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Can Science Reveal the Origin of the Universe?

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ABSTRACT

Recently Nature published an influential paper and introduced a novel perspective: "Quantum theory might make the cosmos more certain than classical physics ever did." [1]. After reading this paper together with the relevant background theory, we think that this conclusion is drawn from continuous misconceptions since relativity theory, quantum mechanics and Big-Bang theory. These misconceptions include: (1) no distinction between Universe and world, thus blurred the boundary between speculative knowledge and scientific knowledge; (2) physical reality and mathematical language; (3) deterministic classical mechanics and probabilistic quantum mechanics; (4) completeness and logical consistency. In this short paper, six issues we found from reading this paper are briefly discussed and our main conclusions are that science cannot reveal the origin of whole Universe but a concrete system within the world we can observe. Scientific theory should not be required to be complete in order to keep its logical consistency. We should not interpret a scientific theory to be either deterministic or probabilistic and this depends on the information available to us for the model parameters. The clarification of these issues may be helpful to promote the development of cosmology theory in the track of scientific theory.

Keywords: Universe, world, classical mechanics, quantum theory, deterministic, probabilistic, causality

INTRODUCTION

Eddy Keming Chen, a philosopher of physics, published an influential paper in Nature (2023) [1], introducing a novel perspective: "Quantum theory might make the cosmos more certain than classical physics ever did." After reading this paper, I realized that the questions raised in this paper are very important and it may be worth discussing these issues further in order to promote the development of cosmology theory in the track of scientific theory. The purpose of this short paper is to discuss the six issues we found from reading this paper.

SHOULD WE DISTINGUISH THE TWO CONCEPTS OF UNIVERSE AND WORLD?

It is clear from his paper that the two concepts, 'Universe' and 'World', are not differentiated and are treated synonymously. He used 'Universe' in his first question, while he cited Albert Einstein using 'World'. In fact, currently, almost all cosmological theories, for example [2], do not distinguish between these two concepts, except for the Buddhist Cosmological Model (BCM) proposed by Cui [3-5].

However, from a systemic perspective, it is crucial to distinguish between these two concepts. This is because in the definition of a system model, as depicted in Fig.1 [6], we need to define four spaces: the Universe, the World, the Environment, and the System.

The universe is defined as the largest system our human beings can imagine and it is of infinite nature both in time and space [3].

The world is defined as the spacetime our human beings can observe and it is of finite nature both in time and space [3].

A system is a group of interacting or interrelated entities that form a unified whole. A system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose and expressed in its functioning [7].

Only by distinguishing between these four spaces can we determine whether a cosmological theory is scientific. As we should acknowledge, "Science is a set of clearly defined and logically consistent knowledge about the structure and behavior of natural and social systems. It is obtained through observation, measurement, and experimentation, and it provides testable explanations and predictions about the systems we can observe within the world we inhabit" [8]. The distinction between the Universe and the World is akin to Mayants' appeal to differentiate abstract objects from concrete ones [9]. The Universe is an abstract object, while the World is a concrete object.

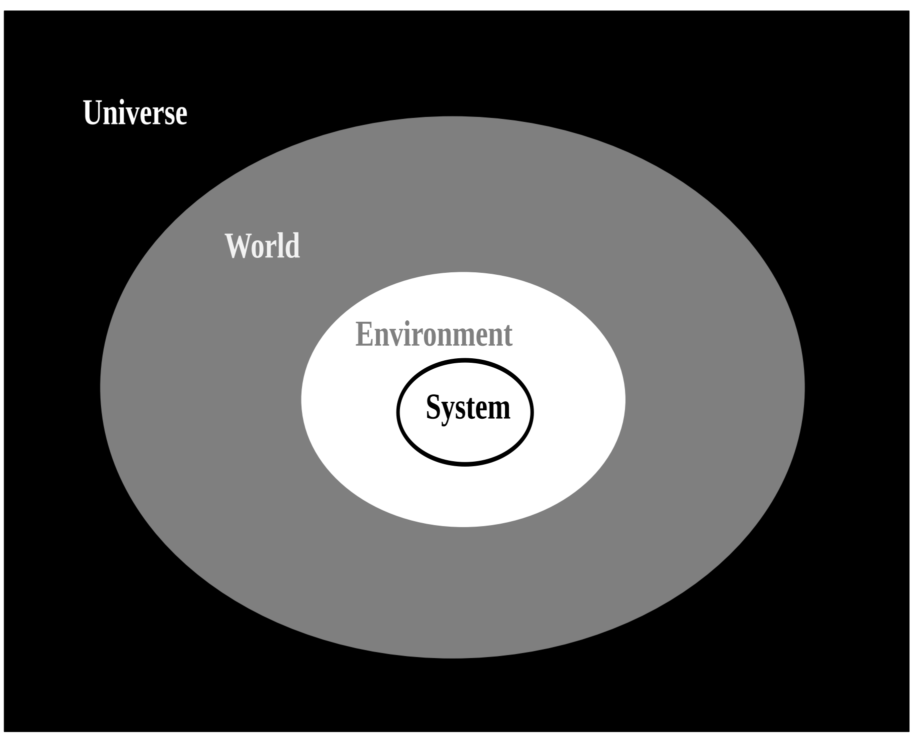

Figure 1: A schematic representation of the concepts of universe and world, system and environment [6].

