Einstein's cosmos: A theoretical framework of the oscillating universe

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Abstract Since the time of the ancient Greeks, the pursuit of a theory of the universe has remained an unfinished task, even as humanity has entered the twenty-first century. Few know that, to lead this development, Einstein defined a scientific task called *Einstein's cosmos* and offered a methodical approach called *principle theory*. Indeed, it is astounding in this scientific golden era that this is not more well known. We have previously promoted some of Einstein's work in this area. Herein, as an extension of our previous literature, we apply principle theory to develop a theoretical framework of our oscillating universe and use this framework to examine research practices concerning the universe, elementary particle physics, and cosmology critically. This paper has two goals: first, to promote Einstein's cosmos and principle theory, to restore his scientific thoughts to their deserved place in the precious pursuit of a final theory of the universe; second, to invite elementary particle physicists and cosmologists to pursue Einstein's cosmos collectively under this theoretical framework of the oscillating universe.

Keywords Einstein's cosmos, Final theory, Oscillating universe, Principle theory, Symmetry principle, Theoretical framework

1 Introduction

When one talks about Einstein's contributions to a theory of the universe, two common false impressions ensue. First, his failure to find a unified field theory pioneered the twentieth-century development of a theory of the universe. Thus, his contributions were restricted to this pioneering role in the twentieth century, period. This reaction completely ignores Einstein's cosmos and principle theory.[1-9] Second, his theory of relativity is traditional or outdated, in the sense that it must be replaced by a new theory, such as quantum gravity, string theory, or quantum cosmos.[10-14] This is simply misleading. As we will discuss, Einstein's theory of relativity has a key role in a final theory of the universe.

The principle theory approach is a scientific method that guides scientists to define the structure of the (empirical) universe in logical unity, with the final product being called a principle theory.[6] Recently, we applied Einstein's principle theory to define the success/failure system, a theory that reflects the mesocosmic structure of the universe, called the mesocosmos.[3-9] Thus, the term *Einstein's cosmos* refers to understanding logically how the empirical universe was created and continues to evolve. Thus, in one single discovery, **the three levels of the empirical universe, the microcosmos, macrocosmos, and mesocosmos,** can be defined by **quantum mechanics, general relativity, and the success/failure system,** respectively.[9]

However, this definition of Einstein's cosmos may not be sufficiently inviting to motivate the scientific community to partake in this scientific effort. The statement that a final theory of our universe in its ultimate form is Einstein's principle theory is also inscrutable.[4] We address these concerns herein by beginning to develop (or deduce) a theoretical framework of the oscillating universe and examining research practices concerning the universe based on this framework. The present work is based on its predecessors,[3-9] which we suggest examining before studying this paper.

2 A theoretical framework

The three levels of the present universe are examined by the **degree of certainty** associated with principle theory. Then, we develop a theoretical framework of the oscillating universe, followed by some remarks.

2.1 The three levels of the present universe

To aid the scientific community to understand principle theory, apart from Einstein's scientific thoughts[1,2] and our work[3-9] in the literature, we would require a central organizing concept. As Russell said, "[In his life, he always was preoccupied with] How much we can be said to know and with what degree of certainty or doubtfulness."[15:11] Thus, we consider that the concept of the **degree of certainty** may well fit our purpose. **Indeed, Einstein had a simple mind.** The degree of certainty associated with principle theory can be judged by the following three criteria: (1) whether a principle theory clearly depicts what the empirical universe was, is, or will be; (2) whether it clearly defines the logical (or probable in mathematics) structure of the empirical universe; and (3) whether it has experiential or experimental support.[3-9] In this regard, the three levels of the universe have high degrees of certainty.

General relativity was discovered by Einstein in 1915 and validated by Eddington in 1919.[6] By depicting a moving universe, general relativity revealed the space-time structure of the universe, reflecting the macrocosmos. There is a common misconception that general relativity, as a theoretical science, succeeded only with human creative imagination, without any connection to the empirical world. Few realize that general relativity is a principle theory. We need to experience a principle theory in order to understand general theory. Although Einstein was the first to experience the principle theory of general relativity successfully, the rest of humanity have not been able to experience it deeply.[3-9]

Quantum mechanics was discovered by several scientists in the 1920s and 1930s. By presenting a jiggling universe, quantum mechanics showed the atomic structure of the universe, reflecting the microcosmos.[6] Quantum mechanics was not explicitly claimed by its discoverers as a principle theory. However, it meets the three criteria associated with principle theory. As such, we consider that quantum mechanics is also a principle theory. It has a high degree of certainty.

