Revista Brasiliense de Engenharia e Física Aplicada

Vol. 8 Suplemento - Janeiro 2023

Filosofia da ciência:
De volta a Kant

ISSN 2526-4192

Revista Brasiliense de Engenharia e Física Aplicada
(desde 2016)

EDITORS' FOREWORD

We live in a "civilization of the spectacle", as Vargas Llosa's criticism points out. The hedonism that has marked humanity's choices has brought harmful consequences to what we once called "culture", huge outcomes apparently irreversible in its most forceful aspects. This is what the current stagnation of scientific thought shows — particularly in physics —, deceitfully masked by the technological machinations engendered by illusion merchants, who infantilize society with trinkets that, in the worst possible scenario, make us mentally numb and incapable of creating and contributing to a better world.

In an excellent paper, Luigi Foschini [1] presents his critical version of what is happening with the physics of our time:

"*Surely, during the latest three-four decades, there were important experimental or observational results, such as the W±, Z, and Higgs bosons, the gravitational waves, the quantum teleportation, the acceleration of the expansion of the Universe, but the theory was developed many years earlier in all the cases.*"[1, p.1]

He continues on the stagnation of physics, referring to relevant publications from a colleague:

"*Sabine Hossenfelder[1,2] wrote about this stagnation many times and the title of her book is exemplary: Lost in math[3]. Hossenfelder denounces, among other things, the dramatic lack of philosophy among her theoretical colleagues, which leads them to consider exclusively the mathematical technique and its beauty. String theory is one clear example, but it is also sufficient to take a look at the works published in recent times to note a complete detachment from physical reality, not to mention the closure in a world of fantasy*."[1, p.2]

Despite all the richness of the article, which is indispensable reading, it is still worth reproducing a last fragment:

"*Science is a technique plus a philosophy: the science-zealot is not only convinced to do science by renouncing philosophy, but also thinks that techno-science must be applied to all the human knowledge. To understand what monstrosity this mutilated science can generate, it is sufficient to remind the scientism-based programs of palingenesis of the human species operated by the Nazi-Fascist and Communist dictatorships in the twentieth century*."[1, p.3]

Physics has become, in fact, one of the best examples of the deleterious effects of the current post-modern civilization; no philosophy, no creativity and no motivation. Then, with a neocritical philosophical outlook, Professors Serpa and Veras bring to the public an interesting study, resuming Kantian thought in an original approach to a crucial topic for contemporary physics and for modern cosmology. Also, the authors offer a serious constructive criticism of our way of life. We believe the reading of this article will awaken important

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[2] Hossenfelder, S., The crisis in physics is not only about physics. *Backreaction*, October 30, 2019.
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reflections both in philosophers and physicists, hoping we can start a new cultural beginning.

The Editorial Team CALIBRE

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CALIBRE ACESSO ABERTO
CIÊNCIA, FILOSOFIA E TECNOLOGIA

The Philosophy of Cosmology: Meeting Kant Again

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Scrutinizing the history of mankind, we see that few things truly distinguish us as a "smart" species. One of them is the ability to develop philosophy, that is, critical thoughts that can lead to better ideas. By some distortion of the goals that should guide us to the future with real progress, we are abandoning reflective thinking to give way to the illusions of pure technology. With respect to the heavens, a side effect of this abandonment is that we are at a loss as to the choices of really fundamental subjects in cosmology, which, once treated with due attention, could shed light on minor issues. The point we are discussing here is precisely the type of choice we should make, assuming that spurious choices which do not respond to test programs, even if restricted, are excluded.

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1. Introduction

Never has philosophy seemed so fundamental to science as in the last 20 years, in particular to cosmology and astronomy in general. Although its function as a tool for the improvement of our ideas is currently little discussed, especially among physicists and biologists, a perfunctory appreciation of the problems of contemporary astronomy would suffice to realize the need for a broad reflection on the true state of knowledge today. Well, it is through the philosophical filter that we eliminate inconsistencies and avoid wasting the intellect with unnecessary ideas.

