The Weaknesses of Modern Cosmology

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Abstract: Cosmology is one of the most interesting and fascinating scientific subjects. It is also one of the most problematic scientific subjects. In fact, cosmology is not a purely scientific discipline noting its intimate relationship with philosophy (and possibly religion) as well as its inherent speculative nature in some of its fundamental aspects due to the lack of real and decisive experimental and observational evidence that can reach (and hence verify and assess) these aspects. In a sense, cosmology is inherently a mix of physics and metaphysics even though its metaphysics is usually treated (in modern cosmology) by scientific tools and methodology and presented through physical concepts and terminology and hence it appears like physics (or it is hidden behind thick layers of physics). In this article we overview the main weaknesses and shortcomings of modern cosmology which suffered in the recent decades (especially in its theoretical sides) from serious problems and challenges due largely to the domination of certain theories, models and assumptions with the absence of a clear and proper epistemological and philosophical framework and lack of regulations that govern the research in this field and determine its routes and destiny. We also propose and discuss briefly some remedies that should be considered to address these weaknesses and shortcomings.

Keywords: Cosmology, modern science, modern physics, general relativity, dark matter, dark energy, creation, Big-Bang theory.

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1 Introduction

Cosmology is usually defined as the study of the origin, structure and evolution of the Universe (or rather the "Cosmos"). It is one of the most ancient and common branches of human knowledge. Almost all the ancient civilizations (mainly the Mesopotamian civilizations, the Egyptians, the Greeks, the Chinese, the Hindus, the Persians, the Arabs, as well as the ancient civilizations of the "New World") have contemplated seriously and deeply about the Universe (e.g. its origin, creation, creator, etc.) and some even developed elaborate ideas and models about the Universe that reflected their cultural, philosophical and spiritual beliefs and values. In fact, even the "primitive" cultures of the "primitive" human groups have developed and embraced some form of cosmological ideas and "knowledge" within their spiritual beliefs and practices.

We should also note in this regard that all the major religions have certain views and beliefs of cosmological nature, as manifested for instance by the Book of Genesis in the Old Testament. We may also mention in this context the acceptance (or rather adoption) of the Big-Bang theory by the Catholic church noting that the theory was originally proposed and partly developed by a Catholic priest, i.e. Georges Lemaître, who is widely regarded as the father of the Big-Bang theory.[1] This should also be seen as an indication and an example of the intimate relationship between cosmology (even in its modern versions and forms) and religion in general (as indicated earlier).

Cosmology actually reflects (at least in its old versions and forms) the curiosity and amazement of mankind about the Universe, its potential creation and creator, as well as the role and position of mankind in this Universe, and hence it is an essential part of the culture and knowledge of mankind (as a thinking species of highly developed brain and cognitive abilities) regardless of any racial or cultural or geographical (or ... etc.) differences and distinctions. In its generic and basic sense, cosmology is a subject that no individual (let alone groups of people or cultures) should evade or avoid because it is related to our existence and destiny as individuals and as a species.

Although ancient cosmologies are deeply embroiled in mythology, religious beliefs and spiritual experiences (which may not be looked at favorably by most modern scientists and scholars) they represent a very important stage in human thinking and knowledge and a first step toward humanizing the *Homo Sapiens*, and hence they are as important and valuable (at least in their own time and within their geographical and historical contexts) as the most sophisticated modern cosmological theories. In fact, we can even find some

[1] Alexander Friedmann may also be mentioned as the other father of the Big-Bang theory. Also see [1].

traces of ancient cosmologies in modern cosmology, which reveals the influence of the past of cosmology on its present, and this actually is typical of all human knowledge despite the deliberate effort of some to disconnect from the past and get rid of it.

The era of European Renaissance and the subsequent developments (up to the beginning of the twentieth century which is marked by the emergence of the modern scientific theories such as quantum physics and the mechanics of Lorentz transformations) witnessed a serious transformation in cosmological contemplation and thinking where the main old cosmological model of scientific nature (i.e. the Geocentric model of Ptolemy and the associated Aristotelian and ecclesiastical schools of thought) were replaced by the new Heliocentric model of Nicolaus Copernicus[2] which was supported by the work of prominent scholars at that time such as Galileo Galilei and Johannes Kepler. This was elaborated and rationalized further later on by the emergence of the classical mechanics[3] in its Newtonian and non-Newtonian versions and variations as well as in its elaborate mathematical formulations and manifestations. The result of all these developments was the emergence of the so-called classical cosmologies which largely rely on the laws and principles of classical physics such as the Newtonian laws of motion and gravity and the laws of thermodynamics. Although most of these cosmologies are superseded by the emergence of modern cosmology (which is commonly marked by the emergence and rise of general relativity as well as by the scientific and technological advancements in theory, experiment and observation), some of them are still in existence and have some staunch followers. However, we should note that most of the remaining classical cosmologies are not purely classical as they are affected and influenced by the theories of modern physics such as the relativity theories and quantum mechanics (as well as by novel developments and advancements in certain classical branches of physics such as statistical mechanics and thermodynamics).

