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Conditions for the Influence of Quantum Mechanics on the Scientific Interpretation of the Holy Quran

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Abstract

In the contemporary era, quantum mechanics is regarded as a foundational framework for both physics and metaphysics. Its application in the interpretation of the Holy Qur'an has attracted the attention of various scholars and thinkers. This study aims to clarify the scope and conditions under which quantum mechanics may influence Qur'anic interpretation. Data were collected through a library-based method and analyzed using a descriptive-analytical approach. A key condition for employing sciences such as quantum mechanics in Qur'anic interpretation is the certainty of the scientific principles involved. Given the philosophical challenges surrounding causality and realism, this paper critically evaluates the alleged contradictions between quantum mechanical assumptions and these two doctrines. The study shows that while quantum mechanics does not affirm deterministic causality in the classical sense and recognizes variability in causal conditions at the subatomic level, it still affirms causality in a general sense. Similarly, it demonstrates that quantum mechanics is not inherently contradictory to the existence of physical reality, supporting its compatibility with realism. Finally, the study outlines the following essential conditions for the effective influence of quantum mechanics on Qur'anic interpretation:1.A comprehensive understanding of Qur'anic vocabulary and the intended meanings of verses; 2. Examination of relevant Hadiths and scholarly opinions; 3. Identification of verse referents based on reliable scientific sources; 4. Comparative analysis of scientific findings and corresponding interpretations, with conclusive evidence supporting or refuting their compatibility; 5. Use of empirical sciences to better comprehend divine referents, while avoiding the imposition of hypotheses or theories onto the text; 6. Reliance on well-established propositions in quantum mechanics; 7. Clear distinction between hypotheses, theories, and technological application

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Introduction

By the late 19th century, physicists had explained natural phenomena using classical laws such as Coulomb's law[1], gravitation[2], and Newtonian mechanics.[3] However, emerging phenomena necessitated new frameworks, leading to modern physics. This comprises relativity (for high-speed systems) and quantum theory (for subatomic scales).

Recent debates on causality, realism, and probabilistic phenomena in quantum mechanics have sparked atheistic critiques misrepresenting Quranic verses. Meanwhile, Islamic scholars dispute the validity of empirical science in Quranic exegesis, with some works exemplifying arbitrary interpretation (*tafsīr bi al-raʾy*) due to inadequate methodological rigor[4]. This underscores the need to establish conditions safeguarding scientific exegesis from error.

Here is the academic English translation of the provided text:

The present study is fundamental theoretical research in which primary data and materials were collected through library research and analyzed using various methods of reasoning.

Given that the main subject of this research is the conditions for the influence of quantum mechanics on the interpretation of the Quran, it is necessary to examine the certainty of the foundations of quantum mechanics and its challenges with religious and theological topics, including the causal argument and the concept of reality.

In fact, it must be investigated under what conditions these scientific achievements can be legitimately and reliably referenced. Therefore, by examining the relevant conditions, the relationship between quantum mechanics and the scientific interpretation of the Holy Quran will be clarified.

The article assumes that if these scientific achievements are employed as interdisciplinary tools to identify and explain Quranic verses, it will bring us closer to a deeper understanding and clarification of their semantic ambiguities, similar to how Allameh Tabataba'i utilized the theory of cosmic expansion in interpreting the verse "Indeed, we are expanding"[5]

Accordingly, although empirical sciences cannot directly determine the meanings of the verses, their efforts to define and depict probable examples in the verses can facilitate a better comprehension of the meanings and concepts.

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[1] Robert S. Elliott, *Electromagnetics: History, Theory, and Applications* (Wiley-IEEE Press, 1999), 239.
[2] I. Bernard Cohen and H. Pemberton, "Pemberton's Translation of Newton's Principia, with Notes on Motte's Translation," *Isis* 54, no. 3 (1953), 956.
[3] Isaac Newton, *The Mathematical Principles of Natural Philosophy*, trans. Andrew Motte (London: Benjamin Motte, 1729), 19.
[4] Seyyed Mohammad Baqir Hakim, *'Ilm al-Quran*, 1st ed. (Tehran: Tebyan, 1999), 233.
[5] The HOLY Quran, AL- Zoriat: 47

In the current era of science and technology, it is essential to introduce Quranic knowledge into society with innovative and contemporary expressions, keeping pace with rapid scientific progress, and to use it to address numerous social problems and challenges. It appears that scientific interpretation of the Quran is necessary and integral to the advancement of exegesis alongside new scientific developments-provided that the interpreter adheres to the principles and criteria of valid scientific interpretation and centers the Quranic verses in an effort to expand interpretive perspectives through new scientific findings and to elucidate verses with scientific indications more clearly using definitive scientific data.

Research Background

In the present century, due to numerous scientific discoveries, attention to the scientific miracles of the Quran has been widely influenced by these discoveries, resulting in a large volume of books and articles on this topic.

Based on conducted searches, no independent research has yet taken an analytical and critical approach to the influence of quantum mechanics on Quranic interpretation. However, broader studies exist, such as the book *Physics in the Perspective of the Quran*[1] (Anjami, 2018), which explains and interprets some scientific verses of the Quran in simple and comprehensible language, illustrating the relationship between contemporary human science and the Quran as a book that shapes humanity. Another work is *Quran and Physics*[2] (Kazemi, 2014), which only touches on examples of interpreting verses in the context of physics.

Additionally, the book *Quran and Natural and Human Sciences* is valuable for its examination and critique of the logic and conditions of scientific Quranic interpretation.[3]

Regarding the challenges of quantum mechanics-such as determinism and free will, reality, and the causal argument-important works have been written, including Dr. Mehdi Golshani's *An Analysis of Contemporary Physicists' Philosophical Views*, which has been influential in this research.

