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**Email:** editor.alraqim@iub.edu.pk



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### ***Al-Ghazali and the Impossibility of Infinite Regress: A Rational***

### ***Proof of God's Existence***

### ***Muhammad Harris Suhaib***

MS Scholar, Department of Islamic Studies, Al Ghazali University, Karachi.

Email: harrissuhaib1999@gmail.com

### ***Dr. Muhammad Aslam***

Assistant professor, Department of Basic Sciences & Humanities (Islamic Studies),  
UET Lahore, Faisalabad Campus.

Email: aslam.siddique@uet.edu.pk

### ***Shiza Fatima***

M. Phil Scholar, Department of Islamic Studies, Fatima Jinnah Women University,  
Rawalpindi.

Email: shizafatima669@gmail.com

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### ***Abstract :***

*The question of whether the universe has a beginning or has existed eternally remains one of the most profound in both philosophy and science. Al-Ghazālī, in his Kalām Cosmological Argument, asserted that an actual infinite regress of causes is impossible and that the universe must therefore have a temporal beginning, dependent upon God. This article critically re-examines his reasoning, situating it within both classical critiques and contemporary scientific discourse. Philosophical challenges from Ibn Rushd (Averroes), David Hume, and Immanuel Kant are explored, alongside modern analogies such as Hilbert's Hotel and mathematical paradoxes of infinity. Scientific perspectives are also considered, including relativity, the Borde–Guth–Vilenkin theorem, the thermodynamic arrow of time, and cosmological observations that determine the universe's age to be approximately 13.8 billion years. Taken together, these philosophical and scientific considerations reinforce the plausibility of al-Ghazālī's central claim: that an infinite regress of temporal causes is metaphysically and physically untenable.*

**Keywords:** *Al-Ghazali, Infinite regress, Hilbert's Hotel, Cosmological argument, Actual infinity.*



# *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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## **Introduction**

The problem of infinite regress has long been a topic of concern for philosophers, theologians, and scientists. At its core lies the question: can the chain of causes extend infinitely into the past, or must there be a first cause that initiates existence? Within the Islamic tradition, al-Ghazālī offered one of the most influential formulations of this argument in his *Kalām Cosmological Argument*. He maintained that the notion of an actual infinite regress of causes is incoherent and that the universe, therefore, must have a temporal beginning, created by God <sup>1</sup>.

Al-Ghazālī's reasoning is notable for its combination of logical analysis, theological commitment, and intuitive appeal. His central claim rests on two premises: (1) an actual infinite cannot exist in reality, and (2) a temporal regress of events is an actual infinite. From these, he concluded that the universe must have begun to exist. This argument has continued to influence debates in philosophy of religion, resurfacing in contemporary apologetics and cosmology alike <sup>2</sup>. However, al-Ghazālī's argument has never gone uncontested. Classical critics such as Ibn Rushd (Averroes), David Hume, and Immanuel Kant each raised objections to the impossibility of infinite regress or to extending causality to the cosmos as a whole <sup>3,4,5</sup>. Their critiques remain powerful challenges that demand engagement if the argument is to remain persuasive in modern contexts.

Moreover, advances in cosmology present new opportunities and challenges. The discovery of cosmic expansion, the thermodynamic arrow of time, and the Borde–Guth–Vilenkin (BGV) theorem all point toward a universe with a finite past <sup>6,7</sup>. Observational data from the Planck satellite likewise fix the universe's age at approximately 13.8 billion years, reinforcing the claim that physical reality is temporally bounded <sup>8</sup>.

This article revisits al-Ghazālī's critique of infinite regress by weaving together classical philosophical analysis, modern mathematical analogies such as Hilbert's Hotel, and contemporary scientific findings. It first examines al-Ghazālī's original argument, then engages with major critiques, and finally considers whether modern cosmology provides independent support for the claim that the universe cannot be past-eternal.

