History of Islamic Philosophy
Home Page: hpi.aletaha
Ale-Taha Institute of Higher Education
Online ISSN: 2981-2097

The uncertainty principle and non-violation of causality in Islamic philosophy (The critical analysis based on Avicenna and Allameh Tabataba'i's view)

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Article Info

Article type:
Research Article

Article history:
Received 12 April 2024
Received in revised form 25 April 2024
Accepted 08 May 2024
Published online 19 May 2024

Keywords:
Principle of Causality; Uncertainty Principle; Classical Physics; Quantum Physics; Islamic Philosophy; Avicenna; Allameh Tabataba'i

ABSTRACT

The principle of causality is one of the most fundamental principles that has been discovered in the history of philosophy and science. Several foundations revolve around this concept. The importance of this principle in classical physics lies in giving physicists the ability to predict phenomena. Furthermore, due to causality is recognized as a fundamental principle in classical physics. With the introduction of the principle of uncertainty, the principle of causality is empirically called into question. Because the claim of the principle of uncertainty in quantum mechanics is that the relationships between fundamental particles are not causally related to each other, and even the behavior of an electron or a subatomic particle is not based on the principle of causality. If we want to identify the speed of particles, we will not be able to identify their state, and if we want to determine their state, we will not be able to identify their speed. The best way to resolve this conflict is to bring the discussion into philosophy, which is exactly what has been done in Islamic philosophy. The concept of causality in Western philosophy seems to be based on Newtonian concepts. But what has been stated in Islamic philosophy is based on metaphysical concepts, and therefore the principle of uncertainty cannot contradict the concept of causality in Islamic philosophy, especially what has been discussed in the philosophy of Avicenna and Allameh Tabataba'i.

Cite this article: Kouchnani, GhA & Davar, MM & Kouchnani, MA, (2024). The uncertainty principle and non-violation of causality in Islamic philosophy (The critical analysis based on Avicenna and Allameh Tabataba'i's view), *History of Islamic Philosophy*,3 (1), 29-45.
https://doi.org/10.22034/hpi.2024.451083.1073

 Publisher: Ale-Taha Institute of Higher Education Institute..
DOI: https://doi.org/10.22034/hpi.2024.451083.1073

1. Introduction

Causality, as one of the most important philosophical and physical topics throughout the history of philosophy, has been discussed. Some consider it a self-evident principle (Avicenna, 1997; Razi, 1984), while others view it as a theoretical law in need of proof (Sadra, 1402 AH). The perspective on this issue also varies. For example, Aristotle's view focused solely on cause and effect, leading him to propose the theory of the four causes (Aristotle, Physics; Ibid, Metaphysics). On the other hand, other philosophers like Avicenna, Suhrawardi, and Mulla-Sadra have considered causality as the relationship between cause and effect (Avicenna, 1997; Ibid, 1983; Suhrawardi, 2002b; Shirazi, 1981). They have regarded the relationship of causality as an independent existential discussion. Furthermore, it is worth noting that some consider the necessity of the effect's dependence on the cause in the occurrence of an entity (e.g., Iji, n.d.; Jurjani, n.d.), while others believe in the possibility of the effect's dependence on the cause in its contingent existence (Avicenna, 1997; Ibid, 1983; Suhrawardi, 2002a; Ibid, 2002b; Razi, 1992; Ibid, 1987; Ibid, 1990; Shirazi, 1981; Tabatabai, n.d; Ibid, 2018). Some like Aristotle consider the relationship between cause and effect as an essential relation, while others like Avicenna and Mulla-Sadra view it as an existential relation (Avicenna, 1997; Ibid, 2012; also see Tusi, 1997; Shirazi, 1981).

Due to the wide-ranging perspectives on causality, individuals' interpretations of this topic vary. For instance, Muslim philosophers consider metaphysical causality, while individuals like Newton consider physical causality. The concept of causality from a Newtonian perspective has influenced Western philosophy. Therefore, it should be noted that causality discussed in Islamic philosophy has philosophical and metaphysical explanations, while causality in Western philosophy is based on epistemological explanations. Based on this distinction, philosophers discuss the possibility of entities but in empirical sciences, causality is discussed concerning phenomena perceived by empirical

senses.

Moreover, the criteria for the effect's dependence on the cause in classical physics are based on the occurrence of an entity and are similar to those held by Muslim theologians. However, in the view of Muslim theologians (mutakallimun), everything other than God is contingent, both physically and metaphysically. In contrast, physics does not delve into metaphysics. Hence, many views on causality are more general than others. It must be asserted that the term "causality" is a common discussion point and should be considered in all discussions with these distinctions in mind. It is worth noting that many Muslim philosophers have explained causality based on the theory of the four causes. However, their explanation differs from Aristotle's. This difference becomes apparent when rejecting Aristotle's theory of forms and proving the existence of atoms; the theory of the four causes will also undergo transformation.