Here is an academic English translation of your provided section on the conceptual analysis of "tafsir":

[1] Arash Anjami and Behnam Baharli Adlu, *Physics in the Perspective of the Quran*, 1st ed. (Ardabil: Jihad Daneshgahi Ardabil Publications, 2018).
[2] Abbas Kazemi, *Quran and Physics*, 1st ed. (Qom: Tak Ketab Publications, 2014).
[3] Mohammad Ali Rezaei Esfahani, *Logic and Interpretation of the Quran – Quran and Natural and Human Sciences*, vol. 5, 2nd ed. (Qom: International Center for Translation and Publication of Al-Mustafa, 2015), 560-561

1. Conceptual Analysis

1.1 Conceptual Analysis of Tafsir

There are two main views regarding the root of the word *tafsir*: the root "fasara" and the root "safara."

If we examine the root "fasara," *tafsir* is the verbal noun (masdar) of the form *taf'il* from the root "fasara." In Arabic lexicons, "fasara" means "to clarify and explain something[1]," "to make apparent what is hidden"[2] and "to reveal an intelligible meaning.[3]" *Tafsir*[4] is understood as an intensified or frequentative form of these meanings; that is, it refers to thoroughly clarifying something or fully explaining the meaning of a statement. Some lexicographers have considered "fasara" and "tafsir" to be synonymous.[5]

Regarding the root "safara," the second view holds that this word is derived from "safara" or is a metathesis of it[6]. This view is based on the rule of major derivation (*ishtiqaq kabir*) common in the Arabic language[7], and some linguists believe the primary meaning of "safara" is "to uncover, to reveal"[8], noting that the two roots are similar not only in form but also in meaning. However, examining their usage shows that the former is generally used for revealing abstract

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[1] There are two views regarding the etymology of the word *tafsir*: one traces it to the root fasara (ف س ر) and the other to safara (س ف ر).
If we examine the root *fasara*, *tafsir* is a verbal noun (masdar) in the *taf'il* form derived from this root. In classical Arabic lexicons, *fasara* is defined as "to explain something and clarify it" or "to unveil that which is hidden." Ahmad ibn Fāris ibn Zakariyyā, in *Muʿjam Maqāyīs al-Lugha*, states: "The letters *fā', sīn*, and *rā'* constitute a root that denotes the explanation and clarification of something." Similarly, Fayūmī in *al-Miṣbāḥ al-Munīr* and Khūrī Shartūṭī in *Aqrab al-Mawārid* define *fasara al-shay'* as meaning "he explained and clarified it."
On the other hand, the root *safara* also conveys a related meaning. In Arabic, *safara* can mean "to uncover" or "to expose to light," as in the phrase *safarat al-mar'atu 'an wajhiha*, meaning "the woman unveiled her face." This root implies the act of revealing something hidden, aligning metaphorically with the interpreter's task of unveiling the meanings of the Qur'anic text.

[2] Mohammad ibn Makram Ibn Manzur, *Lisan al-Arab*, 3rd ed. (Beirut: Dar Sader, 1414 AH), 781

[3] Furthermore, what is meant by "intelligible meaning" (*al-maʿnā al-maʿqūl*) refers to rational and empirical concepts that can be grasped through intellect.

[4] Hossein ibn Mohammad Raghib Isfahani, *Mufradat Alfaz al-Quran*, trans. Seyyed Gholamreza Khosravi, 4th ed. (Tehran: Murtazavi Publications, 2009), 380.

[5] Ismail ibn Hammad Jawhari, *Al-Sihah: Taj al-Lugha wa Sihah al-'Arabiyya*, 3rd ed. (Beirut: offset print Tehran, 1989), 685; Mohammad ibn Hasan Ibn Duraid, *Jamhara al-Lugha*, ed. Ramzi Munir Ba'labaki (Beirut: Dar al-'Ilm lil-Malayin, 1988), 781 & Khalil ibn Ahmad Farahidi, *Kitab al-'Ayn*, ed. Mehdi Makhzoumi and Ibrahim Samarai, 2nd ed. (Qom: Dar al-Hijra, 1405 AH), 247.

[6] Abolfotouh Razi, *Rawd al-Jinan wa Ruh al-Jinan fi Tafsir al-Quran*, 3rd ed. (Mashhad: Astan Quds Razavi, Islamic Research Foundation, 1997), 2324 & Abdul Haq ibn Ghalib Ibn Atiyya, *Muqaddamatan fi 'Ulum al-Quran*, ed. Arthur Jeffery and Abdullah Ismail Sawi (Cairo: Maktabat al-Khanji, 1972/1392 AH), 73.

[7] al-Tahānawī, *Kashshāf Iṣṭilāḥāt al-Funūn wa-l-ʿUlūm*, vol. 2 (Beirut: Maktabat Lubnān, n.d.), 207.