Al-Ghazālī's critique of the philosophers was rooted in his defense of a core Islamic theological tenet: the creation of the world in time. This position is supported by numerous Quranic verses that affirm God's absolute freedom and creative will. For example, the Holy Quran states

بَدِيعُ السَّمَاوَاتِ وَالْأَرْضِ إِذَا قَضَىٰ أَمْرًا فَإِنَّمَا يَقُولُ لَهُ كُنْ فَيَكُونُ<sup>9</sup>

“He is the Originator of the heavens and the earth. When He decrees a matter, He only says to it, ‘Be,’ and it is”.

This verse directly challenges the idea of a necessary, eternal emanation and underscores the volitional act of creation.

## **Methodology**

This article adopts an interdisciplinary philosophical–theological methodology. The analysis proceeds on three levels:

1. **Philosophical reasoning** – evaluating logical arguments for and against the possibility of an actual infinite regress, using both classical and contemporary critiques.
2. **Mathematical analogies** – engaging with thought experiments such as Hilbert’s Hotel to illustrate the paradoxes of actual infinities when applied to reality.
3. **Scientific evidence** – integrating findings from cosmology, relativity, and thermodynamics to test whether empirical data support the claim of a finite universe.

The article does not attempt to provide a deductive proof of God’s existence. Instead, it aims to assess the plausibility and coherence of al-Ghazālī’s rejection of infinite regress by weighing it against philosophical objections and modern scientific models. This methodological stance acknowledges that the issue of infinity is simultaneously logical, metaphysical, and empirical, necessitating careful cross-disciplinary evaluation.

## **Literature Review**

The kalām cosmological argument has been the subject of extensive historical and contemporary debate. Al-Ghazālī’s original formulation in *Tahāfut al-Falāsifa* argued that an actual infinite regress of temporal causes is impossible, thereby necessitating a first cause<sup>10</sup>. His views were contested by Ibn Rushd, who defended the Aristotelian idea of an eternal cosmos<sup>11</sup>.

In the early modern period, philosophers such as David Hume and Immanuel Kant raised further critiques. Hume (1779/1990) questioned the principle of causality itself, while Kant (1781/1998) argued that cosmological reasoning illegitimately applies categories beyond possible experience.

In contemporary philosophy of religion, William Lane Craig has been the leading advocate of the kalām cosmological argument, updating al-Ghazālī’s reasoning with

## *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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modern mathematical analogies and scientific evidence <sup>12</sup>. Critics, however, argue that Hilbert's Hotel and similar paradoxes demonstrate only that infinity is counterintuitive, not that it is logically impossible <sup>13</sup>.

In sciences, Stephen Hawking (1998), Sean Carroll (2010), and others have explored models of the universe that challenge or refine the claim of a temporal beginning. Nonetheless, the Borde–Guth–Vilenkin theorem <sup>14</sup> and measurements of cosmic background radiation <sup>15</sup> have reinforced the view that the universe has a finite past.

This article builds on the existing body of literature by systematically engaging with classical philosophical critiques, clarifying the distinction between mathematical and physical infinities, and integrating recent cosmological data.

### **Historical Background:**

#### **Al-Ghazālī and the Philosophical Impossibility of Actual Infinity**

Abū Ḥāmid al-Ghazālī (1058–1111 CE), one of the most influential Islamic theologians and philosophers, advanced a powerful critique of the eternity of the world in his seminal work, *Tahāfut al-Falāsifa* (The Incoherence of the Philosophers). Drawing from earlier *kalām* debates, he argued that an actual infinite regress of temporal events is metaphysically impossible. If the universe were eternal, it would imply that the past contained an infinite number of moments, which he considered incoherent <sup>16</sup>. Al-Ghazālī framed his reasoning in a two-step syllogism:

1. **An actual infinite cannot exist in reality.**
2. **A temporal regress of causes is an actual infinite**
3. **Therefore**, the temporal regress of causes cannot exist; the universe must have begun to exist.

From this conclusion, al-Ghazālī inferred that the universe requires a cause — a necessary being outside of time who initiated creation. For him, this cause could only be God.

#### **Al-Ghazālī's Paradoxes of Infinity**

To demonstrate the absurdities entailed by actual infinities, al-Ghazālī employed several thought experiments:

- **Revolving spheres** – He imagined two spheres, one revolving once per day and another once per year. If the past were infinite, both spheres would have completed an infinite number of revolutions, yet the faster sphere would have

completed infinitely more. This contradiction illustrates the incoherence of actual infinite sequences of temporal events.