IS CLASSICAL MECHANICS DETERMINISTIC AND QUANTUM MECHANICS PROBABILISTIC?

Within the mainstream physics community, classical mechanics is often interpreted as deterministic, while quantum mechanics is seen as probabilistic. This means that people often assume that if the state of a system is known at any given time, the basic laws of physics fully determine the system's past history and future evolution according to classical mechanics. This is the primary reason why Prof. Chen's assertion that the quantum Universe is more deterministic than the classical Universe comes as a surprise to many readers.

From my perspective, this interpretation of classical mechanics is entirely incorrect. For instance, if we accept the assumption that Newton's second law is a universal law for any physical object that we can measure, this implies that the governing equation for this object can be written as follows:

$$M\ddot{X} + C\dot{X} + KX = F_{active} + F_{weight} + F_{resistance} + F_{buoyancy} \tag{1}$$

In equation (1), M, C, and K represent the mass, damping, and stiffness coefficients respectively, while Fs represents the four types of forces the object is subjected to when it moves in the medium of aether [10]. Whether the problem is deterministic or probabilistic depends on the information we have about these three coefficients and four forces. If any one of them is probabilistic, then the problem is probabilistic. Only when all three coefficients and four forces are deterministic, can the problem be considered deterministic. Furthermore, we need to know at least two states, such as one past and one present, to predict the future or further past. We cannot make predictions based solely on one known point. By introducing an active force for any objects that have the active movement capability, such as stars, molecules, atoms, and subatomic particles, as well as plants, animals, and human beings in the living state, there is no need to create new theories like quantum theory and relativity theory to explain the phenomena observed in complex systems [6, 10].

Let's take the same example used by Prof. Chen for explanation. If the world is a train, it runs on a track governed by the basic laws of physics. We believe that Newton's three laws, the law of gravity, Coulomb's law, and the three conservation laws of mass, momentum, and energy, among others used in classical mechanics, can be considered as the basic laws of physics. These laws should not be violated at any moment in time, even in the inflation period of the Big Bang theory mentioned by Prof. Chen [1]. These basic laws of physics can generally be referred to as the law of causality [11]. Causality, knowability, locality, and extrapolation are the four pillars of any scientific theory, and they should not be violated [6]. The universe is a web of interactions, with every pair of objects in the Universe interacting. However, our general experience tells us that the strength of the interaction between two objects decreases as the distance between them increases. Based on this observation, we have inferred the law of locality. The derivation of the governing equation for any system applies this axiom. This includes the Schrödinger equation for quantum mechanics, Eq. (1) for classical mechanics, and Einstein's field equation for general relativity. Therefore, the claim that quantum entanglement is non-local is incorrect. We can only assume that the decay rate of quantum entanglement is much slower than that of gravitational or electromagnetic forces. The decay rate of quantum entanglement is yet to be discovered, but we should not abandon the law of locality, as debated by Einstein and Bohr [12,13].

In cases where uncertainty exists in some model parameters, probability theory is a useful tool to handle this uncertainty. Thus, quantum mechanics can be seen as a type of statistical mechanics for microscopic particles. However, the interpretation of superposition is also incorrect. There is no need to claim that microscopic particles do not have trajectories and that the state of the particle is caused by observation through wave function collapse. De Broglie's physical wave provides a good explanation for this [14]. Regarding the Schrödinger’s cat, it is clear that it only has two states: dead or alive. Because of the uncertainty in radioactive decay, we cannot accurately know the actual state, so we can estimate the probabilities of it being alive or dead. This does not imply that the cat does not have a fixed state at any given moment in time.

It is accurate to say that Newton's laws allow for situations where the past does not dictate future motion, but it is incorrect to assert that "the laws do not provide an upper limit on how much an object can be accelerated, so in theory a classical object can reach spatial infinity in finite time" [1]. From Eq. (1), we can infer that the speed of an object will depend on the magnitude of the active force and the resistance. Our experience tells us that the active force cannot be infinite and as speed increases, resistance will increase as well, so the speed of an object cannot be infinite.

