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From Nothing to Existence: quantum vacuum in light of the fundamentality of existence

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ABSTRACT

The emergence of the universe from "Nothing" continues to be one of the most challenging questions in both physics and philosophy. Lawrence Krauss, in his theory, identifies the quantum vacuum with "Nothing" and attempts to explain the Cosmogenesis without invoking a metaphysical cause. This study, drawing on the Fundamentality of Existence (FOE) in Mulla Sadra's Transcendent Philosophy (al-hikmah al-muta 'āliyah), shows that the quantum vacuum possesses an ontological reality rather than being absolute Nothingness. According to Sadrian ontology, the quantum vacuum may be considered the weakest level of Existence within the gradational hierarchy of Existence (However, one may also argue—based on its proximity to immateriality and potentiality—that it paradoxically resembles a higher ontological intensity closer to Divine Simplicity. This dual reading remains open to further exploration). Furthermore, this paper critically examines Krauss's assertion that physical laws alone suffice to account for the Cosmogenesis. From the perspective of the Fundamentality of Existence, physical laws are merely descriptive and contingent rather than self-sufficient causes. Thus, the Sadrian framework provides a deeper metaphysical foundation, revealing the limitations of Krauss's scientific explanation and affirming that the cosmogenesis ultimately necessitates a cause beyond physical laws.

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Intruduction

The origin of the universe has long been one of the most fundamental questions in both philosophy and science. In contemporary physics, amid breakthroughs in cosmology and quantum mechanics, some physicists—most notably Lawrence Krauss—have attempted to explain the universe's emergence purely through physical laws, without invoking any metaphysical causation. In his book *A Universe from Nothing Why There Is Something Rather Than Nothing (2012)*, Krauss makes two central claims: first, that the universe originated from "Nothing," specifically from the quantum vacuum; and second, that this process requires no metaphysical cause (e.g., a divine being or a metaphysical principle), as physical laws are self-sufficient and capable of fully accounting for the phenomenon. This perspective has provoked widespread objections among philosophers and intellectuals, raising significant challenges in the realms of the philosophy of science, metaphysics, and epistemology.

Numerous critiques have been directed at Krauss's argument, particularly those emphasizing the necessity of a metaphysical foundation for physical laws. one can challenge his reasoning from a novel perspective that, despite its conceptual simplicity, offers deeper ontological and philosophical rigor. This perspective is grounded in the principle of the Fundamentality of Existence (FOE), known in Islamic philosophy as *asalat al-wujud*, in Mulla Sadra's philosophy. The FOE asserts that all aspects of reality derive their meaning and ontological status solely from Existence itself, which serves as the fundamental and singular ground of all beings. Without Existence, quiddities would remain mere mental constructs, devoid of any external or independent reality, thereby raising profound ontological concerns about the adequacy of Krauss's claims. Based on this principle, Krauss's first assertion—by identifying Nothing to the quantum vacuum—can be critically examined through an existential lens: the quantum vacuum, as something that already exists (albeit at the lowest ontological level), cannot be equated with *Nothing* in its strict philosophical sense. Furthermore, this principle reveals the inadequacy of Krauss's second claim—that the emergence of the universe can be reduced to physical laws—by demonstrating that such a reduction is incomplete without a deeper ontological foundation.

This study employs an analytical-comparative methodology. First, it examines Krauss's account of the universe's emergence from "Nothing" and his claim that physical laws serve as self-explanatory principles in this process. Next, prominent philosophical objections to his second claim—particularly those emphasizing the necessity of a metaphysical grounding for physical laws—are reviewed. Following this, the concept of "Nothing" is analyzed through the lens of the FOE, illustrating how this approach offers a more profound and comprehensive critique of Krauss's second claim than conventional philosophical objections. Finally, the study elucidates why the existential critique based on the FOE provides a more rigorous and encompassing challenge to Krauss's position than alternative philosophical frameworks.