- **The chain analogy** – He compared an infinite regress of causes to a chain with no first link. Without a first link, the chain could never hang; similarly, without a first cause, the sequence of causes could never exist.
- **Library of infinite books** – A library with an infinite number of volumes can never be completed or added to without paradox. For al-Ghazālī, applying this logic to the past shows the impossibility of traversing an actual infinite to arrive at the present.

These paradoxes anticipate modern analogies, such as Hilbert’s Hotel, which highlight the counterintuitive implications of applying transfinite mathematics to reality.<sup>17, 18</sup>

### **Influence and Legacy**

Al-Ghazālī’s argument profoundly shaped Islamic theology, Christian scholasticism, and modern apologetics. While Aristotelian philosophers such as Ibn Rushd defended the eternity of the world, later medieval thinkers, including Thomas Aquinas, grappled with the coherence of infinite regress. In the twentieth century, William Lane Craig (1979; 2009) revived al-Ghazālī’s argument, adapting it for contemporary analytic philosophy of religion and situating it alongside developments in modern cosmology.

### **Classical Critiques of Infinite Regress**

While al-Ghazālī forcefully argued that an actual infinite regress of causes is impossible, several major thinkers disagreed, offering critiques that remain influential in philosophy.

#### **Ibn Rushd (Averroes)**

Ibn Rushd (1126–1198 CE) rejected al-Ghazālī’s temporal understanding of creation. For him, the universe did not begin in time but exists in eternal dependence on God. Just as the sun eternally emits light, God eternally sustains the world. Creation, therefore, is not about a first temporal moment but about ongoing ontological dependence. On this account, causal chains could extend infinitely into the past without contradiction, since their entire existence is contingent on God’s eternal causality.<sup>19</sup>

#### **David Hume**

David Hume (1711–1776) challenged the very foundation of cosmological reasoning. He argued that our belief in causality is based on custom and repeated observation, not on logical necessity. Thus, even if every event within the universe appears to have a cause, it does not follow that the universe as a whole must have a cause. Hume compared this

## *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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inference to saying: “Every human has a mother, therefore the human race must have a mother” — a fallacy of composition <sup>20</sup>. For Hume, causality may apply within the universe but cannot be extended to the cosmos itself.

### **Immanuel Kant**

Immanuel Kant (1724–1804) mounted an equally profound critique in his Critique of Pure Reason. He argued that categories such as causality and necessity are conditions of possible experience, valid only within the realm of the phenomenal. To apply them to the universe as a whole — something beyond all possible experience — is to misuse them. Moreover, Kant claimed that the cosmological argument ultimately presupposes the ontological argument. To move from “the universe requires a cause” to “a necessary being exists” assumes that existence is a predicate of necessity — a claim Kant dismantled in his critique of the ontological proof <sup>21</sup>.

### **Responses to the Critiques**

Despite their force, these critiques are not insurmountable.

- Response to Ibn Rushd – While his model of eternal dependence preserves God’s role as sustainer, it struggles to account for the traversal of an actual infinite. If the universe has no beginning, then an infinite sequence of temporal events must already have been completed, which is precisely what al-Ghazālī argued to be impossible. Modern mathematics (e.g., Hilbert’s Hotel) reinforces the paradoxes of such an actual infinite in the real world <sup>22, 23</sup>.

Islamically, eternal dependence is unacceptable because it makes creation a necessary emanation, like light from the sun, rather than a free act of will. This strips God of *irādah* (will) and *qudrah* (power), reducing Him to a compelled agent. The Qur’an rejects this notion:

إِذَا قَضَىٰ أَمْرًا فَإِنَّمَا يَقُولُ لَهُ كُنْ فَيَكُونُ <sup>24</sup>

“When He decrees a matter, He only says to it, ‘Be,’ and it is”.

Thus, the view contradicts both rational coherence and Islamic theology.