As indicated already, the new era of cosmology began with the emergence and dominance of general relativity (which is commonly seen as marking the birth of modern cosmology) and the "discovery" of the expansion of the Universe which, among other reasons and factors, instigated the Big-Bang theory and laid its foundations. Despite the serious challenges to this theory (such as the challenges and question marks with regard

[2] In fact, the Heliocentric model predates Nicolaus Copernicus but Copernicus should be credited for advocating and substantiating this model in a rather scientific way (unlike the approach of his predecessors which was essentially of contemplative and philosophical nature).

[3] "Classical mechanics" here should obviously include gravitation theories (as well as the laws of "motion" in their static, kinematic and dynamic forms) since gravity plays a central role in any cosmological theory (whether classical or modern).

to the early Universe or its reliance on questionable paradigms like cosmic inflation and dark energy) and despite the continued effort by prominent physicists and cosmologists to propose and advocate alternative theories (such as the Steady State and Quasi-Steady State theories), the Big-Bang theory remains the prevailing and dominant theory of modern cosmology (although its prevalence and dominance seem to be receding in the recent years).

The purpose of the present paper is to present our views about the main weaknesses and limitations of modern cosmology (noting that some of these views are shared by other scientists and scholars; see for instance [2]). Our plan in this paper (following this introduction) is to discuss the main weaknesses and limitations in modern cosmology (see § 2). We then discuss briefly some remedies that we propose to address these weaknesses and limitations (see § 3). We finally conclude the paper by outlining the main achievements and conclusions of the present investigation (see § 4).

2 Main Aspects of Weakness in Modern Cosmology

In the following subsections we briefly investigate the main aspects of weakness and shortcomings in modern cosmology. Although this investigation largely represents our personal views, it also represents (in part) the views of other scholars in this field.

2.1 Reliance on Certain Theories

One of the main weaknesses of modern cosmology is its reliance (or at least over-reliance) on certain physical theories, namely general relativity and the Big-Bang theory. With regard to its reliance on general relativity we note the following criticisms and shortcomings:

1. **Excessive mathematization**: in this respect we note that general relativity is an over-mathematized theory (as manifested, for instance, by its geometric nature and its excessive use of multivariate differential geometry and tensor calculus) and this leads to many mathematical illusions and hallucinations (see for instance [3]).[4]
2. **Invalidity of general relativity in certain areas**: for instance, general relativity (according to its followers and advocates) breaks down at the early Universe (according to the Big-Bang theory) and at singularities in general, and therefore it cannot provide

[4] We should also mention in this context (although it is not directly related to general relativity) the reliance of modern cosmology (in some of its topics and aspects) in the last decades on the string theory which is a highly-mathematized and questionable theory.

a complete framework for modern cosmology (see for instance [4, 5]). In fact, general relativity breaks down (in certain sense and interpretation) even at certain macroscopic scales (say astronomical scales) which necessitates the introduction of the paradigm of dark matter as will be discussed later on (see § 2.3.2).

3. **Incompatibility of general relativity with quantum mechanics** (which is a well-established theory): this is due to fundamental differences in the nature of the two theories, mainly in scales (i.e. microscopic versus macroscopic), nature of reality (i.e. discrete versus continuous) and nature of knowledge (i.e. uncertain versus deterministic).
4. **Questionable up-scaling of physical laws**: i.e. the presumed validity of general relativity at macroscopic scales my not be sufficient to establish its validity at cosmological scale. However, this issue will be discussed in some details in § 2.3.1 (noting that this issue is partly related to the issue of incompatibility of general relativity with quantum mechanics which also involves difference in scale as indicated in the previous point). As indicated earlier (see the second point), we may claim that general relativity breaks down at certain macroscopic scales and hence (by priority) its validity at cosmological scale is more than questionable.

