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The Big Bang of Non-Measurable Theories between Science and Pseudoscience

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Abstract:
Much like the universe, science has also experienced a Big Bang of theories relating to the origins of this world. The so-called string theory is said to bifurcate into a number of M-theories,none of which have been empirically proven or have advanced testable predictions since their inception over four decades ago.Moreover, it is completely unknown upon which physically interpretable principles such theories could rest. Some theories were initially premised on the "seen" – our three spatial dimensions, for example – as well as the scientific findings obtained during the running wheel of history relating to the "seen," such as theconservation of energy. But these theories have since been heavily infiltrated by intuition of the "unseen." This adventure, or *mis*adventure,broke the barrier between physics, metaphysics and religion, going as far as to advance the exchange of energy between the seen and the unseen.The present article highlights the fundamental tensions between mainstream theories of everything and the scientific approach. It also warns against the invasion of philosophy by ill equipped scientists. This work concludes that science should not lose itself to pseudoscience.

Keywords: Inflation, Multiverse, String Theories, Metaphysics, Science, Pseudoscience.

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1.Introduction

Scientists have investigated fundamental questions concerning the origin of the universe, its evolution, its destination, the definition of matter, etc. in the hopes of formulating a single master equation or, at least, conceiving a standard theory, baptized the “theory of everything.” But the pursuit of this theory has had no shortage of divergences. Some scientists have hypothesized that physics can be explained through mathematics, but the abstract nature of this domain is such that possible dimensions are infinite. Physics, on the other hand, is observable by human means. It allows no room for imagination without concrete foundation or for the “observable” by extraterrestrial or divine means. Mathematics, on the other hand, is not limited to physical proof. Some scientists are not aware that mathematics may spill over to metaphysics. Once youargue that energy or matter may be exchanged between our three space dimensions as well as the other seven space dimensions yet to be observedby human means, you have entered the realm of metaphysics. Recall that extra-dimensions are crucial to a number of religions, and hence such abstract theories can be reconciled with notions of supernatural entities (e.g. angels, devils, souls, etc.), something science has historically rejected.

Extradimensions, strings, parallel worlds and multiverse were among the theoretical avenues to explain our physical existence. The boundaries of experimental science, pseudoscience, physics, metaphysics, philosophy and religion seem to have been erased. This paper discusses this concern.

It is not the purpose of this paper to defend an extreme form of empiricism, which has been seriously challenged within philosophy of science, and whichgoes against the general trend of thinking within philosophy of science. I believe that there is a room for intersection between empirical science and metaphysics. However, the papers emphasis the danger for an experimental scientist to consider metaphysical aspects without the tools of philosophy and by only intuition. It is also dangerous not to see the borders between science and pseudoscience. This paper discusses these aspects.

The remainder of this paper is organized as follows. Section 2 briefly covers three important physical elements, namely space, time and dimensions.Section 3 covers the attemptsto understand the universe, and introduces theories strongly related to the aforementioned three elements, such as Einstein’s relativity and multiverse theory. Section 4 presents the major constituents of our universe, namely things which are qualified by the adjective “dark” to denote their unknowability, such as, dark matter, dark energy and dark radiation. The section also provides an overview of related works and scientific theories on the physics of the universe. Section 5makes the distinction between science and pseudoscience, while Section 6questions the misuse of philosophy by scientists who have paradoxically pronounced it dead. Concluding remarks are given in Section 7.Along these sections, I critique 18statements advanced by scientists.

2.Space, Time and Dimensions

The Big Bang theoryis commonly accepted by physicists today (Silk 2009). A “singularity,” a point with a high-density and high-temperature state, exploded and gave birth toan expanding universe.But where did the universe expand if no empty space pre-existed?The classic answer has been to deny the pre-existence of an empty space. But this leaves questions concern the duration of this phenomenon unanswered, after all speed cannot be calculated in a time-less context?

Most scientists agree that space expands with time. In other words, the universe is the expansion of space rather than the expansion in space (Fox 2002). Hence, physical distances between comoving points, and therefore galaxies, are always increasing. To illustrate this phenomenon, imagine a balloon on which you have drawnseveraldots.The more you blow into the balloon, the more the spots are pushed apart. If the balloon symbolizes space, thenthe more you blow, the more you create space.This expansion likely follows three dimensions: upward and downward, to the left and to the right, and forward and backward.Thus, space expansion is not arbitrary. But this begs the question: why did the Big Bang create three dimensions rather than, say, two or five?Essentially, this number is presumed to bea cosmological constant, like the speed of light or Planck’s constant; any change in one of these constants would render our universe inexplicable.Whether it is in fact possible that the universe is expanding in more than three dimensions,is a question with which modern scientists have chosen not to concern themselves, as other dimensions are not observable and henceexceed the domain of physics.

During the classical antiquity and in the first millenniumof thecommon era, mathematicians and physicists were equally concerned with physics and metaphysics. Combining the two fields was very common until the medieval era(White 2008). This is not necessary a negative aspect since, as we will see later, metaphysics is prior to physics and exposes possibilities which science should handle by using an empiric approach to find which possibility is scientifically proven and therefore must exist. In the 10th century, the optician Ibn Sahl(Zghal 2007)gave an important push to experimental science. He used the Arabic word “إِعْتِبَارٌ” (“Itibar”)to define experimental science and the word “مُعْتَبِرٌ” (“Mutabir”) to denote theexperimental scientist.The verb “إِعْتِبَرَ” (“Itibar”) means to make conclusions (lessons) from observations.His follower, Ibn Al-Haytham, detached optics from its philosophical envelopeand embedded it into the framework of experimental science (Zghal 2007). Grossteste, Snell, Descartes and others continued in the same path (Zghal 2007). The push towards experimental science precedes Ibn Sahl and may even be found in the works of Archimedes in the Hellenistic period (Chondros 2010). And yet, is “science” now devolving to a pre-experimental era?We will explore this question later.