Quantum Vacuum and Zero-Point Energy: The Emergence of the Universe

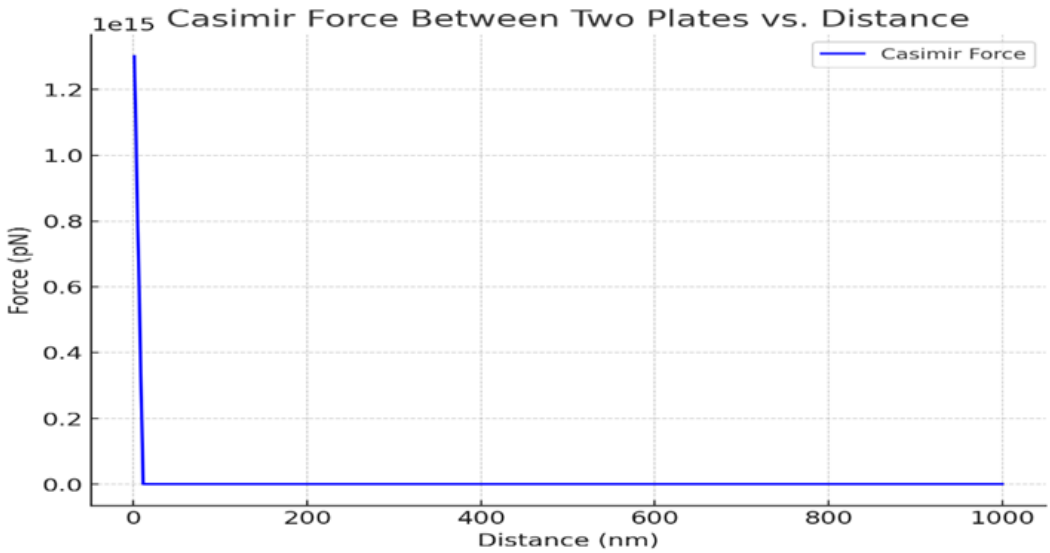
In contemporary physics, particularly in quantum mechanics and quantum field theory, the quantum vacuum is regarded as the most fundamental state of a quantum field (Peskin & Schroeder, 1995, 12–17; Weinberg, 1995, 55–60). The classical notion of vacuum was traditionally conceived as an entirely empty space devoid of matter and energy—a view endorsed by thinkers such as Democritus, Lucretius, Epicurus, and Newton. In contrast, quantum mechanics defines the vacuum as a state in which quantum fields retain their minimum possible energy, while exhibiting spontaneous (random) quantum fluctuations. These fluctuations play a crucial role in the emergence of the universe. On a cosmological scale, they can create conditions that ultimately lead to a cosmogenic event, the initial moment leading to large-scale structure formation (Guth, 1997, 173–180). In inflationary models, these primordial fluctuations serve as the initial seeds for the formation of large-scale cosmic structures.

These fluctuations arise from Heisenberg's uncertainty principle, which states that energy and time cannot be precisely determined simultaneously. As a consequence, pairs of virtual particles continuously emerge within the vacuum, only to annihilate each other almost instantly (Heisenberg, 1927, 172–198).

One of the key experimental confirmations of these quantum fluctuations is the Casimir effect. First proposed by Hendrik Casimir in 1948, this phenomenon manifests as an attractive or repulsive force between two closely spaced conductive plates or surfaces, induced by quantum radiation and oscillations. More specifically, the Casimir effect results from quantum vacuum fluctuations and emerges between two closely spaced conducting surfaces. The force originates from the energy density difference between the regions inside and outside these surfaces, effectively exerting an attractive force between them. This effect is particularly observable at microscopic scales and is highly sensitive to the separation distance between the surfaces. Moreover, in vacuum environments, the Casimir force arises due to the presence of electromagnetic fields and quantum field fluctuations (Casimir, 1948, 793) The magnitude of this force depends on the surface area and the separation distance between the objects.

Broadly speaking, the Casimir effect has significant applications across various fields, including condensed matter physics, nanotechnology, and fundamental particle physics. It has been measured with remarkable precision in laboratory settings and is even relevant to research on black holes and high-energy astrophysical environments.

The following diagram illustrates the Casimir force between two plates, which decreases as the distance between them increases. As shown, the Casimir force increases significantly as the distance decreases, and at microscopic scales, it can have a substantial impact.



Therefore, the vacuum in quantum physics is recognized not only theoretically but also experimentally as a dynamic and active space. In other words, this phenomenon confirms that the quantum vacuum is not empty, but rather contains energy and a complex structure.

Additionally, zero-point energy is another key aspect of the quantum vacuum. This energy represents the minimum amount of energy a quantum system has, even in its lowest possible state (Feynman & Hibbs, 2010, 267-270, 312-315). This concept plays a crucial role in cosmological models, including cosmic inflation and dark energy.

Lawrence Krauss and the Quantum Vacuum: An Examination of Two Claims

In his book *A Universe from Nothing Why There Is Something Rather Than Nothing (2012)*, Lawrence Krauss attempts to address philosophical questions about the cosmogenesis from the perspective of the quantum vacuum. In this work, he advances two central claims. First, that the universe emerged from “Nothing which he understands as the quantum vacuum. Second, he maintains that this emergence does not necessitate invoking any metaphysical causes; instead, the laws of quantum physics are, self-sufficient to account for the universe’s origin.

He defines "Nothing" as an entirely empty space that is filled with quantum fluctuations and zero-point energy (Krauss, 2012, 47-52). Within this framework, he equates the concept of "Nothing" with the "quantum vacuum," using the terms interchangeably.

Krauss clarifies: "By *nothing,* I do not mean nothing, but rather *nothing*—in this case, the nothingness we normally call empty space" (Krauss, 2012, Ch. 4, 58). In redefining ‘nothing’ as ‘empty space,’ Krauss effectively shifts the discourse from ontological absence to a physically structured vacuum. He adds that the "empty space" is the relevant domain from which our observed "something" arises (Krauss, 2012, Ch. 10, 161).