Meanwhile, some Muslim philosophers like Allameh Tabataba'i have reached a different type of proof for causality that is entirely metaphysical in nature and will not be affected by scientific theory changes, but the main proof of other philosophers like Avicenna is valid. It should be noted that the categorize of Avicenna's causality is based on the theory of four causes and this theory is not valid according to the Form Theory. As a matter of fact, the Form Theory is not valid, but we can reform this theory and we must adopt atom and energy rather than formal cause and material cause.

With the emergence of quantum physics, the foundation of classical Newtonian physics shook, and many fundamental physical principles underwent changes. Moreover, many epistemological and philosophical foundations also became subject to doubt and uncertainty. With the introduction of Heisenberg's uncertainty principle, the concept of causality in classical physics was called into question. Heisenberg acknowledged that in order to measure the velocity of electrons and atomic particles, we must disregard their position, and if we want to

identify their position, we are no longer able to measure their velocity (Heisenberg, 1989). Therefore, in the subatomic world, stating the issue of certainty and predicting with certainty is not possible, contrary to the main assumption of Newtonian mechanics, which is predictability of the future. In such a way that Einstein, who was against the principle of uncertainty, said, "God does not play dice with the universe" (Einstein, 1945). Based on this, the theory of the uncertainty principle in quantum mechanics was proposed as one of the contradictions and oppositions to causality.

The issue raised in this study is whether the principle of uncertainty can contradict the causality discussed in the philosophy of Allameh Tabataba'i or not?

It should also be noted that the method adopted in the current research is descriptive-analytical, in a way that first the relevant topics are described and then analytical considerations are presented in certain positions. Additionally, in the evaluation section of this article, our statements are also presented analytically. Furthermore, the data has been collected in a library-based.

In addition, Many studies have been done about the uncertainty principle in different fields of study. For example, "The generalized uncertainty principle" by Li& Qiao (2021) and "The Uncertainty Principle: How Quantum Mechanics Is Transforming Jurisprudence" by Abdikhakimov (2023). According to relationship between the uncertainty principle and causality, numerous researches have been done with different view. Razi et al (2021) has published a paper titled "A Study of the Transcendental Philosophy and Quantum Physics Approach toward Causality and Uncertainty with an Emphasis on Heisenberg and Boehm’s Views". In addition, Kiankhah (2007), Yazdani& Bagheri (2020), and Shakerin (2022) also published their studies about this subject.

It is worth noting that, our study is noble according to our content. We investigated Avicenna and Seyyeh Muhammad Hossein Tabataba'i's view about the causality and we can extract this result that the principle of

uncertainty cannot reject the philosophical meaning of causality. Our understanding of this matter that the principle of uncertainty cannot reject causality in Islamic philosophy is what was concluded in our article and is also considered the innovation of the present research.

~~2. Research Background~~

3. Uncertainty Principle

The uncertainty principle is one of the principles stated in quantum mechanics. In addition, this principle is "one of the most famous aspects of quantum mechanics" (Uffink, 2016). Quantum mechanics is a branch of theoretical physics that is used at the atomic and subatomic scale instead of classical mechanics and describes the behavior of fundamental particles that make up the universe (Ramin, 2013). This theory was proposed by Heisenberg in an environment where previous scientists believed that the existence system is a compensatory and machine-like system and the phenomena of the world are determined by other phenomena during cause and effect relationships. According to classical physics, every phenomenon has a specific position and speed at any moment, and if someone knows this specific position and speed and is aware of the laws of motion, he can predict the position and speed of that object at any other time. (Kiankhah, 2007; Turani and Sultan Ahmadi, 2013). The fact is the classical physics formulated by Galileo and Newton offered a mechanical interpretation of the world and considered nature as a huge lawful machine in which everything was based on a precise and complex order based on cause and effect (Yazdani& Bagheri, 2020).

Quantum physics, whose foundations were laid by Max Planck, challenged Newtonian physics. This is because the claim of quantum physics is that atomic and subatomic phenomena cannot be predicted. Quantum means wave-like particles, that is, something that has both wave properties and particle properties. Physicists believe that phenomena should not be classified as waves or particles, but that quantum

phenomena called quanta are capable of being both. According to physicists, quanta are the basic matter of the universe (Ibid, 2020). This opinion became known as the theory of complementarity or wave-particle duality (Bohr, 1958; Ramin, 2013).