3.Attempts to Understand the Universe

To formulate a unified theory of the universe – a theory of everything – was Einstein's dream (Pais 1982). Many attempts were conducted to make this dream a reality. Eight decades later, Stephen Hawking believed that this taskwas finallyaccomplished: “M-theory is the unified theory Einstein was hoping to find” (Hawking 2010). M-theory is a variant of the string theory. Let us have a look at the path that led to this theory.

3.1.Gravitation and creation of the universe

Stephen Hawking states that “because there is a law such as gravity, the universe can and will create itself from nothing” (Hawking 2010). Gravitation was interpreted in different ways.Newton understood gravitation as a two-body interaction. Each two bodies, whether close to or far from each other, attract each other. However, he could not explain how two objects, e.g. Earth and Moon, that are far away from each other could apply forces on each otheracross empty space. Einstein brought a comprehensive answer to this dilemma by advancing the concept of spacetime continuum. Bodies are dynamic inside a grid of three space dimensions and one timedimension. Thisconceptualized 4D grid in empty space is deformed by heavy objects like black holes, stars and planets. The spacetime continuum is an elegant physical answer to Newton’s concern.

However,Newton’s two-body interaction could be formulated by a field approach similar tothe electromagnetic field approach. Let us suppose that at time t_0, two planets (or stars) with the same mass are suddenly created. Each gravitational field will propagate radially with the causality speed (speed of any massless entity like photons, gluons, and fields) outwards as indicated by dashed arrows in Fig.1. Let us suppose that between the two planets and exactly in the middle of the axis joining both centers of the planets there is an object O_1. The fields at object O_1 cancel each other. However, this mutual cancellation does not prevent them from continuing to propagate. For example, object O_2 is also attracted by mass $m_1$even though field 1 was cancelled before at O_1. In other words, field 1 was not eradicated physically and forever at object O_1. What happened instead is that its effects were neutralized by field 2, emitted by m_2, which is acting with the same strength but attracting in the opposite direction. We obtain a field that is the 3D vector-wise sum of both fields.One can also consider the time dimension to obtain a 4D gravitational grid like the 4D spacetime continuum,however,the speed of a moving body has no effect on time in the 4D gravitation grid.

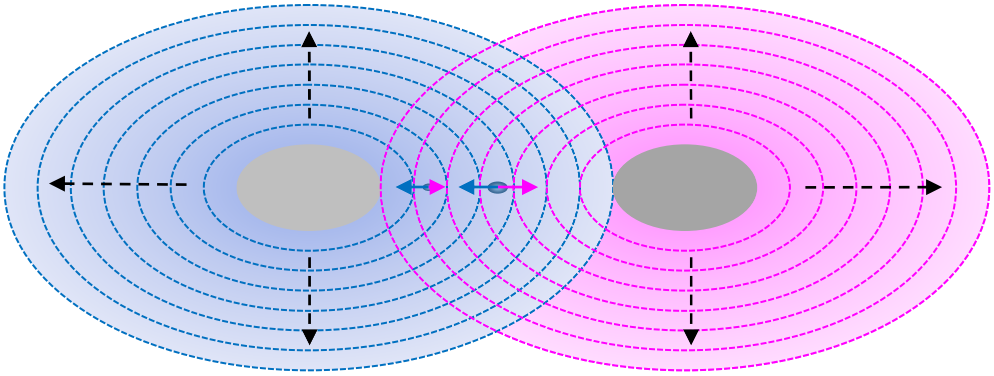

Fig. 1: Gravitational fields of two identical planets (or stars). The fields at object O_1 cancel each other, but this does not prevent them from propagating. Object O_2 is also attracted by the mass m1,even though field 1 was cancelled before at O_1.

However, the centrifugal inertia should be taken into account. When an object of mass *m* rotates around a center it exerts an outward radial force called centrifugal force *F*:

$$F = m\frac{v^2}{r} \tag{1}$$

where *v* is the tangential velocity at radius *r* on the rotating object.

In summary, Newton’s inquiry as tohow a body could exert influence on a distant body, across empty space could be answered by Einstein’s spacetime continuum as well as by the field scheme of Fig. 1. In contrast to special and general relativity, Newton’s field formulation is not Lorentz invariant.

3.2.Einstein’s relativity

While there is scientific consensuson Einstein’s theory of relativity (Hawking 2010), some paradoxes remain unsolved, including the twin paradox.Suppose that a twin, A, travels in space at a very highspeed,*v*, nearing the speed of light, according to Einstein’s special relativity, they will return home to find that their Earth-bound twin, B, has aged more. Conversely, taking A’s spaceship as a reference point,B could be perceived to have traveled at speed -*v*. Let us have a look at thetime dilation formula:

$$\Delta T' = \gamma \Delta T = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\Delta T \tag{2}$$

Where D*T*’ is the time on Earth, D*T* is the time in the spacecraft, and *c* is the speed of light in vacuum.

We can clearly see from the formula that the time dilation factor g does not depend on the direction of travel. In other words, whether a twin travels at speed *v* or -*v*, they will be younger than the static twin. Therein lies the paradox, how can each twin, A and B, be both younger and older than their twin?