Nothing more appropriate than remembering the celestial origins of philosophy, when men were amazed at the magnificence of the firmament and wondered about its nature. Hegel very well recovered this fact in his wonderful "The Orbit of the Planets" (4):

"*Et laus illa, quae a Cicerone Socrati tribuitur, quod philosophiam de coelo detraxerit, et in vitam domosque hominum introduxerit, vel parvi habenda, vel ita interpretanda erit, ut philosophiam de vita et domibus hominum bene mereri non posse dicamus, nisi a coelo descendat, omnemque operam in eo ponendam esse, ut in coelum evehatur*"[1].

This enchantment with heaven must last forever. Almost daily, the universe reveals to us a new fact capable of shattering our understanding of how things work. Until recently, what we thought was a structural pattern for solar systems in general — with rocky planets closer to the star and gaseous ones further away — is now just a mere example among many others, some with rarefied gaseous supergiants being blown by the winds from their very close primaries. In our neighborhood, mysteries do not cease to sprout, from Mercury's hell — which by the way hides water ice in polar impact craters — to the icy confines where Pluto and the Kuiper Belt debris inhabit. Also in cosmology, recent observational results indicate strong suspicions of inhomogeneity in the accelerated expansion rate of the universe (12). Furthermore, type Ia supernovae [2] may not have their origins restricted to the accretion of matter from red giant binary partners; as there's lots of M dwarf-white binary systems, it is worth asking whether they are also capable of generating type Ia supernovae. Surely, many surprises await us with the arrival of the James Web, as happened with the advent of Chandra, Hubble, Kepler, Spitzer and other engines.

Nowadays, we are often being provoked by observational results to review models and concepts that, if not definitive, at least seemed comfortably satisfactory within the boundaries of our possibilities. So, the purpose of this article is to make a meaningful reflection on the ultimate nature of the universe and on what in fact should consume our intellectual effort, putting aside everything that seems to be in force in the world of fiction.

1. And that praise which Cicero ascribes to Socrates, for bringing philosophy down from heaven and introducing it into the lives and homes of men, either deserves no attention, or must be interpreted like this: that philosophy cannot properly apply itself to life and to the house of men, unless it come down from heaven; and that every effort must be made to bring it back to heaven. (free translation to English by the authors).

2. Formerly considered standard candles for cosmological measurements, it is now known that these events are not strictly standard candles, presenting non-negligible variations in their luminosities. However, it is possible to adjust such variations by a model capable of providing more accurate estimates of distances.

2. New insights on Kant's Critique of Pure Reason

We have before us the fundamental question of objectivity and productive effort to increase cosmological knowledge. In Kant's Critique of Pure Reason, henceforth "KrV" (from *Kritik der Reinen Vernunft*), it will be possible to find elements that help us to avoid ways leading to nothing.

To be complete and persuasive in our dialectical discourse, a full approach to what is meant by cosmology in all its cultural aspects is necessary. From a philosophical and theological point of view, the *sui generis* idea of the cosmological argument appears as a kind of name for the set of families of arguments that seek to demonstrate a first cause or sufficient reason for the existence of the world. Thus, for a religious analysis, most cosmological arguments defend the existence of God. In addition, the formulations of the cosmological argument that go back to the thought of Plato and Aristotle, or even to the medieval Arab thinkers, Jewish philosophers, Thomas Aquinas, Duns Scotus, Spinoza and others, probably built a specific conjuncture of cosmological appropriation so that Immanuel Kant (1724 – 1804) could support his thought. Scientifically, cosmology is a branch of astronomy focused on the study of the universe at large scales, seeking to understand wide structures, their origins and their evolutionary interactions. Fortunately, as a science, cosmology was treated with great rigor by Lemaître and, later, by Stoeger, both priests with deep knowledge in theology. We say "fortunately" because these men showed how science and faith can coexist in the same spirit without interference.

Evoking Kant, trying to unwind the dilemma on the use or not of experience in pure reason, it is interesting to observe Kemp Smith's translation of the KrV, where "[...] There can be no doubt that all our knowledge begins with experience [...]", which does not mean that everything follows from experience (6). Apparently, what Kant wanted to draw attention to was the dependence between the properties of metaphysics and the rational use of the senses. There are elements that are rationally perceived through the senses, not requiring any empirical property for experimentation. This is why *a priori* knowledge is absolutely free from any form of empirical verification, as it can already be rationally admitted through any form of sensitivity (7).