Krauss explains that, “Nothing meant empty but preexisting space combined with fixed and well-known laws of physics” (Krauss, 2012, Ch. 10, 170). This characterization of

'Nothing' highlights a key philosophical tension, namely that the supposed nothing already presupposes structured physical parameters. Krauss further elaborates:

> if I take a region of space and get rid of everything within it—dust, gas, people, and even the radiation passing through—namely absolutely everything within that region—if the remaining empty space weighs something, then that would correspond to the existence of a cosmological term such as Einstein invented (Krauss, 2012, Ch. 4, 58).

Krauss explains that within the quantum vacuum (Nothing), even in the absence of material particles, quantum fields are constantly fluctuating, and these fluctuations can create and annihilate particle-antiparticle pairs. From this perspective, the quantum vacuum is described as the lowest energy state of a system. This minimal state of the vacuum has measurable energy, known as zero-point energy. He also refers to the Casimir effect, which demonstrates that zero-point energy can influence the movement of metal plates placed close to one another (Krauss, 2012, Ch. 4, 58).

He emphasizes the idea that quantum fluctuations in the vacuum can play a fundamental role on cosmological scales. He refers to cosmological models where initial quantum fluctuations can lead to primordial density irregularities, ultimately giving rise to cosmic structures like galaxies. From this viewpoint, the quantum vacuum is not only devoid of matter but may also play a crucial role in the formation of cosmic structures.

Additionally, he draws attention to the relationship between zero-point energy and dark energy, which is responsible for the accelerating expansion of the universe. Vacuum energy, is the background energy of space and could serve as a source for dark energy. However, the theoretical values of zero-point energy in current physical models significantly differ from observational cosmological data, a discrepancy that remains one of the fundamental challenges in theoretical physics.

The Self-Sufficiency of Natural Laws in Explaining the Cosmogenesis

Relying on the principles of the quantum vacuum, Krauss argues that there is no need for a metaphysical cause to create the universe 'from Nothing'; rather, the fundamental properties of quantum physics can lead to the formation of the cosmos. He asserts that the universe, including celestial phenomena, can be explained solely by natural laws (the laws of physics). These laws themselves have brought the universe into existence and governed its evolution, with humanity arising as a contingent consequence of these principles. This implies that, despite its seemingly strange and complex nature, the universe may, in fact, exhibit an intrinsic natural order.

Krauss concludes:

> our current understanding of the universe, its past, and its future make it more plausible that "something" can arise out of nothing without the need for any divine guidance (Krauss, 2012, Ch. 9, 147).

Building on this assertion, Krauss extends his argument by shifting focus from the plausibility of a universe arising from "Nothing" to the foundational role played by physical laws themselves in necessitating the universe's existence and shaping its evolution:

> the laws themselves are all that exist. These laws themselves require our universe to come into existence, to develop and evolve, and we are an irrevocable by-product of these laws. The laws may be eternal, or they too may have come into existence, again by some yet unknown but possibly purely physical process (Krauss, 2012, Ch. 9, 142).

In summary, Krauss presents two key assertions:

1. The universe emerged from "Nothing"—specifically, from a quantum vacuum where quantum fluctuations generate matter and cosmic structures.
2. The creation of the universe from "Nothing" does not require metaphysical or divine causes, as the intrinsic properties of quantum physics are fully capable of explaining this process.

Analysis of "Nothing"

When the question arises as to what it means for the universe to have emerged from "Nothing," Krauss considers two possible scenarios:

1. The creation of something from Nothing (i.e., the quantum vacuum), which implies a pre-existing entity.
2. The creation of Nothing (i.e., the quantum vacuum) itself from an absolute Nothingness (See: Krauss, 2012, 174).

In response to this question, if Krauss's notion of "Nothing" aligns with the first scenario (as will later become evident, this must necessarily be his intended meaning), then "Nothing" refers to a pre-existing quantum vacuum governed by physical laws. In this case, it can be argued that this space is an existential entity, making the philosophical designation of "Nothing" somewhat inaccurate or redundant. This usage seems to constitute a terminological distortion, as the term "Nothing" in philosophy refers to absolute nonexistence or pure absence. However, Krauss employs it to describe something that, in reality, possesses ontological reality. In other words, this represents a shift in the conventional application of the term in a way that conflicts with its philosophical meaning, potentially leading to confusion and misunderstanding. The quantum vacuum, in this view, is something that already exists, though it lacks conventional matter or particles. Consequently, the quantum vacuum itself is a physical entity with specific structures and physical laws, which can be naturally considered as part of reality.

Philosophers may not necessarily object to this usage of "Nothing" in the discourse of quantum physics, since the quantum vacuum, despite being devoid of matter, is recognized as a valid physical entity. Indeed, given that the quantum vacuum pre-exists and operates under physical laws, it cannot be equated with "Nothing" in its absolute philosophical sense

(absolute nonexistence). In this respect, philosophers would not classify it as "Nothing" but rather as an ontological reality.

If Krauss's intended meaning aligns with the second scenario—i.e., that the quantum vacuum itself emerged from "Nothing"—a fundamental flaw in this reasoning arises: "Nothing" in this sense must either mean absolute nonexistence (in which case the claim is nonsensical) or something other than absolute nonexistence. In the latter case, "Nothing" remains an undefined metaphysical and even physical concept.