- **Response to Hume** – Hume’s skepticism about causality highlights important epistemic limits but does not dissolve the principle. Contemporary science operates on the assumption that causal regularities are objective features of the universe, not mere habits of mind. Denying causality at the cosmic level undermines explanatory coherence, leaving the universe’s existence as an inexplicable brute fact. By contrast, positing a first cause provides a coherent explanatory terminus.

- Response to Kant – Kant was right to warn against uncritical extensions of categories beyond experience. However, his sharp division between phenomena and noumena is itself contested. If reason cannot legitimately inquire into the origin of the cosmos, then metaphysical reflection becomes impossible. Moreover, modern cosmology explicitly investigates the universe as a whole, suggesting that at least some application of causal reasoning to the totality is both possible and fruitful<sup>25, 26</sup>.

Taken together, these responses indicate that while Ibn Rushd, Hume, and Kant highlight real challenges, al-Ghazālī’s core insight endures: an actual infinite regress of temporal causes is metaphysically and physically implausible.

### **Modern Analogies and Mathematical Reflections**

Philosophical debates over infinity gained new force in the twentieth century with the development of set theory and the popularization of David Hilbert’s paradox of the infinite hotel. Such analogies vividly illustrate the counterintuitive consequences of applying actual infinities to reality, strengthening al-Ghazali’s medieval insights.

#### **Hilbert’s Hotel**

Hilbert’s Hotel is a famous thought experiment devised by the mathematician David Hilbert to illustrate the counterintuitive nature of actual infinities. It imagines a hotel with a countably infinite number of rooms, each labeled with a natural number (1, 2, 3, ...). At the outset, every single room is occupied. In ordinary life, a “full” hotel cannot admit new guests. However, Hilbert’s Hotel, despite being full, can still accommodate additional visitors.<sup>27</sup>

For example, if a single new guest arrives, the manager can ask the occupant of room 1 to move to room 2, the occupant of room 2 to move to room 3, and so on. Since there is no “last room” in an infinite sequence, this shifting process opens up room 1 for the newcomer. More paradoxically, if an infinite number of new guests arrive, the manager can move each existing occupant from room  $n$  to room  $2n$ , thereby freeing up all the odd-numbered rooms — an infinite number of spaces — for the new arrivals.

The strangeness deepens when departures are taken into consideration. If an infinite number of guests check out, it is unclear how many remain. If the manager asks every occupant in an odd-numbered room to leave, then infinitely many people are gone, yet infinitely many remain in the even-numbered rooms. If, instead, everyone beyond room 100 checks out, then only 100 guests are left, even though infinitely many have departed. Thus, depending on how the process is described, removing “infinity” can yield results ranging from zero to a finite number to another infinity.

These scenarios illustrate that, while transfinite arithmetic is perfectly consistent within mathematics (as developed by Georg Cantor), its translation into physical reality yields

## *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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contradictions and absurdities. A real hotel could never carry out these rearrangements, nor could a physical infinity behave in such ways.

Applied to the philosophy of time, Hilbert's Hotel demonstrates why an actual infinite cannot exist in the temporal past. If the past were composed of an infinite number of events, we would face the same contradictions: we could never "arrive" at the present moment after traversing an infinite sequence, and the "subtraction" or "addition" of past events would lead to incoherent outcomes. Thus, the thought experiment strengthens al-Ghazālī's contention that the past cannot be an actual infinite, but must be finite, pointing to a beginning.

### **Traversal Paradoxes**

Al-Ghazālī's original paradoxes anticipate these insights. If the past were infinite, how could we ever "traverse" an infinite sequence of moments to arrive at the present? A beginningless past would imply that an infinite number of days have already elapsed, which is metaphysically impossible because infinity, by definition, cannot be completed<sup>28</sup>.

### **Library and Chain Analogies**

The paradox becomes clearer with everyday analogies. Consider a library containing an infinite number of volumes. Such a collection could never be completed or added to without paradox. Similarly, a chain without a first link cannot hang; likewise, a causal sequence without a first cause cannot exist. These illustrations serve to translate abstract metaphysics into intuitive images of impossibility.