In short, even if we accept general relativity as an important or necessary tool for modern cosmology, the heavy reliance of modern cosmology on general relativity (noting the aforementioned limitations of general relativity) should raise serious questions and motivate further research for alternative or parallel theories which may offer a more accurate and thorough understanding of the Universe.

All this is about the reliance of modern cosmology on general relativity. With regard to the reliance of modern cosmology on the Big-Bang theory, it is essentially a reliance on the expanding model of the Universe (which is allegedly an established scientific fact according to the so-called Hubble's law and alleged observational data in its support). We therefore prefer to discuss this issue separately (see § 2.2) since it is a more fundamental and general issue than the Big-Bang theory (noting that the Big-Bang theory is an elaborate instantiation of the expansion model).

2.2 Reliance on Questionable Models

Modern cosmology depends on certain physical models that underlie its scientific framework, and some of these models are questionable. The prominent example of such questionable models is the expanding Universe model (which is one of the cornerstones of

modern cosmology). This model is questionable from various aspects such as:

1. Physical aspects: there are a number of questionable physical aspects related to the expansion model of the Universe. For instance, this model necessitates the existence of a mysterious force or/and a form of energy that initiates and keeps driving this expansion. Moreover, there is no decisive physical evidence in support of this alleged expansion (noting that there are alternative explanations to the physical phenomena and consequences that the expansion model is supposedly required to explain and justify; see for instance [6]).
2. Philosophical and logical aspects: the expansion is supposedly caused by stretching the space itself (which carries material objects, like galaxies, along with it). As long as we are dealing with scales below the cosmological scale, this kind of expansion may be sensible and imaginable (say geometrically), but when we deal with the cosmological scale itself (since we are in cosmology and hence we are supposedly dealing with the space of the entire Universe) which is the highest imaginable scale, such expansion is difficult to rationalize and digest. In fact, this kind of expansion relies in its sensibility on an implicitly-assumed space (or space-time) at the background of this expanding space, which is nonsensical since there is no higher-rank space above the space of the entire Universe (or at least such higher-rank space is not supposed to exist or not considered within the theory). In more simple words, we are inside the space of the Universe and cannot leave this space to be outside of it (since there is no higher-rank space that can accommodate us when we try to leave the space of the Universe), whereas such expansion requires us to be outside this space (i.e. within a higher-rank space that contains the space of the Universe). In fact, even some alleged physical consequences of this expansion (such as the red-shift of distant galaxies) are difficult to rationalize by this kind of expansion since these consequences are based implicitly on a kind of expansion of limited dimension and size and not the kind of expansion of the space of the Universe itself.[5]
3. There are also serious question marks and challenges to some "fine details" or elaborations on the expanding Universe model and the Big-Bang theory such as the questionable cosmic inflation theory. Most of these details and elaborations lack solid physical

[5] What have been said in this point about space should apply in a similar way to time (assuming that the Big-Bang marks the start of time) since the "beginning of time" (which is implied and marked by the Big-Bang) requires a higher-rank time to which this start belongs (noting that the time initiated by the Big-Bang cannot mark its own start). In fact, there are other philosophical and logical difficulties related to the Big-Bang theory (and related theories and models) as presented in the literature of modern physics and cosmology (see for instance [3]).

evidence (and some are not testable at all and hence even their scientific nature is questionable). Moreover, some of these details and elaborations lead to nonsensical results and implications.

2.3 Reliance on Questionable Assumptions and Ideas

Modern cosmology relies on a number of questionable assumptions and ideas which play central roles in its scientific framework. Some of these assumptions and ideas are outlined in the following subsections.

2.3.1 Up-Scaling of Physical Laws

One of the principal ideas or assumptions that most modern cosmological theories and models rely on is up-scaling of physical laws, i.e. these theories and models assume that the Universe at cosmological scale is subject to the same (or at least similar) laws as the laws of our physical world (i.e. at macroscopic, and possibly microscopic, scale). The least that can be said in this regard is that this assumption is questionable as it lacks credible physical evidence in its support.

In fact, the relatively recent past (i.e. at the end of the nineteenth century and the beginning of the twentieth century) provides us with a simple example of the failure of the assumption of up-scaling (or in the reverse sense as down-scaling) of physical laws where classical mechanics proved to be invalid at the microscopic and sub-microscopic scales, which resulted in the emergence of the quantum theory.[6] In fact, this should apply even to the "speed scale" (i.e. not only "size scale") where classical mechanics proved to be invalid at high speed scales, which resulted in the emergence of the mechanics of Lorentz transformations (see [8]). This simply indicates that physical laws are generally scale-dependent (or at least they are possibly so) and hence up-scaling and down-scaling of physical laws should be treated with suspicion and caution.