To elaborate, if Krauss asserts that the quantum vacuum itself emerged from "Nothing," one must ask whether it is truly possible to conceive of "Nothing" as something capable of creation (i.e., that the quantum vacuum arises from it). Theoretically, even "Nothing" would require physical laws for such an emergence to take place. In other words, if Krauss's intended meaning corresponds to the second scenario, then his statement can be reformulated as follows:

"Nothing emerges from Nothing."

A more precise examination of this proposition requires an analysis of its linguistic structure, semantic distinctions, and logical consistency in statements involving the term "Nothing."

Two major issues arise in this context:

a) The Semantic Analysis of "Nothing" and Its Vagueness

In the statement "Nothing emerges from Nothing," the term "Nothing" appears twice, necessitating a distinct analysis for each occurrence:

1. First occurrence of "Nothing": This "Nothing" refers to the quantum vacuum. However, since the quantum vacuum possesses physical properties, laws, and energy fluctuations, semantically speaking, this "Nothing" actually denotes something rather than absolute nonexistence.
2. Second occurrence of "Nothing": If this "Nothing" is taken to mean absolute nonexistence, then the statement becomes conceptually and linguistically incoherent, as true nonexistence should lack any capacity for producing something, let alone a quantum vacuum.

b) A Linguistic Analysis of Meaning

This statement presents both conceptual and referential ambiguity:

1. On one hand, if the first "Nothing" (quantum vacuum) refers to something that exists, then the statement "Nothing emerges from Nothing" contains an internal contradiction. it simultaneously designates the quantum vacuum as both existing and non-existing.
2. On the other hand, if the second "Nothing" (the origin of the quantum vacuum) denotes absolute nonexistence, then the statement is semantically and logically flawed, as absolute nonexistence cannot function as the subject of a verb (i.e., it cannot be the origin of anything).

Krauss, however, maintains that the first "Nothing" in this formulation refers specifically to the pre-existing quantum vacuum. Regarding the second "Nothing," however, Krauss argues that it cannot be equivalent to the "Nothing" of philosophers or theologians (who claim that God created the universe from absolute Nothingness). Instead, he suggests that the appropriate candidate for the second "Nothing" is the multiverse. Consequently, when one says, "Nothing emerges from Nothing," Krauss interprets this to mean that the pre-existing quantum vacuum arises from the Multiverse (Krauss, 2012, 133).

Beyond the aforementioned linguistic issues, this proposition suffers from two fundamental problems:

1. The multiverse hypothesis remains unverified. Unlike established physical laws that have been confirmed through observation and experimentation, the Multiverse remains a theoretical model without independent empirical verification. Therefore, it cannot serve as a definitive alternative to the concept of a metaphysical cause or creator.
2. It fails to resolve the question of a metaphysical cause. Even if one accepts the existence of a multiverse, the question still remains: Where did this vast collection of universes originate from, and what determined the laws governing it? In other words, this theory merely shifts the question of creation one level backward without resolving the fundamental issue.

In this analysis, it becomes evident that, Krauss's statements ultimately indicate that his intended meaning of "Nothing" aligns with the first scenario. Consider the following passages:

> We all are here today because of quantum fluctuations in what is essentially *nothing* (Krauss, 2012, Ch4, 98).
>
> If we are all stardust, as I have written, it is also true, if inflation happened, that we all, literally, emerged from quantum nothingness (Krauss, 2012, Ch, 98).
>
> The structures we can see, like stars and galaxies, were all created by quantum fluctuations from nothing. And the average total Newtonian gravitational energy of each object in our universe is equal to nothing (Krauss, 2012, Ch7, 105).

These statements clearly reference the first definition of "Nothing," wherein it denotes the quantum vacuum, a pre-existing entity subject to quantum fluctuations. In this framework, "Nothing" (or the quantum vacuum) actively exists and is governed by physical laws, allowing quantum fluctuations to generate structures such as stars, galaxies, and even the universe itself. Thus, the quantum vacuum, with its distinctive properties, represents a tangible ontological and physical space that can be studied and analyzed by physicists and scientists.

A Premature Farewell to Metaphysics!

It has been asserted that, based on his interpretation of quantum vacuum, Krauss concludes that the emergence of the universe from "Nothing" requires no assumption of metaphysical or divine causes. Instead, the laws of quantum physics inherently possess the explanatory power to account for this phenomenon (Krauss, 2012, Ch. 9, 142). Krauss's theory can be formally structured as the following logical argument:

1. The universe and celestial phenomena can be explained through natural laws.
2. These laws have naturally and inevitably led to the emergence and evolution of the universe.
3. Humans and all phenomena are merely the result of these natural laws.
4. Empirical research in cosmology and particle physics suggests that the universe has naturally emerged from "Nothing."
5. If the universe operates under immutable laws, then these laws alone can account for its changes and phenomena.

The conclusion follows that, since the universe is governed by natural laws and there is no need for divine intervention to explain changes or miracles, there is likewise no necessity to postulate metaphysical forces to account for phenomena such as the sun standing still at noon.