Prof. Chen is correct in stating that determinism precludes human free will, but classical mechanics does not. Human behavior significantly impacts the values of the three coefficients and four forces in Eq. (1), so by using Eq. (1), we can account for the influence of human free will and even the free will of other living creatures.

DOES SINGULARITY EXIST IN PHYSICAL REALITY?

It is a well-known fact that the current Big Bang theory begins with a singularity [2]. To facilitate a smooth transition from singularity to non-singularity, scientists have proposed a special period of inflation during which all physical laws are not valid [1, 2]. Prof. Chen does not challenge this point. From the perspective of our new general system theory (NGST) [6], singularity only exists mathematically, but not in physical reality. This should be a general axiom for any scientific theory. If we define the Universe as infinite and the world as finite, then the relationship between the Universe and the world can be expressed as follows: $Universe = \sum\sum world_{ij}$, where i, j represents time and space summations. Each world has finite time and space and cyclically changes from formation to emptiness, and each life reincarnates from birth to death [15]. There is no singularity in these processes.

CAN SCIENCE STUDY THE WHOLE UNIVERSE?

If we explicitly distinguish between the two concepts of the Universe and the world, reserving the specific term "Universe" for the maximum spacetime that we humans can conceive, it becomes clear that we cannot observe the entire Universe. Therefore, whether the Universe has finite or infinite spacetime, we can never answer this question using the scientific method. Thus, defining it as infinite is simply a convenient way to avoid awkward questions about the properties of the Universe [3-5]. According to the testability requirement of a scientific theory, any system, along with its environment, should be confined within the scope of the world we can observe. We must accept the fact, based on current knowledge, that humans can never observe the entire Universe. Therefore, we are unable to construct a scientific theory to reveal the origin of the Universe, including the origin of matter, space, and life. Only with the pre-existence of the Universe can we reveal the origin of a particular world, such as the Milky Way, the solar system, or the Earth. Time is defined based on life experience and is an abstract object, so there is no origin problem for time [9]. However, Stephen Hawking's collaborator, Prof. Thomas Hertog, recently published a book on the origin of time [16]. This book goes further in explaining the origin of the Universe than the Big Bang theory does. With the pre-existence of the Universe, including matter and life, the origin of a particular world can be easily explained, similar to how humans design and construct a complex structure.

If a theory attempts to explain the origin of the entire Universe, the properties outside the observed world can never be tested. Thus, such knowledge is speculative rather than scientific. If we only speculate about the properties of the world we can observe, these properties can be tested. If they are proven to be true, this knowledge is scientific. We should expand our scientific knowledge in this way as observational equipment, such as telescopes and microscopes, progresses. However, we should also strictly distinguish between living and non-living objects, as well as between the alive and dead states of a living object. With such a distinction, if we introduce free will for the living state of some creatures, such as humans and highly intelligent animals, the effect of free will on the operation of the systems in the world can be fully explained. Otherwise, it is difficult to explain the first matter or first force in materialism, and it is challenging to explain how a person cooks a meal without rice in idealism.

In the quantum Universe, the complexity of describing the precise positions and momenta of all the particles at the beginning is addressed by proposing a simple initial condition that encompasses all complexities as emergent structures in the quantum superposition of these states. Such an assumption is a significant one. Who has the power to compel all the particles to adhere to these initial conditions? It must be God. This is the critique made by Prof. Chen, asserting that the quantum universe is more deterministic. In NGST, such a requirement is unnecessary since there is no singularity at the origin of a world.

Hawking's "A Brief History of Time" [2] did not identify the main errors made in the Big Bang theory. They treated what Hubber observed as the entire Universe, rather than the world we have observed, thus leading to the absurd conclusion that the Universe is expanding. To account for the expansion of the entire Universe, the Big Bang theory was concocted. If they had treated it as the world we can observe, which is just a small part of the entire Universe, then there would be no expansion of the Universe. The expansion of this world signifies an encroachment on the space of adjacent (or neighboring) worlds.

The quantum Universe operates under two basic laws: a deterministic law of temporal evolution and a simple one that selects an initial wave function for the Universe. Therefore, Prof. Chen criticizes that the quantum Universe satisfies strong determinism. In NGST, these two basic laws are not required. Instead, we need the law of causality and the initial condition for the world we are concerned with, similar to the system we studied using classical mechanics. In solving any governing equations derived by the law of causality, we need to input the initial conditions to solve the mathematical equations. There is no period of inflation during which all physical laws are violated. This is a significant compromise for a scientific theory.

CAN SCIENCE SEEK A COMPLETE THEORY OR A COMPLETE DESCRIPTION OF A SYSTEM STATE OR PROCESS?