So, using laws or theories or models that belong to sub-cosmic scales (mainly macroscopic and quantum scales) to investigate and analyze cosmic developments and phenomena should be treated with suspicion and caution. This applies for instance to the use of the gravity laws (or quantum physics or quantum-gravity or general relativity or the expanding Universe model and so on) in the investigation and analysis of the origin and

[6] We should note that the correspondence principle (assuming it is really a principle) has very limited validity in practice as it is about certain form of convergence of quantum phenomena and predictions to classical phenomena and predictions (see [7]).

development of the Universe even though we assume that these theories and models are well-established in the sub-cosmic worlds. In fact, this has already proved to be problematic in certain aspects and areas of modern cosmology (such as the need for dark matter and dark energy in the ΛCDM model to fix the cracks of the Big Bang theory; see § 2.3.2).

2.3.2 Dark Matter and Dark Energy

Dark matter is supposedly a form of matter that interacts through gravitational force (with itself and with the ordinary form of matter) but it does not interact with light or other forms of electromagnetic radiation and hence it is not detectable by direct observation (i.e. its existence can only be inferred from its gravitational effects and influences). Regarding dark energy, it is supposed to be a mysterious form of energy[7] that opposes gravity (through negative pressure) and hence it forces the alleged expansion of the Universe at an accelerating rate.

The existence and nature of dark matter and dark energy are entirely speculative and hypothetical and they lack solid evidence and physical explanation (i.e. independent of the need for them to fix the broken theory as will be explained next). These paradigms are proposed by modern physicists to explain some observed astronomical and cosmological phenomena, although in reality they are invented and used to force observational data to fit the theory (rather than the other way around as it should be). In other words, these paradigms are created to rectify the failure of the existing physical theories (such as general relativity) to account for and explain certain physical observations and phenomena.

In fact, the need for the assumption of the existence of dark matter may be an indication to the failure of up-scaling of physical laws (see § 2.3.1). As a consequence of the potential invalidity of up-scaling we may need to search for better gravity laws at astronomical and cosmological scales rather than assuming the validity of the existing gravity laws which require for their validity the assumption of dark matter.[8]

Similarly, the need for the assumption of the existence of dark energy may be an indication to the failure of the expansion model of the Universe or/and the failure of the physical theories which are supposed to explain this expansion (assuming the reality of this alleged expansion).

Anyway, dark matter and dark energy (as well as creation and multiversism which

[7] Some scholars seem to consider dark energy as a type of force (although this may be attributed to loose language).

[8] We should note in this regard that dark matter is not restricted to cosmology since it is also used in modern astronomy and astrophysics to defend the seemingly broken gravity laws.

will be discussed in the next subsections) should be classified as metaphysical paradigms due to their mysterious origin and non-physical nature even though they (as "matter" and "energy") suggest otherwise (or rather they create the illusion of being physical).

2.3.3 Creation

Creation (whether of the Universe itself through the Big-Bang, or as part of the evolution and development of the Universe) seems to be a central idea in modern cosmology. The least that can be said about this is that creation is a metaphysical concept[9] and hence it is difficult to accept and justify within a physical theory or discipline, although it could be entirely legitimate outside science (e.g. in philosophy or theology or religion).

In this regard, we should note that the attempts by some physicists and cosmologists to disconnect cosmology from creation (as well as creator and similar metaphysical and religious ideas and beliefs) by just rejecting the relationship between these ideas and modern cosmology (e.g. by claiming that these ideas are not part of cosmology because cosmology is a physical science) should not be sufficient to get rid of metaphysics in modern cosmology. The reason is that the mere denial of such connection and relationship is not sufficient when rationalizing the physical part of cosmology requires logically the metaphysical part of it.[10]

For instance, if we accept the idea of the Big-Bang which sets a starting point for the space-time and Universe then it is unavoidable to assume (even though implicitly) the creation of the Universe (and possibly even the existence of a supernatural creator or deity) regardless of including this within the theory or not (or stating this explicitly or not). Similarly, when we accept the idea of the emergence of new particles (or matter or energy) rather than their transformation from other forms of matter or energy then the creation is there even if we denied that this is part of the physical theory because the physical theory necessitates creation regardless of our intention to include (or exclude) creation within the theory (or from the theory).