Attempts to solve this paradoxhave often deviated fromthe crux of the experiment. It has been said, for instance, that the situation is not appropriately treated by special relativity because before arriving to the constant speed *v*, an acceleration is necessary. Similarly, to land on Earth a deceleration is necessary(Debs 1996). Others appeal to the fact that in order to return to Earth, the spaceship must change direction, violating therefore the condition of a steady straight-line motion. Essentially, special relativity cannot be applied(Miller 1981). Instead, this scenario must be governed by the laws of general relativity.

These explanations do not give a convincing answer because we can conceive of experiments that avoid issues of acceleration, deceleration and changing direction or apply these operations on both twins equally so as to not make a difference.

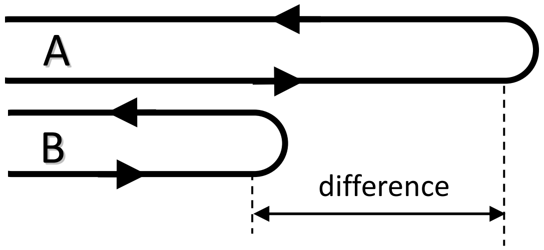

Fig. 2: The twins A and B travel forth and back through two similar circular and straight segments, but A travels a longer path. Unlike B, A additionally travels the segment “difference” back and forth.

Let us consider that the twins A and B travel according to two paths, Path A and Path B respectively, as illustrated in Fig. 2. The twins travel forth and back through two identical paths, except for two segments labeled by difference in Fig. 2. As such, A travels a longer path, as,unlike B, they must additionally travel the segment “difference” back and forth with a constant speed of an absolute value |*v*|. Again, the sign of the speed (*v* or -*v*) is not important in Equation (2) for time dilation. Both twins identically experience acceleration, deceleration anda change of direction. This begs the question, in this scenario, which twinwouldbe younger, bearing in mind that Ahas additionally traveled the segment “difference,” respecting the condition of steady straight-line motion central to special relativity?

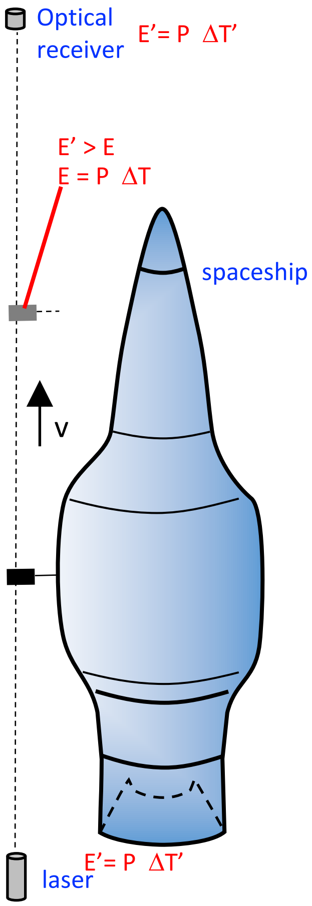

Fig. 3: An optical receiver is attached to a spaceship traveling towards a second optical receiver at a speed close to the speed of light parallel to a light beam emitted by a laser source.

Another paradox is illustrated in Fig. 3. The laser with power *P* emits the energy *E*' = *P*D*T*' during the time period D*T*'. If there is no spaceship, the optical receiver, a photodiode for example,will receive the total amount *E*' during the time period D*T*'(Hamam 2017a and b). The situation is different if a spaceship travels between the laser and the optical receiver at speed *v*. A second optical receiver is attached to the spaceship as depicted in Fig. 3. If the spaceship is static (*v*=0), then the second optical receiver will receive the total amount of energy *E*' during the time period D*T*'.If the spaceship moves at speed *v*, nearing the speed of light*c*, then the second receiver will only receive Energy *E* = *P*D*T*, although the laser will emit light with energy *E*'= *P*D*T*' during the period of time D*T*'. The relativistic time period D*T* and the terrestrial time period D*T*' are related by Equation (2). The principle of conservation of energy would hence be violated as:

$$\frac{E}{E'} < 1 \qquad (3)$$

The amount of energy D*E* = *E*' - *E* is missing.

One could argue thatsince the received energy is transformed to thermal energy by the receiver, conventional thermodynamics does not apply anymore. Instead, one should apply relativistic thermodynamics.Now, if energy is transformed into another kind of energy, say electric energy, one will find another theory to justify it. Essentially, we are justifying an unjustified theory by advancing an additional unjustified theory. One of the ways to explain the missing energy is to argue that it has drifted in extradimensions, as we will see later.

In conclusion, Einstein's theory of relativity is a theory that is supported by some physical experiments, but is still no stranger to paradoxes, while theories such asstring theory are strictly based on mathematics and intuitions. Should we not address the existing paradoxes of commonly accepted theories, such asthe theory of relativity, before diving into unchartered territory? Ultimately, no structure, however impressive it appears, is sustainable if it stands on a shaky foundation.

3.3. Multiverse

Einstein's theory of relativity was intended as a tool among many to better understand the universe. One of the earliest questions relating to the topic asks whether our universe is the only universe there is. The idea of parallel universes or many-worlds is not new; its origins can be traced back tothe classical antiquity (Sedacca 2017).Philosophy and religion have often exploredparallel worlds that supposedly interact with us. Religions, however, rely on faith rather than philosophical tools to justify this concept. In contrast to metaphysics, they are not concerned with all possibilities, as we will see below. In some religions, deities and supernatural entities are believed tolive in parallel worlds. Moreover, many religions incorporate the notion of the after-life, which would see human souls enter different universes, including the heavens or hell. Essentially, the unseen is central to many religions and theism, after all, faith need not be confined to the observable.

