaphysical endeavor towards fundamentals. In this case, similar to the space bordering a black hole's horizon that

generates² Hawking radiation “out of nothing”, (Hawking, 1975) the space-time region corresponding to the Planck Era can be seen engulfed within the fundamental question of metaphysics: *why is there entity instead of nothingness?* The domain of this question covers all that is, was and will be within the Universe and ends where it can no longer be asserted about anything as being Being: the Planck Era. As put by Heidegger: “*The domain of this question is limited only by what simply is not and never is: by Nothing. All that is not Nothing comes into the question, and in the end even Nothing itself—not, as it were, because it is something, an entity, for after all we are talking about it, but because it "is" Nothing.*” (Heidegger, 2000, p. 2) The true Nothing is that out of which the Big Bang presumably commenced (as explained for the Casimir effect, the vacuum is not really empty, is not a *nothing*). Furthermore, the Plank Era is the only era which is limited at one end by Nothing and at the other by something in which entities exist. By continuing this line of thought, we can identify two types of eras from now on. One of them (a single era in this category) starts from the end of the Planck Era and lasts for as much as needed for an entity to come into existence. Thus, this era belongs to something that has entity and, being the first of this kind, is limited on one side by the Planck era and at the other by something that has entities. From here onwards, all eras, no matter how divided, will always be delimited by entity-containing eras. How does that first entity come into existence? Physically, it just transitioned from the previous era in the form of the primeval radiation and can be imagined as a collision of two photons generating matter in the form of particle-antiparticle pairs. By having converted energy into mass, space and time come as byproducts of this process (from the General Theory of Relativity it is known that space and time cannot exist in the absence of matter, just as well as matter cannot exist in a framework outside space and time), and from now onwards the space-time stage is set for all entities to exist. Metaphysically, existence implies the transition from *Being* to *Entity*, the manifestation of a *Being* through *Entity*. To better understand the difference between the two latter terms we can follow one the subtle examples provided by Heidegger:

“Over there, on the other side of the street, stands the high school building. An entity. We can scour every side of the building from the outside, roam through the inside from basement to attic, and note everything that can be found there: hallways, stairs, classrooms, and their furnishings. Everywhere we find entities, and in a very definite order. Where now is the Being of this high school? It is, after all. The building is. The Being of this entity belongs to it if anything does, and nevertheless we do not find this Being within the entity. Moreover, Being does not consist in our observing entity. The building stands there even if we do not observe it. We can come across it only because it already is. In addition, the Being of this building does not at all seem to be identical for everybody. For us, as observers or passers-by, it is not what it is for

² In terms of the same uncertainty considerations explained for the Casimir effect (cf. Figure 3), the vacuum surrounding a black hole will generate pairs of particles and antiparticles. At the black hole's horizon, i.e. the region of space from which nothing can escape its gravitational attraction, the pairing will be disrupted: one of the generated particle will be initially oriented towards the black hole and by passing through its horizon will not be able to return to its partner particle and annihilate; the paired particle, initially being oriented oppositely to the black hole, will have the chance to evade its gravitational sink. The net result is called the Hawking radiation (being formed from the evaded particles). The swallowed antiparticles will eventually lead to the black hole's evaporation.

the students who sit inside, not just because they see it only from the inside but because for them this building really is what it is and how it is. One can, as it were, smell the Being of such buildings, and often after decades one still has the scent in one's nose. The scent provides the Being of this entity much more directly and truly than it could be communicated by any description or inspection. On the other hand, the subsistence of the building does not depend on this scent that is hovering around somewhere” (Heidegger, 2000, pp. 35–36).

For the ancient Greeks, *being* meant either something standing in itself, when referred to by *φύσις* (fysis), either something constant, enduring, when referred to through the word *οὐσία* (ousia). To exit from such a state meant to no longer be and the word used to describe this was *ἐξίστασθαι* (existasthai).³ To bring a being into existence means to transpose it into an entity. Thus, the original, Greek meaning of existence implied to no longer be. Similar to how in the quantum mechanical language, upon measurement, a wavefunction expressed in the Hilbert space collapses into one of its eigenstates expressed in the real space (i.e. fourth QM axiom), in the language of metaphysics bringing a being into existence collapses it into entity. Similar to how a wavefunction cannot be directly observed, but only grasped through its manifestation upon collapsing into to real space (and further observed via a quantity derived from its square modulus), the metaphysical *being* cannot be physically reached but only grasped through its entity manifestation. Both *being* and wavefunction, however, can be reached and tangled through the human intellect. Both are of suprasensible nature and are susceptible in collapsing into sensible manifestations (cf. Figure 5).