### **Methodological Note: Mathematics vs. Reality**

It is important to distinguish between mathematical infinity and physical infinity. In set theory, actual infinities are treated rigorously and without contradiction. The symbol  $\aleph_0$  represents the smallest transfinite number, and transfinite arithmetic consistently describes operations on infinite sets<sup>29</sup>. However, the kalām argument is not directed against mathematical consistency but against instantiation in the real world. The paradoxes of Hilbert's Hotel and al-Ghazālī's revolving spheres show that while transfinite numbers are valid abstractions, their application to temporal events or physical sequences yields incoherence<sup>30, 31</sup>.

### **Scientific Perspectives on the Beginning of the Universe**

Philosophical analysis of infinity is strengthened (or constrained) by what our best physical theories say about the universe. Three lines of evidence are especially relevant: (1) relativity and cosmic expansion, (2) past-incompleteness results such as the Borde–Guth–Vilenkin (BGV) theorem, and (3) thermodynamics and the arrow of time. A

fourth, independent strand is observational cosmology, which measures a finite age for the universe.

### **1. Relativity, Expansion, and the “Cosmic Beginning”**

Einstein’s general relativity links the geometry of spacetime to the distribution of matter and energy. Applied to a homogeneous, isotropic universe (the FLRW models), the Einstein equations predict dynamical scale factors: the universe expands or contracts rather than remaining static. Empirically, Hubble’s law (redshifts increasing with distance) and the near-uniform cosmic microwave background (CMB) support an expanding spacetime that extrapolates to a very hot, dense early phase<sup>32</sup>.

Classical singularity theorems (Hawking–Penrose) show that — given reasonable energy conditions and global assumptions — expanding universes are geodesically incomplete in the past, suggestive of a beginning. Although quantum gravity could modify the precise approach to that boundary, general relativity’s large-scale picture already indicates that universal expansion is not compatible with an eternal past under broad conditions<sup>33</sup>.

**Takeaway.** Relativity, combined with observed expansion, sets the stage for a finite past; however, one still needs a theorem that is robust to many model details. BGV plays that role.

### **2. The Borde–Guth–Vilenkin (BGV) Theorem**

The BGV theorem provides a powerful, model-independent constraint: any spacetime that has, on average, been expanding along a past-directed timelike or null geodesic has no infinite past. More precisely, if the average Hubble parameter ( $H_{\text{avg}}$ ) is positive along that geodesic, then the geodesic is past-incomplete<sup>34</sup>. Two clarifications matter for philosophical use:

- Not a singularity claim. BGV does not prove a classical singularity; it proves past-incompleteness. There must be a boundary to past time (a beginning, a prior phase with  $H_{\text{avg}} \leq 0$ , or a new physics regime). Either way, a past-eternal expansion is ruled out.
- Broad scope. The theorem applies even to inflationary and many multiverse scenarios. As long as expansion is positive on average, eternity to the past is excluded. Attempts to evade BGV typically posit non-expanding (or contracting) past phases; those moves bear their own explanatory burdens.

**Takeaway.** BGV undercuts the claim that “cosmology allows an eternal past” in any straightforward way. At a minimum, the past cannot be an actual infinite of successive expanding epochs.

## *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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### **3. Thermodynamics and the Arrow of Time**

The second law of thermodynamics states that, in a closed system, entropy tends to increase. Cosmology operationalizes this as a thermodynamic arrow of time: the universe evolves from a state of low entropy (an early, uniform plasma with tiny gravitational inhomogeneities) to higher entropy states (structure formation, black holes, and eventual heat death). This arrow is deeply tied to why we experience time as flowing from past to future <sup>35</sup>.

**Two implications bear on infinite regress:**

1. Heat-death problem. If the universe had an actually infinite past, the second law suggests it should already be at (or near) thermal equilibrium (maximal entropy). The fact that it is not — indeed, that it started in an extraordinarily low-entropy state — indicates a finite thermodynamic history or a special boundary condition (the “Past Hypothesis”) <sup>36</sup>.
2. Boltzmann fluctuations. In a truly eternal past, rare fluctuations would dominate observers (producing “Boltzmann brains”) rather than ordered cosmic histories like ours—an outcome that most cosmologists regard as unacceptable. Avoiding that pathology typically requires finite pasts or laws that suppress such fluctuations.