Since the Universe is beyond human observation, we should refrain from speculating about its properties within the scope of scientific knowledge. Instead, we should assume that the world we can observe always operates under causality laws. The mission of scientific research is to discover these causality laws from macro worlds to micro worlds [11]. If one prefers, Schrödinger's equation can be considered one of the causality laws. However, we should never claim that the world can be entirely described by a quantum wave function with no 'hidden' variables. Completeness and logical consistency are a pair of conflicting requirements [6]. For instance, if the editor of a dictionary claims that every concept is defined in that dictionary, then it must be logically circular, which we typically refer to as logical inconsistency. The same holds true for scientific theory. This is the essence of Gödel's incompleteness theorem. For scientific theory, we should prioritize logical consistency over completeness. Since each quantity can be described by other quantities, there is no limit to this process. For example, in classical mechanics, we consider Young's modulus and yield strength as fundamental parameters for material properties. However, they are governed by micro-level parameters such as crystal structure, grain size, alloying elements, phase composition, defects. These parameters can be regarded as hidden variables to Young's modulus and yield strength. So, it is impossible to claim that no hidden variables exist.

THE ULTIMATE THEORY FOR WHAT?

If the Universe is assumed to begin in a low-entropy state and entropy increases monotonically, then the Universe will reach its ultimate demise at maximum entropy. Life is meaningless in such a model. However, if life and the entire Universe always exist, then any individual effort could be beneficial for the future of living conditions, making such efforts meaningful.

In my opinion, the ultimate theory should correspond to the observable world rather than the entire Universe. In such a model, difficult questions such as the origins of the Universe, matter, and life are avoided. Under the conditions that the Universe, including matter and life, pre-exists, we can study the origin of the observable world using the scientific method. This is the fundamental task of scientific research. Since the world is constructed by many lives in the Universe, similar to how we design and construct a building, a ship, or an airplane, the unified theory for complex systems is the ultimate theory we seek. The new general system theory [6] proposed by Cui and his colleagues is a candidate for such a unified theory.

In constructing a unified theory for any systems in the world we can observe, we must clarify the following aspects:

1. The same philosophical foundation for the system theory, including ontology, epistemology, and methodology. We should first clarify what the world is made of. Since two-valued logic is the minimum logic and a pair of concepts have to be used to distinguish each other, ontology is complete only with a dualist philosophy. We can define the essence of matter as aether, which is an assembly of invisible particles, while all visible particles are made of invisible particles by living creatures. The essence of life

is defined as a mind, which is a non-material existence. Life in the living state is defined as a body plus a mind. If the mind is separated from the body, it is dying. Mind-body interaction can generate active force, which is the main cause for the movements of objects.

2. Mathematics is merely a language for presenting a scientific theory. In order to construct a unified theory, the same mathematical language should be used. For instance, currently, classical mechanics is presented in Euclidean space, quantum mechanics is presented in Hilbert space, while relativity theory is presented in Riemannian geometry. These are different mathematical languages. We need to make a decision about which geometry we should use in order to describe the physical phenomena as we have observed. It is suggested that we use Euclidean geometry as our first choice since most people are familiar with this language.
3. All the important concepts must be clearly defined within a scientific theory. Currently, clarification is urgently needed for 8 pairs of 16 concepts. They are Universe/World, Time/Space, Matter/Consciousness, Mind/Aether, Energy/Field, Heat/Work, Life/Entropy, and Probability/Information [6].

CONCLUSION

Recently Nature published an influential paper and introduced a novel perspective: "Quantum theory might make the cosmos more certain than classical physics ever did." [1]. After reading this paper together with the relevant background theory, we think that this conclusion is drawn from continuous misconceptions since relativity theory, quantum mechanics and Big-Bang theory. These misconceptions include: (1) no distinction between Universe and world, thus blurred the boundary between speculative knowledge and scientific knowledge; (2) physical reality and mathematical language; (3) deterministic classical mechanics and probabilistic quantum mechanics; (4) completeness and logical consistency. If we stick to the testability criterion for a scientific theory, then we can only study the origin of a concrete system within the world we can observe using scientific method. We cannot reveal the origin of the whole Universe including matter, space and life. If people seek an ultimate theory, it should be confined within this scope of the world rather than the whole Universe. The present theory of cosmology seems violates this criterion. Furthermore, whether a theory is deterministic or probabilistic depends on the information we have on the parameters in the system governing equations. It is wrong to interpret classical mechanics deterministic while quantum mechanics probabilistic. In order to construct a unified theory for complex systems, we need to clarify the important concepts, make the same fundamental assumptions and select the same mathematical language for presentation. These are the main obstacles for the unification of relativity theory, classical mechanics and quantum mechanics.

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