There is some prejudice against the term "metaphysics" — a certain amount of modernist intellectual childishness that falls on some concepts when appreciated by the circles of scientists —, and we believe that clarifications are required (as Margenau well observed (10), "meta" does not mean "anti"). In a broad sense, metaphysics is understood as the innate disposition of the spirit to operate rationally without resorting to empirical support. In this sense, infinitesimal calculus itself is metaphysical — since there is no empirical support for dealing with infinitely small quantities —, as well as the Holy Trinity and a semasiographic language. The intuition of space-time as an *a priori* form of understanding thus constitutes a metaphysical rational perception insofar as all existence is embedded in space and time inseparably. In addition, metaphysics would have as its objective the attempt to search for certain desiderata of reason, in this way, principles "governed by *a priori* laws". It should be said that "the possibility of metaphysics as a science then depends on the possibility of *a priori* knowledge through pure reason" (14). This precisely seems to apply to the four-dimensional spatio-temporal continuum of general relativity.

To give no more than one example in the line of reasoning outlined above, that modernist intel-

lectual childishness also falls on the concept of entropy (see notion of "negative entropy"), perhaps the most misunderstood within the physical sciences. This situation certainly stems from a complete lack of philosophical perspective on the metaphysical rationality of the notion of entropy and the natural irreversibility it expresses. Still quoting Margenau,

"*To many students of science entropy is something very abstract, something closely related to probabilities. This attitude represents an improper approach to thermodynamics, where entropy enjoys the same status as pressure and temperature. The concept would have perfectly good meaning even if probabilities had never been invented and we beseech the philosophic reader to dismiss at this point all associations with bags of mixed-up marbles and decks of shuffled cards if he desires a correct view of things. Entropy is as definite and clear a thing as other thermodynamic quantities*"([11]).

The main problem with understanding metaphysics is that science hates to question what reality is; Margenau himself said, "science will tell us what things are real but will refuse to say what is reality", and later on "[...] the real world comprises all valid constructs and that part of Nature which stands (or stood, in the wider sense which includes historical reality) in epistemic correlation with them" ([11]). So, for metaphysics reality is everything that can be rationally thought of by concepts independently of experience, while experience is everything that can be rationally constructed to give materiality to thought. Hence, the most sublime characteristic of Kant's metaphysics (as an area of knowledge) is the way in which it is subscribed, that is, as a condition for the possibility of establishing itself as a science constituted by pure concepts, a science that includes in itself the knowledge that can be obtained in a different way from experience, based on the rational structures of the human mind. Therefore, Kantian metaphysics, in this case, specifically, presents itself as a possibility of rational science from its conception, constituting itself as a "natural disposition of reason"[3] ([8]). Note that rationality is the fundamental pillar of an effective metaphysics. This imposition immediately excludes any irrational attempt to seek knowledge.

Within the Kantian framework, resuming a rational metaphysics grounded in aprioristic forms of intuition, it seems to be possible to carry out critical analyzes of the objectives and referents of contemporary cosmology. The construction of a four-dimensional spatio-temporal continuum became, after Einstein, not only sensible to reason, but inevitable to the human understanding. From this revolutionary construction it was possible to proceed with a whole range of astrophysical and cosmological observations, consolidating itself, therefore, as a true a *priori* intuition. The notion of *continuum*, contrary to the Newtonian conception, transforms us into complex configurations of space-time, expressions of a kind of curvature not completely describable by the means at our disposal. For, if all beings are made of this "substance" (space-time), then they are all subject to the same effects, to the same epistemological concreteness.

3. Assuming that, logically, the human mind carries within itself the logic of nature.

3. The main questioning

There are so many points to be discussed again that the first reflection to make is the following: what aspects take precedence for further clarification of the others? Or, which comes to the same thing, who is the essence and who is the appearance? Finding the answer to such a question leads us to a category that we call "space-time philosophy".

A linguistic critique of the symbolic forms we use is also part of such a philosophy. Therefore, in physics we will define a *syntagma* as a metaphysical unit representative of an object. The metaphysical elements that form that unit are constructs whose meanings depend on their mutual relationships. This approach was inspired by the semiology works of Barthes (1), and intends to minimize the usual confusion between the concrete fact and its representation.