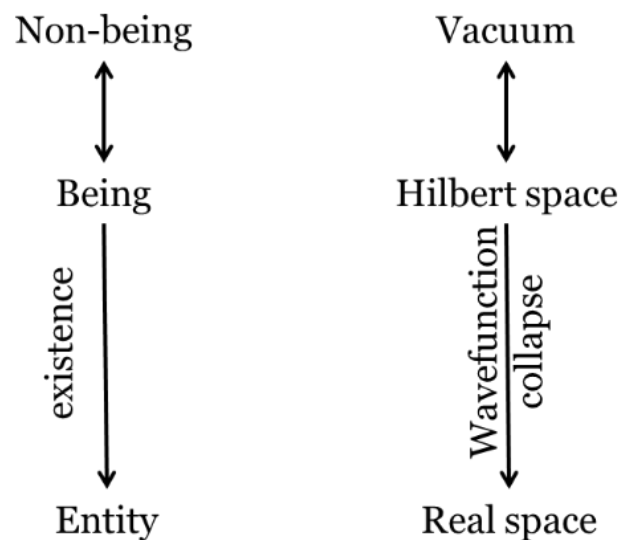


Figure 5. Parallel between Metaphysics (left) and Quantum Mechanics (right) (Author's figure).

In its uniqueness, the *Being* is only matched by the *non-Being* (Heidegger, 2000, pp. 80–84). The two concepts find themselves in a complementary relationship similar

³ Perhaps the etymology of the English word “exit” might be traced to the Greek *ἐξίστασθαι*.

to the complementary quantities appearing in the uncertainty relationship responsible for the vacuum generation of virtual particles and antiparticles.

Being of suprasensible nature, the *Being* can be asserted within the *τόπος νοητός* (topos noetos) and therefore sharing ground with the eide. The *entity* on the other hand, is by the virtue of its sensible nature an object within the *κόσμος* (cosmos) and therefore sharing ground with the aistheta. Thus a third parallel represented by the eide-aistheta binomial can be traced to the previous two parallels. Now, the fully deterministic wavefunction expressed within the Hilbert space can be translated to an ancient Greek as a sort of eidos belonging to the *τόπος νοητός* that by collapsing, in a similar way to which the eide enter in *participation* (methexis), can be observed within the real space similar to how an aistheton is sensed within the *κόσμος*.

Conclusions.

Quale Mechanics is proposed as a Weltanschauung that can be used as an aid to better grasp abstract notions of Quantum Mechanics by providing bridging links to Metaphysics. From a practical perspective, its use can be expected to ease the imagination process of a novice (possessing a Chemistry or Physical Chemistry background) that might become beneficial for its creative quantum mechanical endeavours. Reversely – for a Quantum Mechanics initiated – Quale Mechanics can serve as a diving point into Metaphysics.

Throughout the text it was followed how the discrete was discerned from the continuous in order to arrive at the construction of the parallel between the metaphysical *existence* and the quantum physical *wavefunction collapse* (cf. Figure 5). Thus it was shown that, within its underlying, Quantum Mechanics is not a revolution of thought, but merely a reiteration of a Weltanschauung previously shared by the ancient Greeks – a fruitful reiteration, nonetheless.

For future development, one may further explore the influence of the sensible-suprasensible dichotomy on the history of the development of science, with particular emphasize to its impact on the Quantum domain.

“*It is the study of the Chemists to liberate that unsensual truth from its fetters in things of sense*” was once said by the alchemist Dorneus (Jung, 1959, p. 201). With respect to this view of Dorneus, Quale Mechanics – as presented here – is a study of the *Chemists*.

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Conflicts of interest.

The authors declare no conflict of interest.

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Quale механіка як метафізична світоглядна концепція квантової механіки

Анотація. Термін "Quale Механіка" запропоновано тут для опису якісних аспектів Квантової Механіки, які піддаються метафізичному розгляду. Мета Quale Механіки полягає в тому, щоб упорядкувати квантовий дискурс до його основних засад, щоб побудувати його власний – філософського характеру – Quale дискурс. Рамки дискусії розпочинаються поверненням до платонівського підходу до способу сприйняття/обробки знань, а потім обговорюються чотири стадії до досягнення поняття ейдосів. Природа відчуттєво-надвідчуттєвої дихотомії викривається шляхом протиставлення айстетичного ейдосу. Далі йде обговорення історичного розвитку та основ Квантової Механіки. Це включає розв'язання проблеми чорного тіла Планком з введенням квантів – у конфлікті з Ньютонівською фізикою, а потім поясненням Ейнштейном фотоефекту та наслідками, пов'язаними з подвійною природою світла (частинка проти хвилі) і двома узагальненнями квантового характеру речовини: планетарна модель атома Бора та подвійна частинково-хвильова природа електрона, продемонстрована де Бройлем. Подальше упорядкування цих напівкласичних концепцій в більш абстрактні математичні концепції Гайзенбергом, Борном, Діраком і Паулі потім розглядаються з принципом невизначеності Гайзенберга та поняттям хвильової функції, які недвозначно відходять від класичної детермінованої картини матерії. Прикладом цих досягнень є ефект Казимира – з його наслідками для гравітації і демонстрацією того, що вакуум насправді не можна вважати повністю пустим. Квантова Механіка, як найточніша математична рамка, яку можна використовувати для опису та передбачення природних явищ, які відбуваються на атомних розмірах реальності, можна розглядати як корінь, з якого виникла концепція Quale Механіки для побудови паралелі між метафізичним існуванням і квантовим фізичним згортанням хвильової функції. Зроблено висновок, що, в основі своєї, квантова механіка є повторення Античного Грецького Світогляду.

Ключові слова: квант; існування; згортання хвильової функції; світогляд

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