It can, therefore, be argued that there are several assumptions about quanta:

1. Quanta are both particles and waves;
2. Quanta are neither particles nor waves (the opposite is assumed);
3. Quanta can be both particles and waves (main assumption).

The fact that quanta can be both a particle and a wave is the first point that deprives us of certainty in predicting natural phenomena.

The sum of the physicists' research indicated that in microscopic objects, that is, in the world of particles and atoms, the speed and state of the particles cannot be fully predicted, but because of the existing disorder, physicists can only speak with probabilities. The sum of these experiments conducted in the microscopic world, which was the result of probabilities, was called quantum theory (Yazdani& Bagheri, 2020). In doing so, by observing the disorder among atomic and subatomic particles, and the inability to predict its speed or state, the second proof of uncertainty appears to us.

Another point that deprives us of certainty is that the assumption that electrons are conceivable, as some consider electrons to be like the solar system and go around the nucleus, is a mistake. The structure of the atom is not only far from direct observation, but it cannot even be analyzed based on the categories of time, space, and causality, and it seems that it has a different reality from our common experience, and our conventional concepts cannot be applied to them (Ramin, 2013).

It is on this basis that Feynman says: it can be claimed that with certainty that no one understands quantum mechanics (Feynman, 1967). Bohr also says that if someone does not get a shock after reading quantum, he has not understood it (Bohr, 1958).

In 1927, Heisenberg derived a series of mathematical-physical

equations using the Dirac-Yordan transformation theory, which became famous for Heisenberg's uncertainty principle relations a little later (Kiankhah, 2007). He believed that there is an inverse relationship between the location of an electron and its speed, the more accurately the location of an electron is measured, the less accurate the prediction of its speed will be (Heisenberg, 1989). Therefore, according to the claim of this principle, it is not possible to accurately determine both the spatial position and the kinetic energy of a particle at the same time, because there is an unavoidable error in each of them. So that the product of these two mistakes is always a constant value, i.e. the more accurate one is in determining the other, the less accurate it is in determining the other, and vice versa (Kiankhah, 2007).

In this regard, Heisenberg expresses a conditional proposition: if we know the present, we can predict the future, but due to uncertainty relations, we cannot know the present completely (Golshani, 2020). The result of this conditional proposition is that the future cannot be predicted. In his opinion, quantum laws rule in all experiments and quantum mechanics does not consider the law of causality as valid (Ibid, 2020).[1]

After formulating the uncertainty principle, Heisenberg derived three philosophical consequences:

1. The uncertainty principle leads to the negation of causality. In subatomic phenomena, only statistical analysis is possible. In fact, these phenomena deal with probabilities and not with sure cause and effect chains.[2]
2. The principle of uncertainty leads to the negation of determination in causality. Because we cannot determine the position or speed of electron and atomic particle at a given moment.
3. The traditional distinction between the knowing subject and the

1. Some studies have been done about Heisenberg's uncertainty principle (e.g. see Busch et al. 2007;
2. Heisenberg's formalism confirmed Hume's criticism about causality in a certain range, that is, in the atomic space (Alavinia, 2006).

knowing subject in having causality and between the observer and the observed must be discredited due to the principle of uncertainty. The very experiments we do to find out the reality involve a violation of the reality (Kiankhah, 2007).[1]

These results of experiments and the principles of quantum physics and Uncertainty principle caused deep changes in classical physics and revolutionized the traditional thought of physics. These developments are not limited to physics, because the theorists of quantum physics also entered the field of philosophy of science and epistemology and brought certain consequences from quantum theory to philosophy. Therefore, the physical relations of the uncertainty principle led to a series of epistemological results (Kiankhah, 2007). The most important epistemological consequence of the uncertainty principle was the denial of the causality. Since Heisenberg denies the existence of scientific laws governing atomic events, he believes that quantum mechanics establishes the destruction of causality (Golshani, 2020; Kiankhah, 2007). In addition, the principle of uncertainty brought with it other philosophical consequences. Eddington claimed that the negation of causality and causality at the subatomic level makes it possible for human behavior to be determined by free will (Golshani, 2020; Kiankhah, 2007). Russell also said that atomic particles have freedom and are not subject to law and order (Russell, n.d).