Anyway, creation (as well as annihilation) seems to be an acceptable concept in modern science in general (i.e. not only in modern cosmology, although it is not general with regard to branches, theories or scientists) and it takes various shapes and forms such as the Big-

[9] In our view, creation (as well as annihilation which is its antonym in this context) requires (to be rationalized and imagined) the existence of another world (beyond the physical world) from which the created matter/energy comes (or to which the annihilated matter/energy goes). This is due to the difficulty of imagining something coming from nothing (or going to nothing).

[10] As an example, we may cite in this context [9] although the intention of the author may not be exactly inline with what we are referring to.

Bang (at least in some of its manifestations and scenarios), or the creation of new particles or energy, or the failure of the conservation law of energy, and so on.

2.3.4 Multiverse Concept

Multiverse concept is one of the prominent hallucinations or delusions of modern science (including cosmology)[11] and a manifestation of the excessive use of mathematics and the lack of proper epistemological framework and scientific regulations in modern scientific research. In fact, the idea of multiverse (as well as many other similar ideas) takes modern science back to the middle ages in Europe where this sort of investigations and contemplations (which mixes "science" with nonsense and fiction) dominated the "scientific" thinking (thanks in part to the involvement of the Christian church and its dominance on the intellectual life).

Of course, no one can deny the possibility of the existence of universes other than our own Universe, but no one has the right to introduce such ideas in science which (by definition) is about our *observable* Universe. In fact, the merit of multiverse concept to be a legitimate scientific idea is the same as the merit of afterlife, paradise, hell, angels, God (and so on) to be part of modern science.

Any "universe" that is observable (and hence it is a legitimate subject for scientific investigation and deliberation) should be part of our observable Universe (or at least an extension to it) and hence we cannot consider it as another universe that exists in parallel (and independent of) our Universe. In other words, any "really-other universe" should be non-observable to us and hence it cannot be a subject to science (even though it is entirely legitimate to contemplate and speculate about its existence and nature outside science such as religion and philosophy).

In short, although the idea of multiverse is not nonsensical in itself, it (by nature) lacks scientific evidence and it is actually beyond the domain and realm of science (due to lack of physicality and testability by direct and indirect observation). In fact, it is a purely contemplative and metaphysical idea which more appropriately belong to philosophy or theology or religion (or any subject of metaphysical or supernatural nature).

[11] For example, multiverse exists in quantum physics through some of its interpretations (namely the Many-Worlds interpretation; see [7]). It also exists (more extensively and inherently than in quantum physics) within cosmology as some of the modern cosmological theories and models are entirely and intrinsically based on the idea of multiverse.

2.4 Over-Reliance on Gravitation

Although gravity is a very important factor in any cosmological theory and model, it seems that modern cosmological theories and models are essentially about gravitation (and hence they actually represent gravity theories and models). This may be manifested and exemplified by the dominance of general relativity (which is actually a gravitation theory rather than a general theory or relativity theory as its name suggests; see [10]) in modern cosmology; see § 2.1. This is also manifested by the common approaches and studies in modern physical sciences where cosmology and gravitation are treated as twin subjects (e.g. scientific books and journals usually associate gravitation with cosmology in their titles and subjects of investigation).

In fact, this issue is related to the issue of up-scaling of physical laws which we investigated earlier (see § 2.3.1) because the existing cosmological models[12] are largely up-scaled versions of gravitational models which acquire their sensibility and supposed validity from the gravitational laws and models at the macroscopic scale. In other words, the existing cosmological models assume that our gravitational experiences and knowledge which we obtained by our experiments and observations at the macroscopic scale are valid at the cosmological scale.

Accordingly, the following should be considered as a sample of alternative possibilities in modern cosmological investigations in this regard:

1. Gravity may not be the dominant force at the cosmological scale (unlike its supposed status at certain sub-cosmic scales such as astronomical scale).
2. Gravity may not be the only major force at the cosmological scale, i.e. other known or unknown forces may also be at action and have serious influences at the cosmological scale.
3. Gravity may not be an effective force at the cosmological scale due for instance to the existence of a counteracting force (or forces) which cancel or undermine the effect of gravity, or due (alternately) to scale-limited restriction on the force of gravitation (like the scale-limited restriction on the strong and weak forces).