[8] Ahmad Ibn Faris, *Mu'jam Maqayis al-Lugha*, 1st ed. (Qom: Dar al-Fikr, 1404 AH), 82.

or intellectual meanings, while the latter is used for making external, tangible things manifest[1]. Most lexicographers support the first view and do not mention the second in their works.[2]

Nevertheless, most definitions of *tafsir* aim to describe it as an effort to uncover the intended meaning of God. Thus, various definitions have been offered, all viewing *tafsir* as the intellectual endeavor of humans to understand the divine intent. For example, Tabarsi in *Majma' al-Bayan* states: "Tafsir is the uncovering of the intended meaning of a difficult word"[3]. Aqa Buzurg Tehrani defines tafsir as "explaining the apparent meanings of Quranic verses based on the rules and language of Arabic"[4] . Abu al-Qasim Khoei states: "Tafsir is making manifest the intent of Almighty God from His noble Book"[5]. According to Raghib Isfahani, "Tafsir, in scholarly usage, is the uncovering of the meanings of the Quran and the clarification of its intent, whether due to the difficulty of the word or otherwise, and whether concerning the apparent meaning or otherwise." This definition is cited by Zarkashi in *Al-Burhan*[6] and Suyuti in *Al-Itqan*[7] , both referencing Isfahani.

Among the many definitions of tafsir, the one offered by the late Allameh Tabataba'i appears to be the most comprehensive and best clarifies the intended meaning of tafsir. In *Al-Mizan*, he states: "Tafsir is the explanation of the meanings of Quranic verses and the uncovering of their aims and implications"[8].

Based on the foregoing, it is preferable to define tafsir as follows: "Tafsir is the explanation of the contextual meanings of Quranic verses and the uncovering of God's intent and divine purposes therein, based on the rules of Arabic rhetoric and principles of rational discourse"[9].

Additionally, Martyr Sadr introduces another type of explanation that goes beyond mere concept and meaning, calling it "tafsir" when it addresses the referents. As he explains, tafsir is of two types:

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[1] Mohammad ibn Makram Ibn Manzur, *Lisan al-Arab,* 781.

[2] Ibid: 781; Ismail ibn Hammad Jawhari, *Al-Sihah: Taj al-Lugha wa Sihah al-'Arabiyya,* 685 & Mohammad ibn Hasan Ibn Duraid, *Jamhara al-Lugha,* 718.

[3] al-Ṭabrisī, *Majmaʿ al-Bayān fī Tafsīr al-Qurʾān*, vol. 1 (Beirut: Dār Iḥyāʾ al-Turāth al-ʿArabī, n.d.), 39.

[4] Mohammad Hassan Aqa Bozorg Tehrani, *Al-Dhari 'ah ila Tasaneef al-Shi'ah*, 2nd ed. (Qom and Tehran: Esmaeiliyan and Islamic Library, 1408 AH), 232.

[5] Seyyed Abolqasem Khoei, *Al-Bayan fi Tafsir al-Quran*, 2nd ed. (Qom: Institution for Revival of Imam Khoei's Works, 2013 AH).

[6] Badr al-Din Mohammad ibn Bahadur Zarkashi, *Al-Burhan fi 'Ulum al-Quran*, 1st ed. (Lebanon: Dar al-Ma'rifa, 1410 AH).

[7] Abdul Rahman ibn Abi Bakr Suyuti, *Al-Itqan fi 'Ulum al-Quran*, 2nd ed. (Lebanon: Dar al-Kitab al-'Arabi, 1421 AH), 1190.

[8]Seyyed Mohammad Hossein Tabataba'i, *Al-Mizan fi Tafsir al-Quran,* 3rd ed. (Lebanon: Al-'Alami Foundation for Publications, 2014 AH), 4.

[9] Mahmoud Rajabi, *Method of Quranic Interpretation*, 1st ed. (Qom: Research Institute of Seminary and University, 2004), 23.

1. Verbal tafsir

2. Meaning-based tafsir "Verbal tafsir" refers to explaining the meaning of the word, while "meaning-based tafsir" refers to identifying the external referent to which the meaning applies[1].

3. Since empirical sciences like physics deal with referents, their relationship with verbal tafsir is indirect; however, they have a direct impact in the realm of meaning-based tafsir.

Here is the academic English translation of your provided text:

The unclear and undisclosed meanings and contextual implications of Quranic verses sometimes arise from the difficulty of the wording itself and sometimes from the obscurity or inaccessibility of the ultimate reality that the verse intends to reveal. The verse aims not only to convey a meaning but also to unveil or at least draw the attention of the audience to an external reality.

In this regard, the sciences can play a significant role in interpreting the verses in terms of *tafsir al-ma 'na* (interpretation of meaning) rather than *tafsir al-lafz* (interpretation of the wording) by elucidating external realities. Therefore, while avoiding imposing empirical scientific findings onto the verses, it is necessary to use these findings to approach a better understanding of the realities that the verses seek to explain. This approach aligns with the Quranic injunctions that invite humans to contemplate the heavens, the earth, and the creatures therein, each being a sign of God's infinite knowledge, power, and wisdom: "Say, 'Look at what is in the heavens and the earth'[2].

1.2. Conceptual Analysis of Quantum Mechanics

In physics, a *quantum* refers to the smallest possible discrete unit of a physical quantity, the base amount or quantum of that quantity. A quantized quantity can only take discrete values, i.e., integer multiples of its quantum. Mechanics is a branch of physics that studies the motion of matter and the forces causing such motion. The science of mechanics, based on multiple fundamentals such as time, space, force, energy, and matter, is applied across all branches of physics, chemistry, biology, and engineering. Mechanics is a broad field with a history extending beyond recorded human history. It is divided mainly into classical mechanics and quantum mechanics.[3]

[1] Seyyed Mohammad Baqir Hakim, *'Ilm al-Quran*, 1/232
[2] The Holy Quran, Yones: 101.
[3] J. Renn, P. Damerow, and P. McLaughlin, *Aristotle, Archimedes, Euclid, and the Origin of Mechanics: The Perspective of Historical Epistemology* (Berlin: Max Planck Institute for the History of Science, 2010), 2. & René Dugas, *A History of Mechanics* (Aurora, IL: Thrift Books, 1988), 19.