We discovered the success/failure system, a principle theory, in 2018 and 2019.[3-9] By experiencing an erring universe, the success/failure system exposed the success/failure structure of the universe, reflecting the mesocosmos.[6] However, Einstein was the first to comprehend the existence of the mesocosmos when he said, "[He would like] to contemplate the mystery of conscious life perpetuating itself through all eternity."[1:330] We have expressed the details and process of our discovery in the literature,[3-9] including two key remarks that we wish to highlight here. First, among the three levels of the present universe, the success/failure system is the latest cosmic component to be discovered.[6] Second, based on our logical analysis, we anticipate the success/failure system becoming a permanent part of science.[5] Here, we add another remark. Among the three levels of the present universe, the success/failure system is the most certain, in the sense that we live in the mesocosmic level of the universe and can experience it directly without an aided experiment.

Humanity should acclaim their three successes in defining the three levels of the universe, since one success is difficult to achieve, let alone three. However, “No fairer destiny could be allotted to any physical theory than that it should of itself point out the way to the instruction of a more comprehensive theory, in which it lives on as a limiting case,”[1:362] said Einstein. We consider the role of the three levels of the universe and how they play an important role in a more comprehensive theory of the universe.

2.2 A theoretical framework of the oscillating universe

“The most beautiful gift of nature is that it gives one pleasure to look around and try to comprehend what we see,”[1:446] said Einstein. However, that pleasure depends on the guiding theoretical lens. For example, quantum mechanics and general relativity see the universe around four forces: gravity, the electromagnetic force, the strong nuclear force, and the weak nuclear force.[10,11] The force concept can be traced to its origin, Newton’s theory of gravitation. On the other hand, principle theory sees the universe from two perspectives: **the empirical and the logical**.[3-9] As a consequence, the principle theory approach sees **principles of symmetry** across the three levels of the universe. In other words, the empirical view is symmetrical to the logical view. Quantum mechanics sees the universe empirically as a jiggling universe and logically as the atomic structure; general relativity, empirically as a moving universe and logically as the time-space structure; success/failure system, empirically as an erring universe and logically as the success/failure structure.[6]

Based on the theory of relativity,[1,2] when principle theory sees the universe as a whole, $E = mc^2$ tell us logically that the totality of mass-energy in the universe in time series remains the same as in the present universe and that energy can be transformed into matter and vice versa, symmetrically, as the universe evolves. Furthermore, general relativity predicts that the universe is either expanding or contracting, and Hubble indirectly observed the expansion of the universe in 1929.[10,11] Thus, one may conclude with a certain degree of certainty that our empirical universe is an oscillating universe (i.e., an endlessly expanding/contracting universe). This leads to the conclusion that the past universe, the present universe, and the future universe are all symmetrical empirically and logically. We define the past universe, the present universe, and the future universe respectively as the early universe, including the big bang, the expanding universe, and the contracting universe, in (one cycle in) an oscillating universe.

"The supreme task [Aufgabe] of the physicist is to arrive at those universal elementary laws from which the cosmos can be built up by pure deduction,"[1:363;2:226] said Einstein. Thus, Einstein's cosmos refers to a single logical system of the oscillating empirical universe. We may seek Einstein's cosmos, Einstein's version of a theory of the universe, through a combination of two approaches: **the present-universe approach and the past-universe approach. The present-universe approach:** Given an understanding of the present universe as axioms, deduce an understanding of the past universe and that of the future universe as theorems. **The past-universe approach:** Given an understanding of the past universe as axioms, deduce an understanding of the present universe and that of the future universe as theorems. The key is that any approach must either start from or end in the present universe, as it is the most certain universe. Einstein's cosmos takes the three levels of the present universe either as a complete set of axioms in the present-universe approach or as theorems in the past-universe approach. The three levels of the present universe are most certain across the past universe, the present universe, and the future universe, since we live in the present universe and we judge that all three levels of the universe meet the three criteria associated with principle theory. Both approaches are scientific axiomatic systems, in which axioms and theorems have certain degrees of certainty, as opposed to mathematical axiomatic systems, in which axioms have assumed one hundred percent certainty and subsequent theorems have one hundred percent certainty.[4,6,7,9] Without the methodical thinking of principle theory, the distinction between scientific axiomatic systems and mathematical axiomatic systems is not generally clear in the literature.