But it cannot be said that what remains unseen is *scientific*; the existence of something must be experimentally proven. In fact, it seems that the scientific community has come to see thereligious belief in unobservable worlds as obscurantist. Of course, exceptions exist. Hugh Everett has defendedthe idea of parallel worlds from a scientific perspective, applying namely quantum physicsto advance his many-worlds interpretation (MWI) in 1957 (Everett 1957).With the discovery of quantum decoherencein 1970s, MWI has steadily gained popularity to now become a mainstream interpretation of quantum decoherence(Osnaghi 2009).The dimension of time is regarded as a tree with many branches resembling a butterfly graph. Every possible quantum outcome creates a branch (DeWitt 1968), which results in an immensenumber of universescreated(Osnaghi 2009).

But are these universes observable? Of course not. This constitutes a big jump from science to pseudoscience and deviates from the intellectual revolution led by the likes of Descartes, Snell, Grossteste, Ibn Al-Haytham, Ibn Sahland Archimedes (Hamam 2020). Everett's MWI is not founded on any principle of physics; rather it builds intuitive arguments against a background of quantum physics.

The multiverse theory is among the first attempts to infiltrate the notion of parallel worlds in the scientific conscience.In doing so, the line separating metaphysics from physics has been blurred.While science has rightfully resisted extradimensions theories propelled by religion as unobservable and hence unscientific, it has allowed this concept to serve as the backboneof most modern cosmological theories, such as multiverse,string theories and M-theories.

3.4. Extradimensions

In the pursuit of the theory of everything, the string theory (Greene 2010a)emerged as a promising avenue. Some attempts were conducted to delineate the three fundamental forces of the universe,namely electromagnetic, weak nuclear and strong nuclear forces,as Einstein did for the force of gravitation (Ross 1984).Theodor Kaluzaand Oskar Klein advanced what was later referred to as the Kaluza–Klein theory. In 1918, theyformulated field equations in five-dimensional space-time(Wuensch 2009), introducing an additional dimension. To give scientific meaning to unobservable extradimensions, Klein argued that extradimensions do exist physically but are curled up and very small (Deser 1977).String and M-theorieshave also adopted this illustration.

<u>Statement 1:</u>Klein's idea was illustrated by Brian Greene as follows(Greene 2010a). Let us imagine a long cable. From a distance, itappears to be a straight line to the human eye and hence one-dimensional. But for an ant, things appear different. The ant can not only move along the length of the cable, but also around its girth. And so, the ant sees and experiences a new dimension.But is this *really* the case?

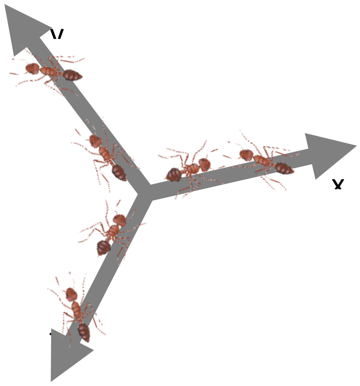

Fig. 4: Three ants are movingalong the length ofthree perpendicular cables, and three other ants are rotating around their designated cable's girth.

Now, let us expand this analogy to three dimensions. In Fig.4, we see six ants moving on three perpendicular cables. The three (x,y,z) axesrepresent the dimensions of our 3Dspace: left and right, upward and downward,and forward and backward, respectively. As depicted in Fig.4, while three ants are moving along the length oftheir designated cable, three other ants are rotating around the girth of their designated cable.

Criticism 1: It is clear that all six ants are moving inside a 3Dspace.The three curves along which the three ants are rotating are not independent from the three lines along which the other three ants are moving. Klein and Greene argue that such curled dimensions are small, andare hence only observable from a close distance. But it does not matter if we can see them from afar or up close, ultimately, no ant has left the 3D space.

The string theory states that there are subatomic entities, referred to as "strings"smaller than the quarks, neutrinos, gluons, photons and gravitons. They are minisculethin filaments of energy that represent the constituents of matter and particles, such as protons, electrons, quarks, gravitons, neutrinos, photons, etc.Astring dances, twists, turns and vibrates in ten or more dimensions and in different patterns to produce different types of particles. A string is the DNA of the particle and therefore of the universe. Eachshape of string is associated to one universe. Given the huge number of shapes (mathematical solutions), this theory predicts the existence of more than 10^{500} universes. We can hence see how the multiverse theories are connected to string theories.

Are there any physical observations of strings? None; strings are pure mathematics. Do strings meet the threshold necessary to be considered a physical theory? No; they are merely a metaphysical elaboration of hypothesized but unobservable dimensions. Is the "science of strings"*truly* science? No; it is in fact, as we shall see later, pseudoscience.

4. Dark matter, dark energy and dark radiation

4.1.Dark matter

Dark matter is an unobservable substance that represents about 27% of the energyin the universe. Atoms make up about only 5% of the universe, while the rest,that is 68% of the make-up of the universe, is dark energy(Trimble 1987).Dark matter does not interact with ordinary matter. Moreover, it does not emit electromagnetic waves, including radio waves, light and X-rays or radio waves. Nor does it reflect or absorb these radiations. Therefore, it is not directly detectable. However, dark matter produces gravitational effects that are measurable on large entities such as galaxies (Hamam 2020).

Statement 2:Dark matter has a mass like ordinary matter, but whatis it*really*? Scientists believe that dark matter might be composed of subatomic particles that we do not yet know about. It is worth noting that ordinary matter is composed of atoms built of protons and neutrons. One family of the hypothetical subatomic particles forming dark matter is the family of Weakly interacting massive particles (WIMPs). These particlesare presumed to have been produced in the early phase of the universe(Trimble 1987). But the failure to find WIMPs has pushed scientists to consider other alternatives. Presently, a particle called axion is the most popular candidate.