Even if we accept that the term "Nothing" in Krauss's theory is not a conceptual distortion but merely a new interpretation of quantum vacuum behavior as understood in contemporary physics, the critical issue remains in his second claim: namely, that the laws of physics—such as gravity, quantum principles, and general relativity—are independently sufficient to explain processes like the Big Bang and cosmic expansion without requiring any metaphysical or divine cause to justify these laws:

> the laws themselves are all that exist. These laws themselves require our universe to come into existence, to develop and evolve, and we are an irrevocable by-product of these laws. The laws may be eternal, or they too may have come into existence, again by some yet unknown but possibly purely physical process (Krauss, 2012, Ch9, 142).

This is where Krauss's theory comes into conflict with competing theological and philosophical perspectives. The flaw here is that, while quantum properties may contribute to the emergence of the cosmos, the fundamental question remains: what is the origin of these physical laws? Why do these specific laws and mathematical structures exist? Such questions indicate that there must be a deeper foundation to account for these laws. Krauss assumes that *the laws themselves are all that exist*, but this response fails to explain how these laws came into existence in the first place. Did they arise spontaneously and without cause, or do unresolved questions remain about their ultimate origin?

Building on this very critique, several philosophers and physicists—most notably David Albert (2012), Sean Carroll (2016), William Lane Craig (Copan & Craig, 2017), and

Richard Swinburne (2004)—argue that even if physical laws are empirically observed and mathematically formulated, they cannot function as complete autonomous realities without a metaphysical foundation. From their perspective, Krauss's proposal merely displaces the original question: instead of inquiring into a metaphysical cause, we are now compelled to ask about the origin and ontological status of the laws and structures that govern the quantum vacuum. David Albert, a distinguished physicist and philosopher of physics, writes in his critique of Krauss's book:

> Where, for starters, are the laws of quantum mechanics themselves supposed to have come from? Krauss is more or less upfront, as it turns out, about not having a clue about that (Albert, 2012, 1–4).

Carroll maintains that physical laws cannot exist in a metaphysical vacuum; rather, "these laws require a metaphysical explanation" (Carroll, 2016, 63, 204). William Lane Craig explores this issue within the framework of the Kalam cosmological argument, asserting that the very existence of physical laws entails the necessity of a metaphysical cause (Copan & Craig, 2017, 36, 75). Similarly, Richard Swinburne argues that physical laws cannot account for themselves unless they are grounded in some ultimate explanatory principle that transcends them (Swinburne, 2004, 202, 211, 347). In a comparable vein, Arthur Burtt (1923, 11, 300) has argued that physical laws, as contingent and derivative realities, are incapable of existing independently of an autonomous metaphysical ground.

The critique posed by these philosophers can be structured as a formal logical argument:

1. (Premise 1) If the laws of physics exist without the necessity of a metaphysical foundation, then they must be independent of any non-natural ground.
2. (Premise 2) Anything independent of a non-natural foundation must either be self-explanatory or reliant on something else to justify it.
3. (Premise 3) However, the laws of physics cannot be self-explanatory because their justification depends on conceptual frameworks such as logical principles, causality structures, and existential possibility, all of which have a non-physical nature. (Based on 1 and 2, the assumption that the laws of physics (Interim Conclusion) are self-sufficient is untenable.)
4. (Premise 4) Therefore, the laws of physics must depend on something else to explain them—either something metaphysical or something physical. (Based on 3, physical laws are not independent.)
5. (Premise 5) If this dependent factor is also physical, it too would require explanation, leading to an infinite regress, which is neither logically coherent nor philosophically satisfactory.
6. (Based on 4, the assumption that physical laws depend on physical factors is false.)
7. (Premise 6) To avoid infinite regress, there must be a fundamental metaphysical principle that accounts for the origin and justification of physical laws. (Based on 4 and 5, the only viable option is to accept a metaphysical foundation.)

8. (Conclusion) Therefore, Krauss's claim that the laws of physics can exist without a metaphysical foundation is incorrect, because:
   - Either one must accept that physical laws exist without any foundational reason, which contradicts rational explanatory principles.
   - Or one must accept an infinite regress of explanations, which is likewise untenable.

This argument compellingly demonstrates that excluding metaphysics from the explanation of physical laws is not only insufficient but also entails fundamental contradictions.
Additionally, the following points further reinforce the philosophical critique of Krauss's second claim:

1. Krauss conflates descriptive laws and causal laws. Natural laws merely describe the governing patterns of the universe rather than serve as the causes that bring them into existence. Therefore, describing a phenomenon does not in itself negate the possibility of metaphysical intervention.
2. More significantly, he commits the fallacy of deriving a conclusion from a flawed assumption—namely, assuming that the mere existence of fixed laws automatically precludes the need for a metaphysical cause.
3. However, physical laws describe the regular functioning of nature; they do not preclude the possibility of events beyond their scope.

Thus, if physical laws are regarded solely as natural elements with no metaphysical association, this approach risks severing their connection to fundamental concepts such as causality, purpose, or meaning. In reality, Krauss attempts to unjustifiably remove the metaphysical dimensions necessary for explaining the universe and its governing principles. Therefore, his endeavor to separate physics from metaphysics may ultimately remain incomplete and inadequate.