3.1. The goal of space-time philosophy

The space-time philosophy must discuss what we can really understand scientifically in cosmology, that is, what really makes sense to theorize under concrete expectations of verification, even if not immediately, taking as a starting point the assumption that everything we can crudely call reality is constituted, in the last analysis, by space-time itself. For a universe in accelerated expansion, it seems logical, considering the success of general relativity, to establish a dynamic subplanckian space-time construct (a subplanckian interval) [4], whose motion, intrinsic to its definition, is its own expansion.

To build *syntagmae* suited to the representation needs, we assume that the dark energy contained in the dynamic subplanckian interval is the space-time expansion energy itself, a concentration of an amount of repulsion energy within arbitrarily small scales. Evidently, the amount of dark energy retained in subplanckian intervals is very small, so that it only becomes perceptible at large scales[5]. Also, we may interpret the space-time expansion as the outcome of a "burst" of dark energy leaving the subplanckian interval over a neighboring region.

Indeed, a subplanckian interval, as this name suggests, has an arbitrarily small size. In fact, it is not a constitutive element in the strict sense, since any space-time interval is expanding, and within these there are expanding intervals, and so on, as in an infinite mirror effect (the images are finite, though in infinite succession)[6]. Owing to this continuity, dark energy does not disperse, but rather any desired fraction thereof stays confined in the expanding intervals in infinite succession [7]. Due to the finiteness of our language, to write equations (*syntagmae*) including these intervals we must use

4. As an example of a revisited Planckian physics, assuming a different quantum of action for geometry, see Lake in reference (9)

5. Thermally, the more compact the region, the greater the concentrated heat, so we can think of the heating of the interior of moons in gravitational dance with their giant partners as a result of contractions of the space-time structure alternating with expansions, producing macroscopic friction.

6. Indeed, it would be a flagrant contradiction to fragment the relativistic space-time continuum. This dynamic "quantum" of space-time is just the reduced mirror image of what happens with a geodesic at any scale you want.

7. There is a great difference between saying that there is a threshold of technological access to the microcosm and saying that nature is made up of finite elements, even if very small. It is ironic that a functional theory at macroscopic scales such as general relativity is at the root of a cosmology that ends up providing a microphysical representation of the expanding universe.

the brackets "$\langle\forall|$" and "$\rangle$",

$$\langle\forall|\ \tau-\tau_0\rangle\,,$$

symbolizing that a time-like finite interval, say "$\tau-\tau_0$", can be taken at any scale ("$\forall$"). In isolation, this construct doesn't mean much physically speaking. Associated with others, however, through an equation or *syntagma*, it integrates an object (an explanatory construction) rationally connected to the material world. From this symbology we can rewrite two *syntagmae*, say, the time-like quadratic arc element over a timeline T and its entropy density vector respectively as

$$ds^2_{(T)} = g_{\mu\nu} d\,\langle\forall|\ \tau-\tau_0\rangle^1 d\,\langle\forall|\ \tau-\tau_0\rangle^1$$

and

$$\varrho^4 = \varrho_0 \frac{d\,\langle\forall|\ \tau-\tau_0\rangle^1}{ds_{(T)}}\sqrt{-g}.$$

Note the suitable introduction of scale as an intrinsic and independent degree of freedom. In this way, differentiation is applied to a scale-determining element. The original equations are well described and discussed in references (15) (16) and (18), although the semasiology applied here represents an evolution of the previous symbology.

Also, there must be a necessary "why", otherwise we will incur in the so-called "dragon hypothesis" (DHY), a conjecture introduced *ad hoc*, purely arbitrary and unjustifiable when confronted with existing facts and theories (e.g.: if there are traces of fire in a medieval castle, then a dragon caused the fire). This type of hypothesis constitutes irrational lucubration, not metaphysics — therefore unscientific proposition —, and may be associated with a certain infantilizing tendency of Western culture, a fact that has become evident in the cornucopia of cinematographic plays crammed with Tolkienian fantasies, technological disparates and pseudo-scientific absurdities, much to the taste of postmodernist subculture (in fact, surprisingly, the infantile idea that everything is a matter of technology is extremely widespread even in some academic circles).