Criticism2:Some scientists question the existence of dark matter or even the need for its existence. Supposed evidence for the existence of dark matter could be explained otherwise. For example, some scientistsadvanceda hypothetical mechanism referred as the Modified Newtonian Dynamics (MOND).This hypothesis is conceived to explain why the velocities of stars in galaxies were observed to be larger than expected based on conventional Newtonian mechanics (Milgrom2014). This is a prime example of the overreliance on non-physical theories, wherein a completely hypothetical theory has been opposed by an equally hypothetical theory.

Attemptsby astronomers to establish the nature of dark matter havebeen in vain.The current main approach is one of elimination, wherein all candidate particles which cannot constitute dark matter are discarded in the hopes that only one candidate remains.

4.2.Dark energy

Like dark matter, dark energy is not directly measurable. However, unlike dark matter, dark energyhas no measurable effect like the gravitational field.

Statement 3:According to Alan Guth, gravity may act in reverse. It is referred to as repulsive gravity (Guth 1997).Positive pressure creates an attractive gravitational field, whereas negative pressure creates a repulsive gravitational field. The latter is the driving force behind inflation.It is worth noting that negative pressure occurs when the enclosed area has a lower pressure than the surrounding area.This inflation theory predicts that the cosmic microwave background should contain some thermic energy remnant from an earlier stage of the universe. In 2003, accurate measurements of the large scale angular fluctuations in the cosmic microwave background turned out to be largely consistent with those predicted by Alan Guth's theory of inflation(Bennett 2003).

Scientists had hypothesized that the speed at which the universe expandswould gradually decrease because of the attractive gravityapplied by the galaxies. However, it was observed that the inflation of the universe is in fact speeding up. Before elaborating on this point, let us first discuss scientists'predictions.

Criticism3:As mentioned above, the universe did not expand in an empty space. In other words, the space did not exist before the universe. Rather, the universe and space share a relationship of causality, wherein the expansion of the universe is the cause behind the existence of space. Space itself expands with time everywhere. Einstein's spacetime continuum also expands "with" space. The relationship of causality is that space is the cause of spacetime continuum (4D grid). Heavy bodies like planets, stars and blackholes deform the spacetime continuum. The relationship of causality is that the heavy bodies are the cause of deformation of an existing spacetime continuum. In other words, the 4D spacetime grid exists and is automatically deformed once a heavy body is created. Causality has a finite speed which is identical to the speed of light in vacuum.Therefore, heavy bodies cannot slow down the expansion of the universe, as the space is far ahead on the grid, and the limited speed of causality cannot be reconciled with the theory of accelerated expansion.

Statement 4:Against the background of causality, the following theory is proposed. There should exist a force – therefore energy –that counteracts attractive gravity and pushesplanets, stars and galaxies apart.This energymust exist in the expanding space. Since this energy remains unobservable, scientists have called it "dark energy".

Criticism4:The notion of unseen energy affecting our universe is very familiar to many religions, which perceive unseen energy as God orgods, the creator(s). Some religions advance the belief that the creator gave power to entities, called "angels," to maintain the universe. According toa number of religions, the universe is not autonomous. It is created and maintained by an external force or energy, believed to be God or gods. This force is not part of the universe, rather it is independent from it, and much more powerful. This force is not blind; rather it is a consciousdecision maker – the intelligent designer of the universe, including species.

Statement 5:When contemplating whether theories such as multiverse can find their place in metaphysics or whether they are merelyphilosophical theories or religious beliefs, Leonard Susskindconcluded that "physicists tend not to ask those questions. They just say: let's follow the logic. And the logic seems to lead there." (Greene 2011).

Criticism5:This line of thinking is not foreign to philosophies or religions (Greene 2015).However, a philosopher develops one's thoughts based on a philosophical approach by using logic and innate information, something cosmologists today neglect to do.If scientists do not bother to ask whether a theory belongs to science, or philosophy, or religion, how do they know which "logic" or methodology to follow?

When elaborating a theory that faces an impasse because it does not agree with reality, if we simply resort to fill these voids with unobservable or "dark" matter, then what is left of science?

Statement6:Where does this dark energy come from and where does it reside? Einstein was the first to predict that empty space is not truly empty (Nasa 2020). Rather, it holds its own energy. This energy is not of nature to be diluted as space inflates and is a property of space itself. The more space comes into existence, the more of this energy comes into existence.

Criticism6:Space is a kind of God, the creator. It expands and creates energy. Space makes energy come into existence and grow. Space, the creator, breaches the principle of energy conservation.

Statement 7:Scientists advance that a force called vacuum pressure is caused by fluctuations inside the fabric of space-time. These fluctuations occur at the sub-atomic level, the quantum level. Calculations of these quantum activities have set vacuum pressure at a forceastronomically (10^{120} times)larger than the one observed by astronomers when studying the force that pushes galaxies apart (Nasa 2020). The issue is that a significant quantity of dark energy would remain unaccounted for, and its supposed consumption during the expansion of the universe unexplained.

Criticism7:What then is this huge amount of energy used for? To answer this question, scientists have turned to the multiverse theory. Assuming that more than one universe exist, it follows thatthis enormous quantity of dark energy governs other universes, while ours consumes a significantly smaller quantity.Essentially, it has become a reflex to turn to unobservable phenomena when an impasse arises.

Statement 8:Some scientistssubscribe to the theory of"quintessence" dark energy. Unlike the energy of space envisioned by Einstein, quintessence is space and time-varying (Caldwell 1998). Quintessence can be either attractive or repulsive. It has been hypothesized that quintessence became repulsive about 3.5 billion years after the Big Bang(Wanjek 2020).