4. Analyze of concept of causality based on Islamic Philosophy

It is certain that quantum physics and its foundations changed classical physics, and as all sciences are influenced by each other, it must be claimed that the influence of the foundations of quantum physics caused the fundamentals of epistemology and philosophy to be revised. The principle of causality is one of the important principles accepted in philosophy and classical physics. The uncertainty principle, as one of the

1. The principle of uncertainty is one of the important positions of the Copenhagen school. (See Alavinia, 2006)

important foundations of quantum physics, questioned experimental causality by stating that the movements and states of atomic and subatomic particles are unpredictable and do not act according to specific rules and laws. It should be claimed that causality has a philosophical concept in general. Therefore, although the uncertainty principle raised as a conflict against the whole concept of causality, it seems that it cannot reject causality in a philosophical sense (especially what is proposed in Islamic philosophy).

4.1 Avicenna's View

Avicenna has built his system of cause and effect on the basis of the four causes (Avicenna, 1997: 96-97; Ibid, 1983: 257; Ibid, n.d: 518-519). The theory of four causes is damaged when atoms are fixed in the bodies, because by accepting the atom, the Aristotelian form theory is rejected. It must be claimed that the content of Avicenna's words about causes is acceptable in some paths. First and foremost, we can modify the system of four causes and consider atoms and energy as causes instead of material and formal causes. It should also be noted that atoms and energy are the causes of material things, just as form and matter were the causes of elemental bodies and material things.

On the other hand, as it appears from Avicenna's view, among these four causes, he considers the existential causes, i.e., the efficient cause and the final cause, and among these, he also considers the efficient cause to be the original (Ibid, 1997: 97; Riahi, Akvan and Najafiafra, 2023: 234-235). In addition to what we mentioned, he does not consider the criterion of the effect's need for the cause in its occurrence, and considers it in the existing contingency (Avicenna, 1997: 97; Ibid, 1983: 261-262; Ibid, n.d: 522-524).

It can, therefore, be argued that Avicenna's opinion about causation refers to the whole of existence, and when the discussion is about the whole of existence, the focus is on the efficient. Just as if we consider form and matter as part of the causes, then they themselves are also the

effects of the efficient. Additionally, if we consider atoms and energy as the cause, they are also the effect of the efficient.

In doing so, according to Avicenna's opinion, existence is either necessary or contingent, I.e. it may or may not be. So, something that is equal to existence and non-existence needs something else to exist, because distinction without a difference is impossible. Furthermore, the existent itself cannot bring itself into existence, because it has not yet existed to be able to bring itself into existence.

4.2 Allameh Tabataba'i's View

Nature in its essence is neither existing nor non-existent, so it is equal to existence and non-existence. Therefore, one of its two sides is primarily dependent on the other. Distinction without a difference is also impossible. Moreover, the necessity of nature in its absence from other than itself is a kind of permissible, and the truth is that the rise and extinction of the other, which nature needs in its existence, is not separate from the rise and extinction of the existence of the nature, due to the dependence of the existence of the nature on the existence of the other. It is clear that this dependence is on the existence of something else and not dependence on non-existence. Because it is not for lack of any nature. In doing so, we call this existence that gives existence as a cause, and we call something dependent on a cause as an effect.

Then, the effect that the cause leaves on the effect is either the existence of the effect or the nature of the effect or the becoming of the nature of the effect into existence. It is impossible for the effect to be the nature, because the nature is credit, while what the effect uses from its cause is something original. Otherwise, everything will be the cause of everything and everything will be the effect of everything, while there is no relationship between nature in its essence and non-nature. Furthermore, it is impossible for the effect to becoming, because in this case, the original objective effect will be transformation, which is a relative matter and equal to the parties. However, according to the

assumption, its nature and existence are two valid things, and it is impossible for the objective and original thing to be equal to the two valid sides, and when it is impossible to have the effect of its nature or form, it is clear that the effect is existence.

1. There is cause and effect.
2. Any contingent is effect.
3. Causality is an existential relationship between cause and effect, and this relationship is circular between the existence of the cause and the existence of the effect. The place of establishment is also the existence of the effect and the nature is dependent on the existence of the effect.
4. Due to dependence is basically for the existence of the effect and the existence of the effect is dependent in its essence, otherwise the dependency would be conditional and the effect would be deprived in its essence, and while with exception, there would be no effect. It can, therefore, be argued that the essence of the existence of the effect is the same as dependence, i.e. the existence of the effect is in its essence independent and dependent on its cause (Tabatabai, n.d.: 156-157).