In short, the role of gravity in modern cosmology may be exaggerated because of the up-scaling approach (as well as because of other potential reasons), and this should be considered in the future investigations of modern cosmology (and cosmological theories and models in general).

[12] In fact, this does not apply only to the modern cosmological models but it applies even to the classical cosmological models such as the Newtonian model which is also largely based on the dominance of gravitation (as manifested and exemplified by the infinitude of Universe to avoid gravitational collapse).

2.5 Lack of Proper Framework and Regulations

One of the major weaknesses in modern cosmology (and modern science in general) is the lack of proper and clear epistemological and philosophical framework and the absence of obvious scientific rules and regulations that determine what should (and should not) be within the subject of scientific investigation and what are the allowed (and not allowed) tools and methods of investigation. These essential issues are generally left for the individual scientists and scholars to determine and decide in accordance with their personal choices and preferences (which in most cases are made even without conscious awareness). This attitude of looseness and carelessness about these essential issues allowed, for instance, the following to happen:

1. Metaphysics to sneak into physics (and science in general), and hence science became contaminated (more than occasionally) with foreign elements that do not belong to the domain and realm of science (see for instance § 2.3.2, § 2.3.3 and § 2.3.4).
2. Excessive mathematization and theoretization of science which reached sometimes the limit of becoming non-observable and non-testable (and actually non-physical and non-scientific) at all, and hence science became in some cases completely detached from the physical reality which science is supposed to represent and reflect.
3. The acceptance and embracement of non-scientific practices and values (such as celebrity culture and cult-like loyalties) which (despite their practical and behavioral nature at the human level) impacted the development of science theoretically and practically and hence determined the evolution and progress of science and human knowledge in general.

In short, this factor (i.e. the lack of proper framework and absence of clear regulations) allowed the chaos in modern science (including modern cosmology) to take place, and hence every individual scientist (or group of scientists) became free to play by his own rules and regulations (or rather lack of rules and regulations) and according to his (academic and non-academic) background and personal choices and preferences.

3 General Proposals about Remedies

In the following subsections we outline some of the proposals that we think they can help (if adopted and implemented) to address the situation of modern cosmology and remedy its weaknesses (or at least they can improve the situation and reduce the current defects and damages).

3.1 Distinction between Physics and Metaphysics

As indicated already, there is an inherent and intimate relationship between cosmology (even in its most modern forms and manifestations) and philosophy and even religious beliefs, and this may be manifested and exemplified by the philosophical and theological nature of fundamental cosmological issues (e.g. the origin of the Universe) as well as by the acceptance or adoption of the Big-Bang theory by the Catholic church (which we referred to previously). In fact, some of these beliefs are part of the common culture and stereotypes and hence they can easily sneak (consciously or unconsciously) into the scientific thinking of scientists and become part of science (noting that science in large part is an organized form of our common thinking and our daily experiences and knowledge). Therefore, it is very important to distinguish between the scientific and physical parts and aspects of cosmology on one side, and the contemplative (or philosophical) and metaphysical parts and aspects of cosmology on the other side.

In this regard, it is important to consider classifying cosmology explicitly into two main parts: physical (or scientific) cosmology, and metaphysical (or philosophical) cosmology. Accordingly, specific and clear criteria should be laid down about this distinction, and this may require classifying and listing the topics and issues of cosmology as those which belong to the first category (i.e. physical) and those which belong to the second category (i.e. metaphysical).[13] In fact, this may even require splitting the subject formally and officially to these two parts as two distinct disciplines: physical cosmology, and metaphysical cosmology where each one of these disciplines should have its own tools and methods of investigation and analysis (and even its own venues of communication and discussion such as books, journals and conferences).

3.2 Embracing Fresh Views and Theories

To address the issue of reliance (or over-reliance) on certain theories and questionable models and assumptions (as well as similar issues which we largely discussed in § 2), it is important to open the door to fresh views, ideas and theories which may challenge the orthodoxy of modern cosmology (and science in general). In other words, it is important to become more inclusive and tolerant toward some of the non-orthodox views and theories

[13] As a broad example, we may distinguish between the origin of the Universe (which is metaphysics) and its evolution (which is largely physics). So, the scientific part of cosmology should be restricted on the evolution of the Universe (noting that "evolution" should not be understood as implicit commitment to certain models or theories such as creation and Big-Bang).

which suffered from discrimination only because they are not inline with some "sacred" views and theories or because they are not looked upon favorably by the establishment.