Criticism8:In antiquity,it was largely believed that the earth was made up of four elements or essences: earth, air, fire, and water. However, stars and planetswere composed of yet another essence. In other words, this fifth essence presents the energy of the cosmos or space. Later in the medieval era, this element was calledthe "fifth essence" or in Latin *quintaessentia*(Gibson, 2004). While this theory was eventually disproven,the term "quintessence"was subsequently used to denotethe purest essence of a thing. By the end of 20th century,it became largely associated with "dark energy," that is, almost 70% of the energy in the universe.But is there any scientific ground forquintessence? Quintessence remains as unproven today as it was in antiquity.

Statement 9:In the framework of general relativity, Einstein's field equations relate the geometry of space-time with the distribution of matter within it:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu} \tag{4}$$

where the Ricci tensor/scalar *R* and the metric tensor *g* describe the structure of spacetime. The stress–energy tensor *T* describes the energy and momentum density and flux of the matter in that point in spacetime, and the universal constants *G* and *c* are conversion factors that arise from using traditional units of measurement. The cosmological constant Λ is the energy density of space or vacuum energy. In other words, it is dark energy and quintessence. The cosmological constant, as expressed by Einstein, does not explain the acceleration of the expansion of the universe. And hence, it should be modified.

Criticism 9:Einstein believed in a static universe. He included the cosmological constant as a term in his field equations for general relativity. Because gravity would cause thecontraction of the universe, that was initially at dynamic equilibrium, the cosmological constant comes to act against this contraction (Rugh 2001). However, the universe turned out to be dynamic.Einstein called the cosmological constant the "greatest blunder of my life." (Lemonick 2011)As such, the current equation cannot stand. And yet instead of rethinking the entire concept, some scientists suggest that Einsteindid not miscalculate. Even so,we now know that the expansion of the universe is accelerating. Hence, the equation should be formulated again without integrating Einstein's constant. One proposal is to modifyΛ, to a positive or negative or even zero value. If Λ equals zero, any error in calculation, however minimal, may make Λ either positive or negative, which would present two completely different situations. It seems that the current reflex is to modify and remodifyimplausible theories rather than rethink their foundations.

Our scientific models of inflation are of nature to lead to a flat universe. Therefore, our universe will also expand forever. But if our universe is actually closed, these modelsshould be modified.

Statement 10:Is the existence of accelerated expansion, and therefore dark energy,accepted unanimously? In the last two decades, intensive research was conducted to confirm acceleration and hence dark energy. The mainargument in favour of this theoryrelies on the baryonic acoustic oscillations (BAOs) in the cosmic microwave background (CMB). These oscillations are assumed to originate from the early phase of the universe, that is, around the first 380,000 years after the Big Bang. Proponents of the acceleration theoryargue that, at present, the average distribution of galaxies rigorously reflects the size of the BAOs in the CMB. In 2011, a Nobel Prize in Physics was awarded to three astronomers "for the discovery of the accelerating expansion of the Universe through observations of distant supernovae." (Perlmutter 2011).

Criticism10:Despite the intensive research to confirm the accelerating expansion of the universe, some scientists remain unconvinced and this, with valid reason.Firstly, quantum field theory-based calculations give a value that is 10^{120} times larger than the energy thathas beeninitially estimated. Given this enormous value, dark energy should have expanded space so fast that individual atoms would have been separated and dispersed in large distances. As such,matter, planets, stars and galaxies would not have been able to form. Given our existence and that of all matter in this universe, a fundamental gap exists in this theory.

Moreover, Tutusauset al. found no evidence for acceleration in BAO data used by proponents of the acceleration theory. They concluded that "without the standard assumption that supernovae intrinsic luminosity is independent of the redshift, low-redshift probes are consistent with a nonaccelerated universe." (Tutusaus 2017).

Furthermore, researchers from Oxford University used a dataset composed of 740 Type Ia supernovae and found no evidence for acceleration (Nielsen 2016). In fact, the data is consistent with a constant expansion rate.

Finally, some researcherstheorize that the accelerated expansion of the universe isin fact an illusion caused by the motion of our galaxyin relation toothergalaxies (Wolchover 2011, Tsagas 2011). Others do not exclude the possibility that the acceleration theory has relied ona supernovae sample size that is not large enough(Nielsen 2016, Gillespie 2016).

4.4. Dark radiation

Like dark matter and dark energy, dark radiation is not directly measurableor even understood. In cosmology, photons mediate electromagnetic interactions between particles in baryonic matter (Standard Model). Similarly, hypothetical dark radiation is presumed to mediate interactions between hypothetical dark matter particles (Ackerman 2009). Like the hypothetical dark matter particles, the hypothetical dark radiation does not interact with particles according to the Standard Model.

5. Science or pseudoscience

It is important to draw a line between what *is*scientific and what merely *appears* scientific, that is pseudoscience. This distinction tackles the fundamental question ofhow do we know whether something is true?It does not suffice to say that something is true because our powers of observation tell us so.

Scientific philosopher, Karl Popper, explored thisquestion for several decades. He investigated which thought process should guide the scientific method.Among other objectives,he sought to understand what truly constitutes an explanatory theory(Popper 1962).For Popper,the main difference between science and pseudoscience is manifested at the level of attitude. According to him, while pseudoscience seeks to find confirmations, science is looking for falsifications (Popper 1962). Put differently, pseudoscience consists in advancing claims first and looking for evidence second. Science, on the other hand,seeks to not only advance claims,but also to challenge them andlook for evidence that maydisprove them(Stemwedel 2011).