In summary, we use a combination of the two approaches, the present-universe approach and the past-universe approach, to form a theoretical framework of the oscillating universe. Our axiomatization supplies a formalized method for the process of future discovery. All axioms and theorems are **theories, principle theories, and also symmetry-principle theories.** Einstein's cosmos refers to the output of this theoretical framework of the oscillating universe, in which all theories form a threading web of beliefs based on degrees of certainty. Quantum mechanics, general relativity, and the success/failure system are limiting cases of a more comprehensive theory of the universe, and indeed, they are most certainly components of a final theory of the universe.

2.3 Some remarks

An oscillating universe cycles endlessly but still must have begun with the creation of the universe.[10-14] Since Einstein's principle theory takes the existence of (potential) sense perceptions as given, the creation of the original universe in Einstein's cosmos, or the so-called first cause, is simply unknown and thus not considered in the question.[1,2]

To show how humanity is ignorant of Einstein's principle theory, not least of Einstein's cosmos, we quote Einstein's philosophy of science as described by the online Stanford Encyclopedia of Philosophy: "But Einstein's most original contribution to twentieth-century philosophy of science lives elsewhere, in his…principle theory….[which] becomes a methodological tool of impressive scope and fertility. What is puzzling, and even a bit sad, is that this most original methodological insight of Einstein's had little impact on later philosophy of science or practice in physics."[16]

3 Research practices concerning the universe

In two branches of physics, elementary particle physics and cosmology, research is conducted on the universe.[10-14] Whereas elementary particle physics mainly addresses the logical structure of the universe, cosmology focuses on the history of the empirical universe. We critically examine both these research practices according to the theoretical framework of the oscillating universe. Since most of these research practices are not final, we focus on the research, rather than reporting specific details or versions.

3.1 Elementary particle physics concerning the universe

Elementary particle physicists take either the present-universe approach or the past-universe approach to obtain a picture of the universe. For example, the standard model takes quantum mechanics in the present universe as axioms and assumes a set of symmetry principles to deduce an understanding of the three forces, electromagnetic force, strong nuclear force, and weak nuclear force, in some low energy area in the past universe.[10,11] However, the standard model does not account for gravity and does not accurately describe the past universe at the Planck time scale when the energies and densities of the universe were colossal. Thus, the past-universe approach can be adopted for this period, where the axioms are of a more speculative nature than those of the present-universe approach. Quantum gravity and string theory take the past-universe approach.[10,11] For example, string theory considers the past universe as composed of tiny one-dimensional vibrating strings as axioms to deduce the standard model in the past universe and both quantum mechanics and general relativity in the present universe.[10-12] However, we suggest that string theory still needs to predict the success/failure system in the present universe.[6]

Principles of symmetry are the key to physics.[10-14] The standard model and string theory are largely based on a set of assumed symmetry principles.[11,12] If all laws of nature describe symmetry in one way or the other, there remain opportunities to discover all as-yet found laws of nature by guessing or seeking all symmetries in the universe. However, a century-long preoccupation with the principles of symmetry in science has resulted in some successful applications, such as equivalence principle and gauge principle, but without any rationale.[10-14] One may now learn that the rationale underlying nature's deepest laws lies in the methodical thinking of principle theory successfully applied across the three levels of the present universe, in which we obtain symmetry principles empirically and logically.[6] This is what Einstein meant by "[The scientist's] religious feeling takes the form of a rapturous amazement at **the harmony of natural laws,** which reveals an intelligence of such superiority that, compared with it, all the systematic thinking and acting of human beings is an utterly insignificant reflection."[1:333;2:40]

The anthropic principle states that the laws of nature in the universe must allow the existence of intelligent beings that can question the laws of nature. This principle in practice is used to produce a range of values for any given parameters to allow life to form.[10-14] This has been considered a *post hoc* fallacy in the literature,[14] but we disagree because "[science] is the attempt at the posterior reconstruction of existence by the process of conceptualization,"[2:44] as Einstein defined it as a principle theory. It is a far graver error in research practices concerning the universe to commit what we call the **'fallacy of incomplete axioms.'** This is when only two levels of the present universe are defined by quantum mechanics and general relativity, but the mesocosmic level of the universe we live in is totally unknown, and even invisible, to the scientific community, as the success/failure system has only been recently defined.[3-9]