Although the philosophical critiques challenging Krauss's second claim are, to some extent, commendable, it seems that his claim can be contested from a fresh and fundamental outlook, one that, despite its simplicity, carries greater precision. This perspective is the *Fundamentality of Existence* (FOE). From this viewpoint, not only Krauss's second claim but also his first can be re-analyzed in a new light—an approach that has been overlooked by the aforementioned philosophers. Therefore, both claims will be examined through the lens of *FOE*, revealing its superior insights in comparison to the previously mentioned critiques.

Krauss's theory in Light of the FOE

The Concept of the Fundamentality of Existence (FOE)

The FOE is one of the core principles of Mulla Sadra's philosophy. According to this doctrine, reality is constituted by "Existence". "Quiddities" (i.e., all possible beings, derivative entities, and conceptual as well as natural and scientific laws) are nothing but determinations of *Existence*. In other words, "existence" is regarded as the fundamental basis of all actual and possible phenomena—both physical and metaphysical—whereas "quiddities" are secondary and grounded in it. This relationship resembles that of a shadow

to a person: just as a shadow is entirely dependent on the person and cannot exist independently, quiddities cannot attain reality apart from existence (Mulla Sadra, 1981, 8).

The notion of "Existence" is intuitively comprehensible; however, its true essence cannot be captured through definitions or universal conceptual frameworks. This is because existence, as an entity independent of any external cause, does not belong to the category of universals nor does it correspond to any particular type of quiddity. Existence is an uncaused, unitary, and simple reality, yet it is graded (tashkiki), meaning that it encompasses varying levels of intensity and weakness, perfection and deficiency, priority and posteriority. As an absolutely simple reality, existence is indivisible—whether physically or conceptually—whereas quiddities are composed of intellectual components and essential differentiae (Mulla Sadra, 1981, Vol. 1, 35).

From this principle, several key conclusions emerge:

> Existence is an objective reality that constitutes all that is real, whereas quiddities are mere mental constructs (Mulla Sadra, 1981, 8).
>
> Quiddities, in themselves, lack causal efficacy and cannot bring about effects (Mulla Sadra, 1981, 8).
>
> Existence takes precedence over and is ontologically prior to quiddities (Mulla Sadra, 1981, 8)
>
> Existence is graded (tashkiki), exhibiting varying levels of intensity and weakness (Mulla Sadra, 1981, Vol. 2, 381).
>
> Existence is absolutely simple (basit), devoid of any composite structure—either conceptually or in external reality (Mulla Sadra, 1981, Vol. 1, 37).

Accordingly:

> Quiddities, in relation to fundamental existence, are merely mental constructs and lack any independent external reality (Mulla Sadra, 1981, 8).
>
> All beings represent varying levels of the same singular reality of existence (Mulla Sadra, 1981, 8).
>
> Existence is fundamental and precedes all quiddities (Mulla Sadra, 1981, Vol. 1, 38).

One of the critical consequences of the FOE is the principle of *Emkan Faqri*. According to this principle, quiddities neither possess existence in themselves nor can they come into existence independently; rather, they derive meaning solely through their relation to Existence. Consequently, the very possibility of existence for anything is, in fact, nothing but its absolute dependence on an independent and self-sufficient entity (e.g. Existence). (*Emkan Faqri* can be understood as the existential indigence or ontological dependence of possible beings.) (Lahiji, 2007, 395).

The absolute reality of Existence is the ultimate source of all causal chains. No phenomenon can exist in isolation from it; without such a connection, it would be reduced to sheer nothingness. However, since all beings are manifestations of this absolute reality, their existence is real—yet entirely dependent on it (Lahiji, 2007, 395).

The closer an entity is to absolute existence, the more complete, expansive, and actualized it becomes. Conversely, the farther an entity is from absolute Existence, the more limited, deficient, and dependent it is. Hence, it is asserted that the purer an entity's existence, the more distant it is from imperfection and deficiency (Lahiji, 2007, 395).

Having established the conceptual framework of the FOE, we now turn to Krauss's two key claims and analyze them through this philosophical lens. Since his first claim has been subject to less controversy, we shall begin with it before proceeding to the second claim.

The Ontological and Dynamic Nature of "Nothing"

It has been established that Krauss equates the concept of "Nothing" with the quantum vacuum, reducing the former to the latter. The quantum vacuum is defined as a state that, despite being devoid of particles, still contains quantum fluctuations, energy fields, and governing physical laws (Weinberg, 1995, 55–60). From the perspective of the FOE, the quantum vacuum, interpreted as 'Nothing,' does not signify absolute nonexistence but instead represents a preexisting ontological reality. Consequently, this ontological reality finds its most coherent explanation within the framework of the FOE, a point that requires further elaboration.