The foundations of quantum mechanics were established in the early twentieth century through the efforts of Werner Heisenberg, Max Planck, Albert Einstein, Louis de Broglie, Niels Bohr, Erwin Schrödinger, Max Born, John von Neumann, Paul Dirac, Wolfgang Pauli, Richard Feynman, and others. This new mathematical formalism, known as the Copenhagen interpretation or traditional interpretation, overturned many philosophical foundations of classical physics. Some fundamental aspects of the theory are still evolving. Early twentieth-century discoveries and experiments showed that classical theories could not fully describe atomic-scale phenomena, leading to the initial ideas and inventions that formed quantum theory[1].

Quantum theory, which began with Max Planck's discovery of the photon concept[2] in 1900 and advanced significantly through Niels Bohr's work, was initially not a coherent theory but a set of hypotheses, principles, propositions, and computational rules.

Key points in quantum mechanics include:

- Atomic-scale entities are described by wave-like structures based on differential equations. These quantum entities cannot be conceived in terms of definite spatial and temporal realities but only through the probability wave function that permeates all space.[3]
- Quantum mechanics does not explain events or phenomena per se but relies on theories that justify observations. The method of observation and the observer affect experimental results and the formation of phenomena.
- The causal relationship between natural events and the predictability of individual events is abandoned in quantum mechanics due to Heisenberg's uncertainty principle.[4]

The uncertainty principle in quantum mechanics was formulated by Werner Heisenberg, a German physicist, in 1926. It states that certain pairs of physical properties, such as position (x) and momentum (p = mv), cannot be simultaneously measured with arbitrary precision[5]

$$\Delta x.\,\Delta(mv) \geq \frac{\hbar}{2}$$

[1] David J. Griffiths, *Introduction to Quantum Mechanics*, vol. 3 (Prentice Hall, 1995), 123.
[2] M. Planck, *The Theory of Heat Radiation*, 2nd ed., trans. M. Masius (Philadelphia: Blakiston's Son & Co., 1914), 42- 43.
[3] W. Greiner, *Quantum Mechanics: An Introduction*, vol. 4 (Springer, 2001), 2.
[4] Mehdi Golshani, *An Analysis of the Philosophical Views of Contemporary Physicists*, 4th ed. (Tehran: Institute for Humanities and Cultural Studies, 2006), 208.
[5] Debashis Dutta, *Fundamentals of Quantum Mechanics*, 2nd ed. (New Delhi: Alpha Science International, 2014), 218.

Here is the academic English translation of the provided text about Planck's constant and related quantum mechanics concepts:

In other words, the uncertainty in measuring a particle's position multiplied by the uncertainty in its velocity, multiplied by the particle's mass, cannot be smaller than a certain value known as Planck's constant[1].

Planck's constant is a fundamental natural constant in physics and a basic concept in quantum mechanics that relates the energy of a photon to its frequency; specifically, the energy of a photon equals Planck's constant multiplied by its frequency. This constant is named after the German physicist Max Planck, who discovered it in 1900. In physics, it is denoted by hhh, with a value of approximately 6.626×10−346.626 \times 10^{-34}6.626×10−34 joule-seconds (J·s). A reduced form of this constant, known as the reduced Planck constant or Dirac's constant ($\hbar$\hbar$\hbar$), equals approximately 1.054572×10−341.054572 \times 10^{-34}1.054572×10−34 J·s.

This lower bound on the product of uncertainties is independent of the particle's mass and the method used to measure its position and velocity. To measure a particle's position more precisely, one must use light with a shorter wavelength, which increases the energy of each quantum of light and consequently causes greater disturbance to the particle's velocity. This means that the more precisely the position is measured, the less precisely the velocity can be known, and vice versa. Heisenberg's uncertainty principle is an inherent and unavoidable property of the physical world.

2. Challenges Raised by Opponents of Quantum Mechanics

Various theories have been proposed regarding the measurement problem in quantum mechanics. Three noteworthy perspectives are:

1. The realist view, supported by Einstein.
2. The traditional view, also known as the Copenhagen interpretation, supported by Niels Bohr.
3. The agnostic or non-committal view, whose proponents generally refrained from making definitive statements.

Founders of the Copenhagen school and physicists such as Bohr, Heisenberg, Pauli, Born, Jordan, and Dirac argued that one should limit oneself to organizing sensory data and use mathematical formalism to predict experimental outcomes. Born and Heisenberg, in a joint paper presented at the Fifth Solvay Conference, stated: "We hold that quantum mechanics is a

[1] R. Shankar, *Principles of Quantum Mechanics*, 2nd ed. (Plenum, 1994), 115.

complete theory and that its fundamental physical and mathematical assumptions are not subject to change"[1].

Opponents of quantum mechanics, led by Einstein, Schrödinger, and later de Broglie and Bohm, believed that theories are not merely computational tools but are fundamentally intended to describe physical reality. They were not satisfied with merely predicting experimental results; they sought explanations for what actually occurs.

Some of the criticisms leveled against quantum mechanics include: [Further points would follow here.]

Here is the academic English translation of the provided text on Einstein's criticisms of quantum mechanics:

2.1. Incompleteness of Quantum Mechanics

Einstein, Podolsky, and Rosen, through a thought experiment known as EPR (which aimed to determine a property of a particle without disturbing it), demonstrated that quantum mechanics is not a complete theory[2]. This experiment was based on the assumptions of locality and realism. These two assumptions together are called *local realism*, a key feature in classical mechanics, electrodynamics, and general relativity[3].