Of course, we do not call for opening the door to crazy and unsubstantiated views or pseudo-scientific theories (which one of the objectives of the present article is to get rid of), but we want to advocate equal opportunities on pure scholarly criteria where no view, or idea or theory is favored (disfavored) because it is created or advocated by a high-profile (low-profile) scientist or because it is published in a high-impact (low-impact) journal or because it emerged from a research group situated in a reputable (disreputable) university, and so on.

In fact, we should exceed this limit (of opening the door to fresh views, ideas and theories) by calling positively and actively for novel views, ideas and theories through urging young scientists and new-comers to research (in particular) to look for and consider such views, ideas and theories instead of brain-washing and indoctrinating them on the old views, ideas and theories (as it is actually happening in most academic circles and research groups around the world).

3.3 Adopting Proper Framework and Regulations

To address the issue of lack of proper and clear epistemological and philosophical framework and the absence of obvious scientific rules and regulations (see § 2.5), it is important to create and adopt such framework and regulations. As indicated earlier, the purpose of such framework and regulations is to make clear to everyone involved in cosmological studies (especially the young cosmologists and new-comers to cosmological research) what is in and what is out (by identifying the scope and domain of *scientific* cosmology), and what is allowed (and what is not allowed) to use in the investigations of *scientific* cosmology, e.g. tools, methods, models, practices, and so on. For example:

1. A clear epistemological definition of *scientific* cosmology should be created and adopted by the academic circles and research centers around the world. A definition like this should provide a basis for a common understanding about the nature of the subject of *scientific* cosmology which distinguishes it from other aspects and perspectives of cosmology as well as from other scientific branches and disciplines.
2. A clear distinction should be made between what is physical and what is non-physical (or metaphysical) in cosmology. For instance, lists of concepts (or ideas or models or ... etc.) can be prepared to categorize what is physical and what is non-physical in the field of cosmology.

3. Guidelines should be provided to those involved in the cosmological studies and research about the approaches and tools which are allowed (and not allowed) in the studies of cosmology. For instance, such guidelines may include instructions and clarifications about the nature of mathematical tools and theoretical models that are appropriate to use in *scientific* cosmology.
4. A proper code of conduct should also be created and adopted by the cosmological community around the world. This code should regulate the practices and set the standards (whether moral or academic) that represent the substance and reflect the spirit of science. This code may also include rules and items of educational nature about the values and culture that should be accepted and embraced by cosmologists (and scientists in general). For example, emphasis should be laid on the quality of research itself (as opposite to the current emphasis, for instance, on the celebrity status of the scholars, or on the manipulatable/misleading citation metrics and indicators, or on the prestige of the academic institutes and research centers, or on the impact of journals, or ... etc.).

4 Conclusions

We outline in the following points the main achievements and conclusions of the present paper:

1. Modern cosmology is not a purely scientific subject due to its contamination with non-scientific elements (i.e. concepts, ideas, models, theories, methods, etc.). This is partly inherited from the past of cosmology (i.e. being historically a subject for mythical, theological, religious, and philosophical contemplations) and partly related to the character of cosmology as a subject of strong speculative nature due to the limitation of experiment and observation to reach and inspect some of its fundamental aspects and perspectives.
2. The weaknesses of modern cosmology include reliance (or excessive reliance) on certain theories (notably general relativity and the Big-Bang theory), reliance on questionable models (notably the expanding Universe model), reliance on questionable assumptions and ideas (such as up-scaling of physical laws, dark matter and energy, creation, and multiversism), excessive reliance on gravitation, and lack of proper and clear epistemological and philosophical framework with absence of obvious scientific rules and regulations.
3. Our main proposals for addressing the problematic situation of modern cosmology and

remedy its weaknesses are: making a clear distinction between what is physics and what is non-physics in cosmology (which may require splitting cosmology explicitly into two main disciplines: physical cosmology and philosophical cosmology), embracing fresh views and theories (which may include encouraging the new generation of cosmologists to break with the orthodoxy of modern cosmology), and adopting a clear epistemological framework and setting obvious scientific rules that define and regulate the academic and research activities in cosmology (which should include things like: synthesizing a clear epistemological definition of *scientific* cosmology, distinguishing between what is physical and what is non-physical in cosmology, creating clear guidelines about the approaches and tools which are allowed and not allowed in the cosmological investigations, and setting a proper code of conduct and educational instructions to regulate the practices and set the standards that represent the substance, values and spirit of science).

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