Takeaway. The thermodynamic arrow strongly disfavors a past-eternal cosmos in which entropy had infinite time to maximize. The universe’s low-entropy beginning is better explained by a finite past (or a boundary condition tantamount to one).

### **4. Observational Cosmology: A Finite Age (~13.8 Gyr)**

Independent of theory, precision observations of the CMB and large-scale structure fix a finite age for the universe. The Planck satellite’s measurements (within  $\Lambda$ CDM) give an age of  $\approx 13.8$  billion years, consolidating a standard picture in which cosmic time is finite to the past <sup>37</sup>. Whatever new physics may describe the earliest instants, the empirical clock we can read points to a universe with a beginning in finite time.

**Takeaway. Observations do not merely allow a finite past; they measure it.**

#### **Objections and Clarifications**

- “Quantum gravity could remove the beginning.” Quantum cosmologies (e.g., bounce models) can avoid classical singularities, but they do not automatically yield past eternity. Unless the pre-bounce phase has  $H_{\text{avg}} \leq 0$  over the relevant geodesics (and avoids Boltzmann-type problems), BGV-style constraints still apply <sup>38</sup>.

- “But mathematics allows actual infinities.” Yes — in set theory. The kalām contention is about physical instantiation: when transfinite structure is mapped onto temporal sequences or causal chains, paradoxes and explanatory breakdowns arise<sup>39, 40</sup>.
- “Spatial infinity is different from temporal infinity.” This is correct. However, a spatially infinite universe is logically compatible with a finite temporal age. The kalām focus is specifically on temporal regress — successive events — rather than spatial extent.

### **Why This Matters for the Infinite Regress Question**

These scientific results do not, by themselves, prove theological conclusions. They do constrain live cosmological options and undermine the claim that an actual infinite sequence of past physical events is a plausible feature of our world. Relativity and expansion make eternal pasts difficult; BGV shows expanding histories are past-incomplete; thermodynamics points to a low-entropy beginning (not an eternal thermal past); and CMB observations measure a finite cosmic age. In that evidential context, al-Ghazālī’s contention that the temporal regress is finite gains independent support.

### **Integrating Science and Philosophy**

The philosophical rejection of an actual infinite regress gains striking resonance in light of modern science. Al-Ghazālī’s paradoxes of infinity — from revolving spheres to the impossibility of traversing an infinite past — anticipated questions that set theory and Hilbert’s Hotel later dramatized. Contemporary cosmology adds further weight: relativity points to dynamical spacetime, the Borde–Guth–Vilenkin theorem rules out eternal past expansion, thermodynamics suggests a finite arrow of time, and precision measurements confirm a universe of finite age.

While mathematics accommodates transfinite numbers without contradiction, their application to physical temporality yields incoherence. The cumulative picture suggests that al-Ghazālī’s insight is not only philosophically defensible but empirically reinforced.

### **Conclusion**

The kalām cosmological argument stands at the crossroads of metaphysics, mathematics, and science. Its central claim — that an actual infinite regress of temporal causes is impossible — finds support in both intuitive paradoxes and empirical cosmology. At the same time, serious critiques by Ibn Rushd, Hume, and Kant remind us that the argument is not beyond challenge. Ibn Rushd emphasized eternal dependence, Hume questioned

## *Al-Ghazali and the Impossibility of Infinite Regress: A Rational Proof of God's Existence*

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the necessity of causality, and Kant warned against extending categories beyond experience.

However, when these objections are weighed against the paradoxes of infinity and the cumulative evidence from physics, al-Ghazālī's position remains compelling. The philosophical incoherence of an actual infinite, the thermodynamic arrow of time, the BGV theorem's past-incompleteness result, and the observed age of the universe together reinforce the plausibility of a finite past.

Ultimately, while the kalām argument does not provide a deductive demonstration of God's existence, it establishes a strong case that the universe is not eternal. In doing so, it sustains al-Ghazālī's central conviction: that the cosmos had a beginning, and that this beginning points beyond itself to a necessary cause.

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