In their famous EPR paper, Einstein stated: "We are thus forced to conclude that the quantum-mechanical description of physical reality by wave functions is not complete"[4]. However, the notion of local realism was later refuted by Bell's inequality theory.

Critique

In subsequent years, physicists made many efforts to address these shortcomings, including the "potential barrier" experiment, which led to the consideration of *hidden variables*[5]. This theory posits that some aspects of quantum mechanics involve unknown variables that cannot be directly measured but must be introduced as hidden variables[6]. According to this view, identical particles encountering a barrier are not truly identical; besides their velocity, they possess other

[1] Mehdi Golshani, *An Analysis of the Philosophical Views of Contemporary Physicists*, 6.

[2] It means that no instantaneous effect is possible; in other words, a system cannot affect another part of the system at any arbitrary distance without any delay.

[3] The reality is that "the sea is there even if we don't look at it!" This means that all measurable properties of physical objects must have a prior value before we perform any measurement.

[4] A. Einstein, B. Podolsky, and N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" *Physical Review* 47 (1935): 777.

[5] F. J. Belifante, *A Survey of Hidden Variable Theories*, vol. 3 (Oxford: Pergamon Press, 1973).

[6] Latent variables (as opposed to observable variables) in statistics are variables that cannot be directly observed but are inferred from other observable variables through a mathematical model. They are also sometimes referred to as latent variables, model parameters, hypothetical variables, or hypothetical structures.

microscopic variables that may differ and influence their fate. Thus, the quantum system might have properties unknown to us, possibly due to the observer's influence. Since the physical world affects the brain, the reverse should also hold. This idea was championed by Wigner, who later amended his view to suggest that even non-conscious systems can influence experimental outcomes[1].

In 1957, Everett proposed that during measurement, the universe splits into multiple worlds, each representing one possible experimental outcome. This interpretation is called the *many-worlds* interpretation[2]. Subsequently, concepts like parallel universes and other interpretations emerged, indicating that quantum mechanics is still evolving.

3. Rejection of Chance as the Governing Principle of Nature

In quantum mechanics, all phenomena are determined probabilistically. Einstein believed that a complete physical theory should describe actual events, not merely their probabilities. Therefore, he considered the statistical behavior of quantum mechanics a sign of its incompleteness. A central aspect of quantum mechanics relates to Heisenberg's uncertainty principle, which states that it is impossible to simultaneously measure the position and velocity of a quantum system with arbitrary precision. This principle challenges the notion of strict causality, especially *deterministic causality*, implying a world governed by probabilities that also calls into question realism and the external reality of the world[3].

Critique

In philosophy, the cause of something is what that thing depends on; the dependent thing is called the effect of that cause[4]. Two important laws derive from the law of causality:

1. The law of necessity of cause and effect[5]: If the cause exists, the existence of the effect is necessary; if the cause does not exist, the effect's existence is impossible. That is, the cause not only brings the effect into existence but also necessitates it.
2. The law of similarity between cause and effect: This means expecting the emergence of a particular effect from a particular cause. In other words, affirming the principle of similarity denies the possibility of anything arising from anything indiscriminately.

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[1] E. Squires, *The Mystery of the Quantum World*, vol. 1 (Bristol: Adam-Hilger, 1986), 18.
[2] H. Everett, "Relative-State Formulation of Quantum Mechanics," *Reviews of Modern Physics* 29 (1957), 454.
[3] W. Heisenberg, "Quantum Theory and Measurement," in *Zeitschrift für Physik* 43 (1927), English trans. in Wheeler and W.H, 198.
[4] Abdul Rasul Abudiyat, *Introduction to Islamic Philosophy*, 1st ed. (Qom: Imam Khomeini Educational and Research Institute, 2001), 105.
[5] It is a philosophical concept according to which every event, including human cognition, behavior, decisions, and actions, is causally determined by a continuous chain of prior events. Determinism can also be defined in another way: as a hypothesis that, at every moment, there is only one possible and achievable physical future.

In response to Einstein's objection regarding the non-governance of chance over nature, six points are briefly presented:

First: Sometimes causality is used to mean predictability, but these are not the same. If general causality holds and we know all natural laws and initial conditions, we can predict the future. However, it is possible that causality holds but we cannot predict due to lack of necessary information. General causality is a metaphysical concept related to what actually exists, whereas predictability is an epistemological matter that presupposes general causality.[1]

In Newtonian physics, the rule is that to know the future of a system, we must know the position and velocity of all points in it. Therefore, if we cannot measure the position and velocity of a particle precisely, we cannot know its future.

After the emergence of quantum mechanics, the rejection of determinism was formally and effectively introduced by Born. While solving the problem of particle collisions via Schrödinger's formalism, he concluded that the outcome of a collision is not uniquely predictable and that the key is the rejection of determinism in the atomic world. It seems physicists' rejection of determinism refers to the necessity of cause and effect, not the denial of all causality. Overall, necessity and certainty cannot be obtained through observation, and the principle of necessity has not been proven in the world. Meanwhile, causality as influence and interaction-non-necessary-is acceptable and evident, recognized probabilistically without needing mathematical or logical certainty, and is, in a sense, impossible to prove.[2]

Second: If quantum mechanics is assumed incomplete, atomic events can be based on unknown causes, while currently not all causes and reasons for phenomena are discovered, and our knowledge of physical causality is limited and incomplete.