Krauss offers two possible interpretations of "Nothing": (1) "Nothing" as the quantum vacuum, which is presupposed to exist, and (2) "Nothing" as that from which the quantum vacuum itself arises. Based on Krauss's own statements, it is clear that his use of the term primarily corresponds to the first interpretation. An evaluation of this notion through the lens of the FOE reveals several important implications.

It is quite evident that, according to the FOE, the only objective reality is Existence itself, while "Nothing" is merely a mental abstraction derived from the negation of existence. Accordingly, any entity that produces effects, undergoes changes, exerts influence, or exhibits endurance cannot be classified as 'Nothing' Rather, it must possess some level of Existence, even if it is the weakest possible level. Given that the quantum vacuum, as Krauss describes it, possesses energy, obeys physical laws, and generates virtual particles, it cannot represent absolute nonexistence. Rather, it constitutes a mode of existence occupying the lowest, yet real, ontological status compared to ordinary material entities.

Since Existence is graded (tashkiki), admitting varying levels of intensity and weakness, the quantum vacuum can be interpreted as representing the lowest level of existence within this framework. This is because it contains energy and has the potential to generate particles. This analysis reveals that what Krauss calls "Nothing" is, in reality, the weakest manifestation of graded Existence rather than absolute nonexistence.

This perspective, which interprets "Nothing" or the quantum vacuum as the weakest mode of Existence, is not only compatible with empirical physics but also situates it within a more coherent metaphysical framework.

From this standpoint, both Krauss's view of the quantum vacuum and Mulla Sadra's doctrine of the FOE share two key points of convergence:

1. In both perspectives, the quantum vacuum represents the weakest level of Existence.
2. Both the quantum vacuum and the FOE imply a form of intrinsic dynamism and change.

To elaborate: Just as in quantum physics, the vacuum, despite its apparent emptiness, is teeming with fluctuations and zero-point energy. Existence, according to Mulla Sadra, is inherently dynamic and fluid. Both views suggest that "Nothing," or what appears to be empty, is in fact a field of latent potentialities for transformation and emergence. In the quantum vacuum, fluctuations in quantum fields give rise to virtual particles, demonstrating that even in the absence of material entities, Existence manifests dynamically. This phenomenon can be seen as an illustration of the intrinsic transformation and dynamism of Existence, as emphasized by Mulla Sadra. In other words, the quantum vacuum serves as a substrate for the emergence of transient microscopic entities, a notion that parallels Mulla Sadra's theory of the continuous flow and transformation of Existence. In both views, Existence is not a static entity. In quantum physics, even the lowest energy state (the ground state) exhibits activity and fluctuations. Similarly, in Mulla Sadra's philosophy, beings are in a state of perpetual transformation and manifestation, with this transformation being intrinsic to the very nature of Existence. Thus, one can argue that the quantum vacuum, with its continuous fluctuations and emergence of zero-point energy, exemplifies the concept of a "dynamic Existence" that Mulla Sadra asserts.

The Priority of Existence over Physical Laws

Given the doctrine of the FOE (*asalat al-wujud*), a precise argument can be formulated to demonstrate why reducing the emergence of the universe to physical laws—without considering ontological foundations—is inadequate and incomplete. As previously discussed, Mulla Sadra's philosophy categorizes physical laws and scientific concepts as quiddities (mahiyyat)—abstract constructs that merely describe relationships and attributes of natural entities. In reality, scientific laws and concepts do not possess independent existence; rather, they are contingent upon actual beings. Therefore, according to the FOE, scientific laws cannot be regarded as independent causes. All causal influences must ultimately be realized through absolute Existence, which constitutes the foundation and principle of all reality. Furthermore, within Mulla Sadra's philosophical framework, a law is an * اعتبار * (mental construct) rather than an independent existential reality. Physical laws, without being actualized in an ontological reality, merely describe how entities interact rather than serving as the cause of their existence. Thus, eliminating metaphysics and ontological reality from scientific explanations is an oversimplification that ultimately deprives empirical sciences of the very metaphysical foundation upon which they rely.

A formal Argument Against Krauss's Claim

1. *(Premise 1)* According to the principle of the FOE, no quiddity (*mahiyyah*) can exert causal influence without being actualized in existence. That is, abstract concepts—including physical laws—merely describe relationships among entities and do not possess independent reality.
2. *(Premise 2)* Physical laws, such as gravity or quantum principles, are abstract quiddities used to explain the behavior of natural entities; they do not, in themselves, possess independent existence.
3. *(Premise 3)* Given (1) and (2), if physical laws were considered as the origin of the universe, it would imply that abstract concepts have the capacity to generate external reality. However, this contradicts the principle of the FOE, which states that only existence (*wujud*) can be causally efficacious, not concepts that are merely dependent on it.
4. *(Premise 4)* If one were to claim that physical laws are self-sustaining, one would have to accept that they possess independent and necessary existence. However, as explained in (2), physical laws lack independent existence and are not self-conscious agents capable of causation. They require a higher ontological reality as the source of their efficacy.
5. *(Premise 5)* According to the principle of ontological indigence (*imkan faqri*) in Mulla Sadra's transcendent philosophy, all contingent beings depend on an absolute, simple, and infinite existence. Consequently, physical laws, by their very nature as contingent realities, cannot serve as the ultimate source of the universe without being grounded in a higher, simple, and transcendent existence.