Statement 11:Let us consider, for example,the string theory, which is based on extra-dimensions. Brian Greene states that researchers are trying to prove the existence ofsuperpartner particles by using the Large Hadron Collider. Since superpartner particles are conceived to travel in extra-dimensions, the experiment using the Large Hadron Collider, if successful, would serve as confirmation of the existence of extra-dimensions. But according to Popper, this attitude is not scientific. Could we prove that the statement of the existence of extra-dimensions is false?Greene himself insists that "even if superpartner particles are not found by the Large Hadron Collider, this fact alone will not rule out string theory, since it might be that the superpartners are so heavy that they are beyond the reach of this machine as well." (Greene 2010b). It is clear that such an attitude is one ofpseudoscience rather than science.

Criticism11:In response to Green's stance, Reiner Hidrichargues that "such an argumentation is certainly in no way acceptable for a physical theory. Most ironical in this case is the fact that a shortcoming of the theory, the inability to make quantitative predictions, is used as a strategical advantage for its self-immunization. This is probably something new in physics." (Hedrich 2007).

Moreover, Greene's approach cannot be applied discriminately. The self-immunization granted to the theory of strings, multiverse, extra-dimensions should then also applyto supernatural entities, such as angels, souls, devils, etc. It is impossible to prove that angels do not exist since they have extra-universal properties and travel in extra-dimensions. Researchers such as Greene would likely agree that science cannot integrate theories about angels or devils, and hence it is equally estopped from inauguratingtheories that remain refutable such as multiverse. Such concepts are pseudoscientific.

As Popper puts it, "scientific theories cannot be verified but only tentatively refuted, and that the best philosophy is about profound problems, not word meanings" (Stemwedel 2011). Scientific claims are said to be falsifiable when we canspecify what observable outcomes would be impossible if the claim were true.However, pseudoscientific claims fit within any imaginable set of observable outcomes. It does not suffice to observeone million white rabbitsto reach the conclusion that *all*rabbits are white.However, it is enough to observe a single blackrabbit to refute this claim. Now, if a proponent of the theory that all rabbits are whiteargues that the black rabbit is not a rabbit but rather another animal that resembles a rabbit,then the theory is irrefutable and therefore pseudoscientific. The aforementioned quote by Greene is embedded in the same spirit – all that is not a white rabbit is not even a rabbit, and therefore all rabbits *are* white.

6. Science or bad philosophy?

6.1.Metaphysics and science

According to the philosopher Edward Jonathan Lowe, metaphysics is (a) the science of the possible and (b) the science of essence(Lowe 1998).Concerning the first prong, metaphysics does not tell us what exists (or what must exist) but rather what *may*exist (or what is *possible*). In other words, metaphysics exposes all possibilities and science investigates these possibilities through empirical methods to determine which one among them is actual. Hence, metaphysics precedes science and the empiric approach. Since metaphysics is concerned with possibilities, it is open to the theory that many universes *may* exist. But the multiverse theory can only become scientific once it has proven through an empirical approach that more than one universe must and hence do exist.Similarly, strings are possibilities but not scientific realities. For now, they are confined to the corridors or metaphysics and philosophy, and it is up to scientists to advance the necessary empirical evidence in favour of their existence and hence transport such theories from the realm of pseudoscience to that of science.

*6.2.*Misunderstanding philosophy

Statement 12:In the *Grand Design*, Leonard Mlodinow and Stephen Hawking pronounce philosophy dead(Hawking 2010):

"Living in this vast world that is by turns kind and cruel, and gazing at the immense heavens above, people have always asked a multitude of questions: How can we understand the world in which we find ourselves? How does the universe behave? What is the nature of reality? Where did all this come from? Did the universe need a creator? Most of us do not spend most of our time worrying about these questions, but almost all of us worry about them some of the time.Traditionally these are questions for philosophy, but philosophy is dead.

Philosophy has not kept up with modern developments in science, particularly physics. Scientists have become the bearers of the torch of discovery in our quest for knowledge."

Criticism12:While the book is full of philosophical views, the authors declared philosophy obsolete. Among others, the authors appealed to multiverse theory as well as M-Theory and discussed at length metaphysical problems of being. Knightsbridge professor of philosophy at the University of Cambridge, Tim Crane, commented that Hawking himself proved that philosophy is unavoidable, since he relied heavily on philosophical takes. Unfortunately, these amounted to "bad philosophy, because he is unaware of it as a discipline and a practice with a history"(Reisz2015). Moreover, to defend the multiverse theory is to engage with metaphysics and science. If philosophy had indeed died, then the multiverse theory is proof of its renaissance.

Philosophy provides scientists with the tools necessary to guide and execute an inquiry. Logical and epistemological processes are required in all fields. Besides, if philosophy is dead because science now bears "the torch of discovery in our quest for knowledge," then what about ontology,epistemology and particularly ethics, which are often concerned with what precedes knowledge?

In Hawking's and Mlodinow's defence, given that they were writingabout the nature of reality, they may have used"metaphysics" and "philosophy" interchangeably.But even then, their argument misunderstands metaphysics completely given that the former is concerned with possibility, something that multiverse theories and M-theory remain confined to. As discussed above, the distinction between science and pseudoscience is an important one and remains central to the philosophy of science. Science is philosophical because its tools and parameters are defined by philosophy. Professor of the history and philosophy of science at the University of Leeds, Greg Radick, points out that "three of the most powerful scientific thinkers – Charles Darwin, Albert Einstein and Noam Chomsky – were also notably philosophically literate" (Reisz 2015).

6.3.Exploring science without philosophical tools

Statement 13:Hawking and Mlodinow argue that(Hawking 2010) "because there is a law such as gravity, the universe can and will create itself from nothing".