Third: The principle of causality is a metaphysical principle explainable by reason[3], whereas empirical principles are explained by observation and repetition. Empirical science cannot negate or prove a metaphysical and universally exceptionless rule. According to Islamic philosophers, cause and effect belong to types of existence, and causality is a rule of existence. Thus, the principle of causality is beyond empirical sciences, which deal with bodies and their properties, while bodies and properties pertain to essence, not existence. It seems Islamic

[1] Mehdi Golshani, *An Analysis of the Philosophical Views of Contemporary Physicists,* 256.

[2] Mohammad Benyani, "Causality as Certainty, Simultaneity, or a Boundary Between Them?" *Religious Thought Quarterly*, University of Shiraz 16, no. 61 (2016). 1-16.

[3] The universe consists of two realms: 1) The realm of physics (the realm of matter, or in other words, the material world), which is discussed in the domain of empirical sciences, including classical physics and quantum mechanics, and 2) The realm of metaphysics (the realm free from matter and the effects of matter), which can include concepts that are mental and abstract.

philosophers, like Heisenberg, have difficulties understanding the truth of causality and epistemology, and their debates logically reach no conclusion.

Fourth: Many of Heisenberg's and his colleagues' statements on uncertainty are philosophical and subjective, not scientific and binding. Heisenberg and Einstein agreed that humans have not yet fully understood electron states; their disagreement is philosophical-whether causality exists everywhere or is absent in places like the atomic world. Physics, as physics, cannot affirm or deny causality and thus does not comment on it.

Fifth: The principle of causality must be accepted by sciences for meaningful scientific inquiry. Any hypothesis denying causality proves its own falsehood because no hypothesis is proven without reasoning, which involves premises and a conclusion; the conclusion is the effect of its premises. Therefore, a hypothesis denying causality closes the way to its own proof.

Sixth: Most physicists following Bohr, Born, and Heisenberg agree that necessity or determinism of cause and effect does not exist in atomic and microscopic phenomena and reject it. Necessity applies only to macroscopic objects. In quantum physics, causality at macroscopic scales (visible to the naked eye) remains valid. Quantum physics does not intend to deny causality; it states that causality is expressible at large scales but not at microscopic scales. However, with this definition of causality, small scales cannot be justified, so the current definition of causality must be abandoned and a new definition introduced that encompasses both macroscopic and microscopic events.

Seventh: According to some other physicists, quantum mechanics also negates the principle of similarity in cause and effect. According to the principle of similarity, which is a condition of the causal relationship, only a specific cause produces a specific effect, and every effect has a definite cause. For example, under identical and uniform quantum conditions in the experiment of particles passing through a potential barrier, some particles pass through while others are reflected. In other words, under the same quantum conditions, particles do not behave identically[1].

Among our thinkers, some have accepted Heisenberg's theory, not as a philosophical principle but stating that the principle of similarity is not a philosophical rule but an empirical one based on all observations so far; however, if a counterexample occurs someday, it is not logically impossible. The late Allameh Jafari holds this view. He considers the principle of similarity in the natural world an empirical principle derived from experience[2]. In his words, the phenomenon we face in the world of particles does not imply more than that the condition of

[1] Mehdi Golshani, *An Analysis of the Philosophical Views of Contemporary Physicists*, 227.
[2] Mohammad Taqi Jafari, *Jabr wa Ikhtiyar (Determinism and Free Will)*, 8th ed. (Qom: Institute for Compilation and Publication of Allameh Jafari's Works, 2019), 26.

similarity is an illusion. The resemblance among creatures should not force us to accept that they are produced from particles with the same similarity at the fundamental level.

Furthermore, there are other discussions about the simultaneity of cause and effect related to the issue of quantum nonlocality, where without considering any spatial or temporal separation and without either cause or effect being temporal, like electrons, they appear simultaneously.

In fact, if two quantum systems interact and then move apart, their behavior cannot be explained by signals traveling at or below the speed of light; rather, this phenomenon is known as nonlocality, involving direct and instantaneous activity or speeds exceeding that of light signals.

"In fact, if nonlocal correlations are exactly and literally instantaneous, they would violate the natural law of causality. If two phenomena occur exactly simultaneously, cause and effect become indistinguishable, and it cannot be said that one event causes the other through force transmission, since such transmission cannot occur at infinite speed. Therefore, no natural mechanism of current transmission exists to explain it." It is clear that denying the known natural law of causality in some cases does not imply denying the principle of causality itself.[1]

4. Realism

According to supporters of quantum mechanics, no atomic phenomenon has an independent reality apart from the observer, and unlike classical physics, it is impossible to completely separate the studied object from the measuring devices; the entire system must be considered. From Einstein's perspective, this mathematical definition is unacceptable, and physics must provide a real representation of what occurs in space and time.

Critique

Classical physics accepts objective reality and the existence of an independent, local world outside the human mind. For example, a book exists whether or not we look at it; its existence is independent of anything else, which is a physical reality in classical physics. However, with the advent of quantum theory, classical realism was challenged, meaning that objects exist only as long as an observer perceives them; in other words, objects do not have independent existence apart from surrounding phenomena. The founders of this theory mostly denied reality beyond phenomena and regarded the mathematical formalism of quantum theory as a tool for predicting phenomena. Einstein and his colleagues tried to demonstrate reality and locality through

[1] Seyyed Morteza Hosseini Shahroudi, "Quantum Physics View on the Principle of Causality," *Philosophical-Theological Teachings*, Razavi University of Islamic Sciences, no. 8 (2009), 33-61.

experiments such as EPR, which they succeeded in, but later these were questioned by Bell's inequalities.[1]

Although realism weakened at the beginning of quantum theory, in the last two to three decades, especially since the late twentieth century, some prominent physicists have changed their views, and after the violation of Bell's inequalities, the realist interpretation has been strengthened.