There is undoubtedly a kind of synergy between science and fiction. Several ideas born in fiction had a visionary character. In addition, it is necessary to demystify the image of the researcher as someone who places himself above the mortals, parading his frowning face with absolute disdain for fantasies and toys (unfortunately, this is an image still worshiped in backward countries). Scientists, whether biologists, physicists or anthropologists, are human beings like everyone else; they are subject to the same imperfections, passions and dreams. All of us, to a greater or lesser degree, are influenced by the stimuli that surround us, especially the visual ones. Astronomers also enjoy going to the movies, and one often hears someone compare the uncommon configuration of the bright star Fomalhaut — with its large ring of dust — to the "Eye of Sauron" of Tolkien mythology. The ludic remains in our adult spirits, and it is good that it is, because good insights can emerge from toys. The point is to keep "toy models" in the realm of rationality.

So, we are not claiming that science is infantilized, or that scientists are childish; nor are we condemning the wholesome entertainment fiction, which we all enjoy in our moments of leisure and mental rest. We are discussing how massively close infantilization is to science and scientists — both through the manipulation of science and through the excess of television fantasy —, and farther

how the teaching model limited to mere repetitions of what has already been said contributes to such infantilization (the "student-parrot" model!)[8]. Soromenho-Marques defines infantilization as "*absence, partial or total, of argumentative thinking*". And he goes on: "*At the limit, it's about not realizing the difference between reality and fiction*"(19). On the manipulation of science, he continues:

"*A recent example. Elon Musk sent his new model car into space, targeting Mars and driven by a doll, named Starman. It was one of the most expensive and polluting publicity stunts in history. However, like a bomber escorted by protective fighters, the pathetic initiative of the young billionaire was accompanied by an epic constellation of narratives: it was written about the very brief arrival of man on Mars, about the future exodus towards the exoplanets, which are discovered all days, about Silicon Valley's enthusiasm for the new industry that promises to indefinitely prolong the lives of the super rich... We are treated like children by those who, in fact, consider us imbeciles.[...] The Apollo program, which lasted between 1961 and 1972, was only possible because it had behind it all the power of an America which, at that time, was really big. Mars is a qualitatively different target. The capital available today to get there is very scarce, taking into account the immense technical problems that exist to solve. Only fools or charlatans can soon promise a human footprint on Mars! Moore's law (which describes the exponential growth of the hardware industry) does not apply to the physical systems of energy and space navigation, which have much stricter ceilings of complexity.[...] Those who point the finger at the stars only distract us from the contemporary ethical mega-scandal: we know that our civilization is ravaging the only planet that can guarantee us a future, and we are still immersed in ignoble excuses not to change the way. Inhabitants of an autophagic culture, it is no wonder that, in a childish drift, we prefer soft superstition to the harshness of reality*". (free translation by the authors).

Much of what is fantasized operates in our subconscious, and, even without clarity about the complex mental processes involved, we are seduced by certain symbolic constructions, which undergo a rational rearrangement so that they can be communicated within a scientific framework. Even so, in face of a DHY, the evocation of Ockham's Razor's Edge — as a heuristic and parsimonious principle of investigation with regard to the complexity of a hypothesis or theory — becomes inevitable in cases such as those in which an explication is sought outside of our universe, since to impute a problem existing "here" to another universe, without any indication of the existence of other universes, is to open doors for the invasion of pseudoscience and fantasy in science.

4. Contemporary DHY

The list of DHY below does not bring news. DHY in physics only became better known, thanks to the popularization media and, whilst in a fanciful way, through the literature and filmography of entertainment with its interdimensional portals giving way to other universes.

It is astonishing to talk about parallel universes without having the slightest indication that they

8. Just repeating what is already known does not stimulate the process of intellectual maturation, which requires, in order to be complete, wide space for creation and freedom to choose lines of investigation.

exist, while we cannot account for the hiatuses in the Standard Model. At the moment, we don't have anything better than the Standard Model, with all its limitations. We know that the Standard Model leaves many gaps; it does not account for dark matter, does not include gravity, and involves a large number of unexplained quantities (20). As Weinberg points out, it does not follow directly from observations of nature, nor is it deducible from mathematics alone, but results from conjectures guided by aesthetic judgment, and, evidently, by the success of various predictions (20). Therefore, what we need least is a DHY, since we have plenty of problems to solve.