5. Critical Remark

On the other hand, it should be said that in order to answer Heisenberg's doubt, one should refer to Avicenna's words in the Book of Healing. Avicenna's claim is that sometimes we do not find the true cause of knowledge and consider something else as the cause (Avicenna, 1983: 264), and in other words, negate causality. What is sensed is the succession of phenomena with each other. Discussion of causality is not an empirical discussion at all. Sense only discovers the succession between phenomena, whether or not there is a causal relationship between them. It is for this reason that it is not possible to conclude the rejection of causality with experimental sciences. Being unable to understand the causal relationship between particles is a proof of the violation of

causality, of course, it will not be in a philosophical sense. For this reason, it should be claimed that quantum physics can violate causality in the empirical sense, but it is not capable of violating and rejecting causality in the philosophical sense.

As a realist physicist, Albert Einstein said in a letter to Max Born that "God does not throw dice in the work of the world" (Einstein, n.d). Niels Bohr also told him in response that " Einstein, stop telling God what to do" (Bohr, n.d). Moreover, Stephen Hawking said in response, " Not only does God definitely play dice, but He sometimes confuses us by throwing them where they can't be seen." (Hawking, 1999).[1]

Einstein writes in a letter to the Royal Society of England on the occasion of the 200th anniversary of Newton's death, "It is only in quantum that causality is not strictly valid, but the final word has not yet been said. It is hoped that Newton's spirit will grant us the power to establish unity between physical reality and Newton's deepest teachings, namely the causality" (Golshani, 2020). He and other physicists such as de Broglie and Bohm, in opposition to the Copenhagen school and the principle of uncertainty, believed that quantum uncertainty is related to our intellectual and practical ignorance (Kiankhah, 2007). Aristotle also has a similar statement and names the things that humans consider to be equivalent to coincidence as indeterminate (Aristotle, Physics). Not knowing these causes does not provide understanding for humans, and humans consider them luck or coincidence (Saberi Fathi, 2020). Farabi also names uncertain causes as far causes and says that not knowing the far causes makes some people think these events are coincidences (Al-Farabi, 1992). Max Planck also expressed the same statement (Planck, 1963).

Some physicists believe that quantum systems are also subject to scientific laws and one day their secret will be revealed and it will be known that nature follows very precise laws uniformly everywhere and

1. Stephen Hawking (1999) also said in his lecture:

there is no coincidence in nature. Every phenomena is the effect of a cause that we may not have reached yet (Kiankhah, 2007).[1] Bertrand Russell also said that there may be laws governing the phenomena that are not yet known (Russell, 1931).

6. Final Remarks

Although the theory of uncertainty principle can be a violation of causality in an empirical sense, it cannot in any way violate causality in a philosophical sense that has a holistic view. We must also say that ignorance of the cause is not a reason for its non-existence. Based on this, it should be said that causality in the empirical sense is as valid as causality in the philosophical sense, and in atomic particles, there is ignorance about their behavior. Therefore, the movements of atoms in two directions cannot rule out causality. Firstly, the atomic particles themselves also have a cause according to the law of causality, secondly, not knowing the cause is not a reason for the absence of causality.

7. Conclusion

The scientific world is a world that witnesses the presentation of new scientific theories every day and the previous ones are refuted. If we accept that the principle of uncertainty is a scientific principle, then there is no problem in trying to refute it, and it is completely based on the scientific method. The debate here is whether we consider the principle of empirical causality to be a metaphysical principle or a scientific principle. If we know the philosophical and metaphysical principle, its circle goes beyond the senses and empirical sciences, and then this principle cannot

1. The term quantum causality can be expressed in this position. Quantum causality can also be considered as a substitute for experimental causality and scientific causality. In this case, the term empirical causality and scientific causality will become a historical term that refers to causality in the Newtonian sense. But if we consider quantum causality to be synonymous with empirical causality and scientific causality, all terms can be used interchangeably. For example, we can refer to the Bohemian quantum mechanical system, which is considered a causal mechanical system (Golshani, 2020; Kiankhah, 2007).

reject the metaphysical and philosophical causality. In Islamic philosophy, causality is expressed in a philosophical sense and is not based on sensations. Avicenna and Allameh Tabataba'i have proved the principle of causation by looking at the essence of beings, and everything that exists is possible to exist, and everything that is possible to exist has a cause. As a result of this, atoms also have causes as beings. On the other hand, it should be claimed that not knowing the cause is not a reason for the absence of a cause, and this makes the uncertainty principle unable to reject the causality principle. It can even be said that causation in the empirical sense is not rejected with this view, because perhaps there is no access to understanding the cause. It should be claimed that by violating causality in the empirical sense, no harm is done to causality in the philosophical sense, and atomic particles themselves have a cause.

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