According to Bell's inequality[2], in a world with locality (no phenomenon influences another), all correlations between measurement results must satisfy an inequality. Considering a classical world, this inequality holds. However, multiple experiments have shown violations of this inequality, meaning our world is not local and independent, and phenomena influence each other. Here, quantum mechanics explains these correlations through entangled systems and expresses their real values. Another important result of Bell's inequality is that it also refutes hidden variable theories formulated classically, as it proves that correlation relations do not hold in a local world.

Therefore, the definition of reality in quantum mechanics differs from classical physics in that phenomena in quantum reality are influenced by other phenomena, whereas classical physics deals with completely independent and local phenomena. A noteworthy point is that the current inability of physicists to provide an understandable picture of the microphysical world is not sufficient reason to deny objective reality in that domain.

5. Explanation of the Relationship of Quantum Mechanics

As mentioned in the introduction, the term *tafsir* in this study refers specifically to the interpretation of the Holy Qur'an, which seeks to explain the meanings of its words, compound phrases, sentences, and the divine discourse as a whole. Thus, in addition to conceptual meaning, the interpreter also aims to clarify the referential or actual meaning of the text—sometimes referring to material realities, and at other times to metaphysical ones.

Metaphysical issues in the Qur'an—such as God, angels, the embodiment of actions in the afterlife, and similar concepts—are affirmed through rational sciences like mathematics, quantum theory, and philosophy, as well as through signs, effects, and transmitted reports from religious authorities such as prophets, via revelation. However, many of these realities cannot be supported by empirical evidence.

"Physics deals with observable and unobservable quantities. Some scientific theories are derived from direct observation of natural phenomena, while others are not directly observable

[1] A. Aspect, P. Grangier, and G. Roger, "Experimental Tests of Realistic Local Theories via Bell's Theorem," *Physical Review Letters* 460 (1981), 460

[2] Ibid.

and are formed through hypotheses and educated conjectures. The current state of science is such that the further it advances, the less it relies on direct experimentation. This is because it ventures into more minute domains, higher energy scales, and more distant horizons, where access to comprehensive information becomes increasingly limited. As a result, metaphysical assumptions inevitably become involved in all these domains."[1].

The scientific method in physics includes:

1. Examining existing evidence and finding causal relationships between phenomena.
2. Proposing a hypothetical model that explains the evidence systematically and makes predictions.
3. Designing experiments (both inferential and sensory findings) to test the hypothesis's predictions.
4. Converting the hypothesis into a scientific theory after successful experimental results.

Regarding the certainty of these inferential findings on which physical sciences are based, it should be said that from a logical and rational standpoint, this scientific method lacks absolute certainty and only produces psychological certainty, which is essentially a dominant conjecture. This is because the method infers cause from effect, known as reasoning by analogy, which many philosophers[2] consider not to provide logical certainty but only conjecture. How can we be sure that what we call an electron and base all theories upon is not something else, and who has claimed to have seen an electron with absolute certainty?

Therefore, according to definitions of scientific interpretation, in interpreting the Quran, matters lacking absolute certainty should not be discussed with certainty but only probabilistically, to clarify and scientifically exemplify the verses.

It seems cosmology is directly related, and theology and anthropology indirectly related, to sciences such as physics. Since physics is an empirical science, it directly relates to the material world, and because quantum mechanics can study metaphysical matters, it can indirectly assist in theological discussions (such as God's attributes) to better explain the verses. The term "indirect" is used because no being can truly know God; only manifestations of this infinite truth are perceptible in creation.

[1] Mehdi Golshani et al., *Religious Science: Views and Analyses*, 2nd ed. (Tehran: Islamic Wisdom Institute, 2015), 211-212.

[2] Hossein ibn Abdullah Ibn Sina, *Al-Isharat wa al-Tanbihat*, commentary by Al-Muhaqqiq al-Tusi, 1st ed. (Qom: Al-Balaghah Publishing, 1996), 308.

In anthropology, if physical aspects are considered, such as the "three darknesses" in which the fetus resides or human creation, medical sciences usually intervene. However, matters related to the human soul and spiritual truths, like traveling through the earth or seeing deeds, might be explained, albeit not definitively, by new physical theories. Due to the immaterial and transcendent nature of the soul, precise knowledge of its existence and effects is impossible, hence the term "indirect" is applied.

Based on the above, what can be stated about explaining and identifying Quranic verses is that parts of quantum mechanics presented as technology (e.g., teleportation) can be reliably referenced like empirical sciences, but a significant portion of quantum mechanics, according to rational sciences, consists of inferences and hypotheses that should be used probabilistically, not definitively, in interpreting Quranic verses. In other words, quantum mechanics is still evolving and improving, while divine teachings are certain, although interpreters may not fully comprehend all truths in some cases.

"And nothing is hidden in the heavens and the earth but it is in a clear Book." Nothing hidden in the heavens and earth (the universe) is absent from the Preserved Tablet, the Clear Book. The earth of Resurrection is illuminated by the light of God’s essence for reviving creatures and humans. The light of God’s essence is a very rich source of photons, similar to the beginning of the universe’s creation, within the Planck scale and singularity or unity.

What is quantum entanglement and what role can it play in Resurrection? This issue may be closely related to the parallel universe theory. All these matters and their relation to Quranic verses are my theory, supported by Quranic references, and presented for the first time in Islamic history. It is solely a theory intended to stimulate thought and reflection on the meanings of the verses. First, the concept and method of these theories must be clarified to understand their application in Resurrection.