Criticism13:This argument is not logically sound and ironically only confirms the necessity of philosophy in shaping the scientific mindset. First, to suppose "there is," is to suppose existence. Second, if "there is" a "law," then there is"something."After all, a law cannot be "noting." Third, if the law of gravity exists, then gravity must exist. Fourth, to say that "the universe can" means that the universe exists *and* has the capacity to doing something. And yet surprisingly, Hawking and Mlodinow can only see "nothing."

Statement 14:B. Lemley stated that (Lemley 2002) "the universe burst into something from absolutely nothing – zero, *nada*. And as it got bigger, it became filled with even more stuff that came from absolutely nowhere. How is that possible? Ask Alan Guth. His theory of inflation helps explain everything."

Criticism14:But how can inflation be nothing – zero, *nada*?Inflation is a cause; it causes the expansion of the universe in an accelerated way.It obeys equations. We can describe it,we can calculate andwe can determine its properties. As such, it is not *nothin*g. Nothingness cannotbe described or calculated, nor can its propertiesbe determined, because it does not exist – it is inexistence.

Statement 15:In his book,"A Universe from Nothing," (Krauss 2012) Lawrence Krauss explores, among other phenomena, quantum fluctuation, ruled by Heisenberg Uncertainty Principle, and how it caused the creation of the universe*from nothing*.

Criticism15:According to Krauss, nothing – that is quantum fluctuation – caused the creation of the universe,which supposedly has no cause.Essentially, the Heisenberg Uncertainty Principleis also nothing. Moreover, a quantum fluctuation of the vacuum assumes that there was a vacuum of some pre-existing space. Vacuum is very different from "nothing." Vacuumhas energy and tension, it can bend and warp, and so it is unquestionably something. Furthermore, where there is fluctuation, there is something that fluctuates. Fluctuation hence inherently excludes the notion of nothing.

Statement 16:Paul Davis statesthat (Davies 1983)"spacetime could appear out of nothingness as a result of a quantum transition […] Particles can appear out of nowhere without specific causation […] the world of quantum mechanics routinely produces something out of nothing."

Criticism16:Quantum mechanics cannot produce something out of nothing. Quantum fluctuation presupposes that there was something which does the effort offluctuation. As such, two candidates present themselves: matter and antimatter. If an empty field has the potential to give rise to vegetation – a potential it actualizes – then it cannot be said that "vegetation sprang from nothing."The potential itself is something.

Statement 17:Hawking states that(Hawking 1996)"the idea of inflation could also explain why there is so much matter in the universe […] The answer is that, in quantum theory, particlescan be created out of energy in the form of particle/antiparticle pairs. But that just raises the question of where the energy came from.The answer is that the total energy of the universe is exactly zero."

Critics 17:But what makes zero a special number?Hawking does not provide any calculation that justifies the fixed zero value. Presently, no human being can possibly determine the precise energy of the universe. To verify theclaim that the total energy of the universe is exactly zero, we have to account for all the forms of energy in the universe, including gravitational potential energy and the relativistic energies of all particles.

Statement 18:Kraus said "nothing is not nothing anymore in physics, it is particles."

Criticism18:And yet central to the works of Krauss and Hawking are theories of universes springing out of nothing, the properties of nothing and the categorization of nothing, among other similar topics. Clearly, the word "nothing"has been used too loosely. Nothing denotesthe absence of anything, it is inexistence.

Thefirst major issue with these worksis that they defend the thesis that the universe sprang out of nothing by assuming complex principles, topologies and theories as well as physical entities, such as particles, dark matter and dark energy, while neglecting to scientifically authenticate the foundations of such theories. The second major issue is that they consider this arsenal as "nothing." Considering the complexity and volume of this arsenal, it is surprising that it has been labelled "nothing," and this "nothing" has since become the protagonist of a multitude of books.The third major issue is that they advance unverifiable statements and values.Another major issue is thatvery little attention is given to defining the universe in the first place.

7.Conclusion

All scientists agree that the universe exists and is governed by laws, such as the principle of conservation of energy. But in the quest to understand the universe and its origins, many scientists have resorted to non-physical or unprovable assumptions to fill the voids of now mainstream theories of everything. This has led to the excessive and improper reliance on the descriptor "dark." Problematically, given that many of these theories serve as a foundation for other theories, their valid criticism has been arduously rejected by the scientific community. Einstein's theory of general relativity serves as a prime example.

The increasing tendency to plunge into unmeasurable assumptionshas overwhelmed science with pseudoscientific theories.To name just a few, the theories of the multiverse, strings and membranes do not embody the spirit of science. They are premised on emotionally appealing assumptions that have been normalized, but not proven, as factual. Pseudoscience is guided by an approach that seeks to advance a theory first, and look for evidence to support it second. Moreover, pseudoscience is indifferent to the possibility of disproving theories, a condition central to science. Pseudoscientific theories often integrate scientific principles discriminately and paradoxically depending on their benefits to the validity of the theory.For example, it incorporates the principle of causality and the fact that events occur according to principles and rules. And yet, it advances that quantum fluctuations created the universe from the Heisenberg Uncertainty Principle and the ability of pre-existing particles to fluctuate, that is, inconsistently, *nothing*. Scientific theories must have a solid foundation builtby measurable elements, rather than intuition or abstract mathematics, and their elaboration must be guided by philosophical tools. A physical theory must be the result of a planned theoretical development. It must also originate from obvious physical problems or from an empirical dataset. Otherwise, science will become a battleground for endless hypothetical and abstract theories, with no surer loser than the real scientific debate – that is, the debate of experimental science theories that has culminated to our present scientific and technological world.As such, it is incumbent upon many scientists to break away from pseudoscience and uproot their hostility against philosophy, for the price to pay is *immeasurable*.

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