Therefore: based on (3), (4), and (5), Krauss's claim suffers from two fundamental flaws:

1. Incompatibility with the FOE: Physical laws merely describe interactions but do not constitute independent causes.
2. Reductionist fallacy: It erroneously replaces an ontological reality, the source of all phenomena, with physical laws that are contingent and descriptive rather than causally autonomous.

Thus, the universe cannot have emerged solely on the basis of physical laws; rather, it necessitates a metaphysical cause namely, Necessary Existence (*wajib al-wujud or God*).

A Complementary Note

Although quantum mechanics suggests that certain events may occur without an apparent cause, this does not entail the complete abandonment of causality. Quantum fluctuations, despite their probabilistic nature, occur within a well-defined mathematical and physical framework. Thus, the emergence of the cosmos, via such fluctuations, still presupposes a *causal framework* that allows for their occurrence. For quantum properties to lead to the formation of the universe, a preexisting set of physical laws and fundamental parameters must be in place. These laws function as "primary causes"; while they may not resemble

classical mechanical causes in a direct manner, their very existence necessitates an explanation one that can only be adequately provided by the doctrine of the FOE. For this reason, the assertion of a "self-sufficient physical explanation" ultimately fails to negate the need for a metaphysical cause.

The FOE in Evaluating Krauss's Argument

The distinctive strength and innovation of the FOE in criticizing Krauss's second claim, compared to conventional philosophical critiques, lies in its profound engagement with the concept of Existence as the ultimate foundation of ontology. This perspective offers a broader and more comprehensive framework that transcends mere abstractions and physical laws.

1. **A Deeper Ontological Foundation**

Conventional philosophical critiques emphasize the necessity of a metaphysical foundation for physical laws but do not directly address the nature of these laws and their relationship with *being*. In contrast, the doctrine of the *FOE* presents *being* as a singular and simple reality, within which physical laws can manifest only in a specific ontological framework. This perspective provides a clearer ontological explanation of why physical laws cannot, by themselves, be the origin of the universe and why they depend on a higher ontological reality.

2. **A Metaphysical and Evolutionary Critique**

From the standpoint of the *FOE*, not only do physical laws require a metaphysical foundation, but as abstract essences, they also cannot exert any real effect unless realized within *Existence*. In other words, physical laws are mere abstract concepts; they must be actualized within Existence itself. This critique, particularly from Mulla Sadra's viewpoint where Existence is fundamental and quiddities are merely its derivatives.

3. **Addressing the Problem of Cosmic Evolution**

When the *FOE* asserts the necessity of a metaphysical cause, it not only resolves conceptual gaps but also raises a fundamental question: how has the universe evolved from a singular and simple reality that serves as the source and principle of all beings? This issue naturally challenges Krauss's argument, which presents physical laws as a self-sufficient cause. The doctrine of the *FOE*, however, suggests that such an explanation is inadequate without accounting for the ontological origin from which all existence unfolds.

4. **Emphasis on the Fundamental Unity of Existence**

Finally, the *fundamental unity of Existence* underscores the idea that all possible entities are unified within a singular ontological reality, and no entity can exist independently. This principle demonstrates that physical laws cannot exist independently of a *metaphysical cause*. While conventional critiques primarily highlight the necessity of a metaphysical foundation, the *FOE* primarily emphasizes the interplay between derivative

entities (possible beings) and the Existence, thereby offering a deeper and more conceptually rigorous critique.

Conclusion

A comparative analysis of Lawrence Krauss's view on the Cosmogenesis from quantum vacuum and the FOE reveals that Krauss's notion of "Nothing" is, in fact, a form of *Existence* rather than absolute nonexistence. Despite being devoid of matter, the quantum vacuum still possesses energy, fluctuations, and specific laws, placing it within the realm of ontological reality. From the standpoint of Mulla Sadra's *FOE*, this can be interpreted (at least) as the weakest level of *Existence*, which preexists and serves as a point of departure for cosmological explanations.

Furthermore, Krauss's second claim physical laws alone can account for the emergence of the universe from Nothing was critically examined through the lens of Sadrian metaphysics. Within The FOE, scientific laws (specifically quantum vacuum) are merely descriptive frameworks that articulate relationships between entities; they do not constitute actual causal agents, as all effects must ultimately be grounded in the reality of *Existence*. Thus, disregarding metaphysical foundations not only fails to provide a comprehensive explanation for the Cosmogenesis but also renders the very existence of physical laws dependent on an underlying metaphysical cause.

Therefore, compared to conventional critiques of Krauss's theory, the *FOE* offers a deeper and more encompassing foundation for analyzing the question of cosmic origins. This approach not only highlights the limitations of quantum physics in causal explanation but also shows that any account of the universe must ultimately be rooted in a fundamental reality that transcends physical laws. Nevertheless, the ontological comparison between Krauss's view and Sadrian metaphysics must remain cautious, as each framework is grounded in radically different epistemological assumptions

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