When building a theory of the universe, it is said that one considers two problems: the intrusion of historical accidents and the concept of complexity and emergence.[11,12] Thus, the historical accidents of the universe impede the seeking of the laws of nature.[11,12] From the methodical thinking of principle theory, there is a history and there are no such things as historical accidents, since only one universe is studied and it has its past, present, and future. Complexity and emergence refer to how when one looks at nature at levels of greater and greater complexity, one sees problems emerging that have no counterpart at the simpler levels.[11,12] From the methodical thinking of principle theory, complexity and emergence have been subsumed in the part-whole structure of the success/failure system.[5] Furthermore, any detailed research on complexity and emergence should belong to disciplinary research.[6]

3.2 Cosmology concerning the universe

Cosmologists tend to resolve the creation of the original universe hastily and to promote the unperceivable multiverse by relying on the uncertainty principle in quantum mechanics.[10-14] It is indeed very hard to examine these ideas critically by using the theoretical framework of the oscillating universe since this framework simply ignores the first-cause problem and the multiverse. However, when seeing the universe as a whole, the totality of mass-energy in time series remains the same as in our present universe. Any energy debit or credit against this totality, which leads to the breaking of the energy conservation law, is quite confusing. Thus, when one talks about the creation of the original universe or the multiverse empirically or logically, they almost immediately lose certainty, even if they are correct or irrefutable. These concepts are simply beyond what humanity can obtain through the methodical thinking of principle theory.

Quantum-mechanical uncertainty tells us that the universe is a quantum universe: a teeming, chaotic, frenzied arena on microscopic scales.[10-14] From the methodical thinking of principle theory, one may ask whether this quantum universe refers to the past universe or the present universe (or even the future universe). In either case, the quantum universe must be analyzed empirically and logically. If we refer to the present universe, then the quantum cosmos may replace quantum mechanics as the microscopic level of the present universe. However, as science has advanced, quantum mechanics has served well as the microscopic level of the present universe, a jiggling universe.

In the early universe, there was some time period when the universe was inflating with a speed faster than that of light.[10-14] From the methodical thinking of principle theory, one still needs to build the logical structure of this inflationary universe. Thus, like a theory of the inflationary universe, all theories in an oscillating universe are space-unrestricted, but time-limited. For example, general relativity accounts for the macroscopic level of the present universe.

3.3 Some remarks

Clearly, the mesocosmos we live in and the success/failure system play an important role in the theoretical framework of the oscillating universe. Einstein said, “In the matter of physics [education], the first lessons should contain nothing but what is experimental and interesting to see.”[1:100] Thus, we propose that the mesocosmos and the success/failure system should be the first lessons that the general public and students should learn as part of a public information campaign about Einstein’s cosmos and principle theory; eventually, these can be taught in school systems once Einstein’s cosmos is completely established and taught.

Currently, elementary particle physics and cosmology are still fragmentary and disciplinary. Under the theoretical framework of the oscillating universe, elementary particle physicists and cosmologists could contribute their theories of the universe empirically and logically, respectively. Furthermore, the theoretical framework not only allows scientists to build a final theory of the universe collectively, but also associates this final theory with a threading web of beliefs with degrees of certainty. Just as Darwin’s theory of evolution provides a framework for biologists to research historical accidents in biological evolution on Earth, Einstein’s principle theory provides a framework for scientists to seek a final theory of the universe.

4 Conclusions

“The important thing is not to stop questioning. Curiosity has its own reason for existing. One cannot help but be in awe when one contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries to comprehend only a little of this mystery every day,” [1:425] said Einstein, from the memoirs of William Miller, an editor, quoted in *Life* magazine, May 2, 1955. Now that we know that our empirical universe is an endlessly oscillating universe, we live in an erring universe with the success/failure system as its logical structure, and our universe has the three levels of the present universe. Thus, we are ready to head in the right direction toward a final theory of our universe at the beginning of this golden twenty-first century.

Under the theoretical framework of the oscillating universe, we hope that the scientific community can collaborate smoothly toward this treasured goal of seeking a final theory of the universe. By the end of this twenty-first century, the general public would gain the knowledge of Einstein's cosmos and the great mysteries into which they were born (like conducting humanity's root search). The scientific community must enthusiastically tackle Einstein's scientific thoughts on the cosmos and principle theory. Again, the important thing is not to consider (or even judge) Einstein's cosmos and principle theory as utterly incomprehensible or without impact. "To be sure, nature distributes her gifts unevenly among her children,"[2:4] said Einstein, whose scientific talents and temperament command humanity's respect and whose principle theory and cosmos will usher science into a vivid new era.

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