In the foundations of some explanatory constructions of cosmology, it is common to find the following main DHY-type conjectures:

The multiverse - Making a lot of appearances on the sci-fi television series and feature films, the multiverse presupposes an infinity of possible universes, but dealing with infinities has never been physics' strong point. Therefore, swapping an infinity for another is not exactly a productive way. This is ultimately what string theory does; on the one hand, it introduces an ingenious way to eliminate the infinite quantum corrections; on the other hand, it cannot indicate which of its numerous solutions corresponds to our universe, leaving an infinite number of possibilities (5). Although we admire its beauty, we are not sure that string theory will lead us to convincing answers, even because the theory does not offer a feasible program of corroboration. So, we are forced to agree with Ellis when he said:

"*The situation is not*

Known Physics $\rightarrow$ *Multiverse, (1)*

as some writings suggest. Instead it is:

$$\textit{Known Physics} \underset{\textit{Extrapolation}}{\overset{\textit{Major}}{\rightarrow}} \textit{Hypothetical Physics} \rightarrow \textit{Multiverse (2)}$$

The physics is hypothetical rather than established! This extrapolation is untested, and indeed may well be untestable: it may or may not be correct. The multiverse proposal is not based on known and tested physics"(2).

The imperceptible extra-dimensions - The extra dimensions have been around for a while in physics — although not in the popular press —, and have not favored experimental programs that can prove them. Being cautious, they may appear one day, revealing themselves by sub-millimeter tests in particle accelerators, but we don't believe that. Strictly speaking, we can accept them only in a meta-theoretical context, within which they describe the generators of the symmetry groups of the theory (17). Aside from that, there is no veritable physical evidence to sustain these hidden dimensions, which look-like a modern version of the old "aether" concept, as some have already said.

The "Before" the Big Bang - There are conjectures in this subject that just sound vagaries. Some physicists suggest that creation as we conceive it is running by an eternal ballet of colliding bubble universes. Others believe that on the other side of the "mirror" (as an archetype inspired by the mirror in the Snow White's fairy tale), at "Time Zero", there is another universe going back along with time. In quantum cosmology, Hawking and his colleagues envisioned the universe as a kind of autonomous entity, a fusion of all possibilities in "imaginary time". There are also those who think that the creation of the universe takes place out of time, so it must occur all the time, with the Big Bang happening here and now, realizing every moment. But all of this will remain just fanciful ideas until we find ways to testing them.

The trans-Planckian censorship conjecture - "The observer must be safeguarded from directly observing the smallest structures in the cosmos". This is the idealistic statement that sums up the trans-Planckian censorship conjecture. The problem is that the inflation models — so important to the view of cosmological evolution that we hold today — require the universe grows to the point where differences below Planck become macroscopic. But, trans-Planckian censorship conjecture states that quantum fluctuations below Planck must remain quantum, since we don't understand the physics running on the scale at which the gravitational interaction rivals Planckian sizes. Even if we had a theory of quantum gravity, anything that lives in the sub-Planckian regime will never "cross over" into our macroscopic world. So, there is a great possibility that we will ever know what actually happens at sub-Planckian scale. Howsoever, it is not that there is a hidden physics at sub-Planckian scales, but that we can only metaphysically intuit the trans-Planckian quantities — in the Kantian sense defended here —, assuming them to underlie the observational facts of relativistic cosmology, and presupposing their continuous micro-scalability. Thus, to ask if there is a micro-scale limit, or if there is an ultimate element of space-time, is to insist on following a way that finishes in an epistemological dead-end.