Quantum entanglement is a quantum theory; it is somewhat complex, but an example is used to simplify understanding. If we merge two fundamental particles of the same kind, for example, two photons, they become one particle, and physically we deal with a single identity. The two photons in this set no longer have individual identities; they are entangled. If we examine the physical coordinates of one particle during entanglement, that particle shows the same characteristics because they are entangled or, in other words, dependent on each other and share unified properties. This event occurred in the creation of the universe, i.e., in unity or, as science calls it, singularity. At 10^-43 seconds after the Big Bang, all fundamental particles, including photons, were entangled, and the four fundamental laws of nature were unified. When the universe contracts, all return to unity and entanglement.

Quantum mechanics has the capability to penetrate the explanation of the reality of beings in the world, which are divided into material and immaterial categories. An important assumption

in accepting reality, as mentioned, is the correlation of phenomena and their mutual influence. The principle of causality, which itself is influenced by philosophical and metaphysical interpretations of scholars, remains valid in quantum mechanics, and this empirical science cannot refute the principle of causality; because causality is a metaphysical principle and cannot be disproved by experience.

Therefore, in quantum mechanics, causality conditions are fully acceptable at the macroscopic level, but at the microscopic level, the necessity of cause and effect and the similarity of cause and effect are not acceptable, as emphasized in numerous experiments; for example, under identical and uniform conditions in the experiment of particles passing through a potential[1] barrier, some particles pass through while others are reflected. This shows that under identical quantum conditions, particles do not behave identically[2]. Of course, microscopic events can be based on causes that are currently unknown and inaccessible to humans.

According to the mentioned premises, the following conditions should be considered when applying quantum mechanics in interpreting the verses:

1. Complete awareness of the interpretation of words and apparent meanings of the verses under discussion and examination of all restrictions of the verse in question.
2. Review of all hadiths and opinions of scholars and interpreters regarding the verse in question.
3. Mentioning scientific examples and using rational and valid sources with citation of their scientific references.
4. Comparing scientific results and related interpretations and examining definitive reasons for their agreement or disagreement.
5. Employing principles and results of quantum mechanics to better understand the concepts and depths of divine verses and avoiding imposition on the Holy Quran.
6. Using definitive propositions in quantum mechanics that practically have conclusive results and are not controversial among scientists. For example, the multiverse idea[3] is

[1] This issue examines a particle that is free throughout space but suddenly encounters a potential V0V_0V0 at a specific point. This potential is referred to as a barrier or potential wall.

[2] F. J. Belifante, *A Survey of Hidden Variable Theories,* 199.

[3] H. Everett, “Relative-State Formulation of Quantum Mechanics,” *Reviews of Modern Physics* 29 (1957), 454-462.
In 1957, Everett concluded that during measurement, the universe splits into a set of parallel worlds, each containing one of the possible outcomes of the experiment. This interpretation was named the "many-worlds" theory.

still controversial, but teleportation technology based on entanglement theory[1] has no opposing theory yet and has even been experimentally tested. Since human sciences that are not self-evident and are derived from induction have no certainty, according to Popper's falsifiability theory, as there is always the possibility of obtaining a proposition contrary to what we have found, this research emphasizes the examples of verses, not the essence of the verse itself. For example, regarding the nature of traveling through the earth (ṭayy al-arḍ) in the Holy Quran in Surah An-Naml, there is no definitive scientific opinion, but new sciences have reached examples that help us better understand the verses, such as teleportation.

7. Familiarity with technology[2] and distinguishing between hypothesis and theory.

Conclusion

With the advancement of sciences and the emergence of a new branch of physics called quantum mechanics, which employs microscopic concepts (at scales of 10^-35) and metaphysical ideas, new definitions of causality and realism have arisen, leading to challenges in these areas, including debates on causality and realism. For a branch of modern science like quantum mechanics to be effective in the scientific interpretation of the Holy Quran, it must be free from rational challenges and possess certainty. Therefore, by examining the mentioned challenges and considering the principles of proponents and critiques of quantum mechanics, it is concluded that quantum mechanics is continually evolving. Some of its principles are hypotheses and theories, and a distinction must be made in their application; definitive theories should be used probabilistically rather than with absolute certainty to explain the verses.

Moreover, causality in quantum mechanics is not negated; rather, interpretations of causality at the microscopic scale differ from those at the macroscopic scale. The law of causality and the cause-effect relationship, as an exceptionless philosophical law, applies in all cases without distinction between microscopic and macroscopic views. Of course, many causes of objects and phenomena remain unknown to humanity, and with scientific progress, the causes of some phenomena and their relation to effects may become clear.

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[1] E. Schrödinger, "Discussion of Probability Relations Between Separated Systems," *Mathematical Proceedings of the Cambridge Philosophical Society* 31, no. 4 (1935): 555–563.
In entangled systems, two particles are considered to originate from the decay of a single particle, such that they move in opposite directions upon separation. These two particles share the same wave superposition, meaning that any event affecting one of them will be instantly known by the other.

[2] Technology refers to any application of scientific knowledge (theories and hypotheses) for a specific purpose—whether to gain further understanding, design a product, develop a process or medical treatment, invent newer technologies, or predict the impact of human actions.

Realism of beings also holds in quantum mechanics. Phenomena in quantum reality are influenced by other phenomena and should not be considered independent and separate.

Therefore, in applying this science to Quranic interpretation, one must first be familiar with the world of quantum mechanics and its definitive terms and interpretations, then, by utilizing Quranic sciences and adhering to the principles, rules, and conditions of interpretation-and avoiding arbitrary interpretation-employ these scientific propositions in interpreting divine verses.

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