In any case, we understand that at the present stage of knowledge this is a fruitless discussion, all the more so as there is a veritable conundrum of opinions on whether gravity can be quantum[9]. For us, sub-Planckian facts will remain sub-Planckian not because they are

9. The hypothesis of the existence of a conventional quantum formulation for gravity seems to reign between a scientific proposition and a DHY. The complication (not complexity!) is so great that we need to be very careful to the statements commonly made, else we will make serious mistakes. Just for starters, a conventional quantum theory of gravity would have to deal with the terrible contradiction of "discontinuing the space-time continuum" (not to mention the still supposititious gravitons and gravitinos), since space, time and gravitation are inseparable ingredients of a continuous woof. On this subject, as Oriti well observed,

"*The situation for philosophical reflections is excellent. It is also very different, however, from most philosophy of physics, since we are not dealing with the conceptual issues arising within established (mathematically and observationally) physical theories. The only way to deal with this peculiar situation is to exercise extra caution in adopting the points of view coming from specific approaches to quantum gravity as if they were more established than they are, and to refrain from resting too much on specific results as if they were a necessary part of any future theory*" ([13]).

forbidden, but because they concern the physical continuity of the space-time expansion process as described above.

The mindful reader has certainly realized that metaphysics is nothing but methodology itself in the purest sense applied to rationalization. As a result, it can embody all observational objectivity without being conditioned by this latter, thriving in the realm of intuition.

First and foremost, we have to seek to understand the universe as we see it today based on what observations offer us. It is evident that our ignorance about many features frustrates us, but the truth is that we are still far from a satisfactory "Theory of Everything", if not condemned to never having one.

5. Infinity of infinities: Final comments

Until some evidence is set up, there is only one universe, contained within itself. There is no boundary, no mirror universe where time flows from the future to the past. Although this universe is globally dominated by accelerated expansion, gravity manifests itself locally by the opposite phenomenon of contraction. So, to exert gravity is to compact (dense) space-time; to compact space-time is to contract the infinite intervals of space-time by contracting the interval that contains them into an infinite succession of intervals that contain intervals. This is precisely an example of what we mean by continuity in physics.

Accordingly, questions such as "why does the universe expand?", "why has there been inflation?", "are there other universes?", etc., although interesting, lack real meaning for the possible knowledge.

In short, we looked at this ideas long ago, and, in fiction media, they sound wacky stuff. When we've looked at enough of these things, we are persuaded to tell — just from intuition — "there is no rational basis in the observable universe". In our opinion, these ideas — while captivating —

In particular, there are discussions about gravity as an inherently classical emergent phenomenon. About this, Hedrich was quite enlightening when he said that

"[...] *if gravity is an intrinsically classical phenomenon, it can not be a fundamental interaction. It has to be an induced or residual effect, caused by a quantum substrate dominated by other interactions. Therefore, if gravity should indeed be an emergent, intrinsically classical, macroscopic phenomenon, and not a fundamental interaction, it would not have to be quantized to make it compatible with Quantum Mechanics. Resulting as a classical phenomenon from a quantum substrate, it would already by compatible with Quantum Mechanics. Moreover, it would not only be unnecessary to quantize gravity — it would rather be completely nonsensical to try to quantize gravity. A quantization of gravity would be a quantization of collective, non-fundamental, emergent, macroscopic degrees of freedom. A quantization of General Relativity would be the quantization of an effective theory describing the dynamics of these collective degrees of freedom. It would be as useful as a quantization of the Navier-Stokes equation of hydrodynamics. The resulting 'theory of Quantum Gravity' would be analogous to something like 'Quantum Hydrodynamics': an artificial, formal quantization of a classical theory describing collective, macroscopic degrees of freedom, without any implications for, or any clarifications with regard to, an underlying quantum substrate*"(3).

However, although this is a perspicacious argument, beyond anything that can be conceived, quantum or not, space-time will always remain as a fundamental woof, with gravity being the expression of the dynamics of this woof. In this way, it is no longer a matter of discussing which interactions are fundamental, but what is the cosmic ground for such interactions to exist.

moved physics very little towards an overall understanding. We really have a lot to discuss about our complex and intriguing universe. At a time of great uncertainty, when we need to debate the impacts caused by the new discoveries that accumulate, we believe that it would be an unjustifiable waste of time to insist on the curious DHY.

6. Acknowledgements

This article resulted from an ongoing project supported by the Research Group Scholarship Program at the Centro Universitário ICESP, Brasília - BR. The authors are grateful for the financial incentive and for the research encouragement that is always present in the aforementioned institution.

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