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The Miraculous Nature of the Qur'an and Infinite Complexity in Fractal Geometry

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The Qur'an possesses a form of infinite complexity and depth, from which new dimensions of scientific insight continue to emerge as scientific knowledge advances. As time progresses, an increasing number of findings from contemporary sciences become evident. Some researchers have examined these sciences and concluded that they correspond with the teachings of the Qur'an, thus serving as evidence for its scientific miracles. The deeper we explore the scientific aspects of this subject, the more profound and intricate these miracles become. This complexity is reminiscent of the infinite structures found in fractal systems. Consequently, this study investigates various scientific data that have been revealed over time and are also referenced in the Qur'an, focusing on the notion of scientific miracles within the text. By employing descriptive, analytical, and comparative methods, this research aims to demonstrate the existence of such data within the Qur'an, particularly in relation to its complexity, which resembles that of fractals. It must be acknowledged that some of the data present in the Qur'an can only be understood through the passage of time and the emergence of new scientific knowledge. This process reflects the

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ongoing harmony between the Qur'an and human scientific inquiry. Addressing complex scientific topics not only highlights the enduring relevance of the Qur'an but also underscores its timelessness, as it was revealed for all times and generations.

KEYWORDS: The Qur'an, Infinite complexity, Fractal, Scientific miracles, Scientific interpretation, Cosmic expansion.

1. Introduction

Numerous studies have been conducted on the miraculous nature of the Qur'an, a topic that has consistently captivated researchers across different historical periods. Consequently, a substantial body of literature exists on this subject. The majority of scholars and researchers are well aware of the Qur'an's miraculous quality. However, differences arise in the manner of articulating this notion. These differences are influenced by the perspectives and historical contexts of individual exegetes and researchers.

Contemporary Qur'anic scholars have also contributed significantly to this discourse. For instance, Mohammad Hossein Baroomand (2005, 226), in his book *"Critique and Assessment of Methods for Establishing the Veracity of the Qur'an,"* not only evaluates the views of various commentators on this topic but also highlights aspects of the Qur'an's miraculousness that pertain to specific historical contexts. He argues that, in an era of scientific advancement, the most compelling approach to affirming the Qur'an's authenticity for contemporary researchers and scientists, particularly in the empirical sciences, is to examine the truths articulated in the Qur'an that may not have been comprehensible in earlier ages.

To date, no independent research has emerged that explicitly aligns the characteristics of fractal systems with the Qur'an or its components. However, a study titled *"Fractal Geometry in Fuzziology and Its Role in the Modeling of Understanding the Language of the Qur'an"* (Bagherian et al. 2022) has been undertaken to model the comprehension of meaning and language in the Qur'an using a fractal framework.

Additionally, another noteworthy article, *"A Systemic Approach to the Fractal Cohesion of Surah Structure with Emphasis on Opening and Closing: The Case of Surah Ar-Rum"* (Assadi et al. 2021), explores the interrelationships among the components of a surah using fractal concepts. By examining elements such as the opening and closing verses, the article investigates the potential for structural harmony governing the composition of the surah.

The present study employs descriptive, analytical, and comparative methods to explore the congruence of scientific miracles in the Qur'an with the attributes of infinite complexity found in fractals. It seeks to address the question of the relationship between complexity in fractal systems and the scientific miracles of the Qur'an. Furthermore, it examines how this complexity may be illustrated in relation to the Qur'an, which is here considered as a fractal system.

2. Fractals

The limitations of Euclidean geometry in elucidating natural order and in modeling various components of nature have paved the way for the emergence of fractal geometry, which is, in fact, a more advanced form of geometry. The term "fractal" derives from the Latin word *fractio,* meaning "to break" or "to create irregular fragments" (Mandelbrot 1983). Fractal geometry was first proposed by Benoit Mandelbrot in 1975 (Ghobadian 2013). Its applications primarily involve the description and modeling of structures characterized by repetitive patterns at smaller scales (Bovill 1996). Thus, at a fundamental level, fractal geometry provides a new language for analyzing the complex shapes found in nature (Peitgen et al. 1993).

2.1. Infinite Complexity and the Generative Capacity of Fractals

Any attempt to define fractals remains incomplete due to their intrinsic structure, which encompasses multiple interrelated features (Pickford 1996). Given that the characteristics of fractals are interconnected like pieces of a puzzle, features such as interconnectedness, evolution, and infinite complexity—a central focus of this study—are deeply interdependent. Among these, infinite complexity is closely linked with other fractal properties.

Complexity in fractals increases with magnification. As one zooms into a fractal structure, new details continuously emerge (Pickford 1996; Mandelbrot 1983; Albers 2008). The concept of infinite detail, or infinite complexity, constitutes the core of Mandelbrot's definition of fractals, which he explores in various forms throughout his work. The infinite complexity in fractals does not only signify the existence of details at every scale. It also reflects the generative capacity of the structure itself. This complexity is the result of the infinite iteration of a simple rule or generating principle. In other words, a fractal structure follows a simple initial law.

With each repeated application of this law (iteration), new layers of complexity and detail are produced. Consequently, this complexity is not random chaos but rather a form of lawful or structured complexity. It demonstrates the capacity to generate infinite patterns and details from a single origin (Mandelbrot 1983). It is this generative and repeatable nature that distinguishes fractal complexity from other types of complexity, thereby making it particularly suitable for modeling layered systems such as the meaning of the Qur'an.

2.2. Exemplifications of Infinite Complexity

One significant outcome of the infinite complexity inherent in fractals is that they do not possess a definitive characteristic scale. In a Euclidean shape, such as a square, there exists a specific characteristic length — namely, the length of a side. If magnified, the structure eventually simplifies and resolves into a straight line. However, in a fractal, no particular scale exists at which details vanish or the structure simplifies. This implies that complexity is present at all levels, from the largest to the smallest, thereby affirming the boundless nature of detail. Stephen Strogatz (2015), in his discussion on fractals, emphasizes that, unlike systems with defined temporal or spatial scales, fractals do not possess such attributes. Accordingly, regardless of the degree of magnification, new intricate patterns and details continuously emerge. This continuity of detail across all scales directly reflects the concept of infinite complexity.

2.3. An Exemplification of Infinite Complexity in Nature

Nature is abundant with phenomena that exhibit fractal characteristics and infinite complexity. Coastal lines provide a classic example of this, as illustrated in Figure 1. Imagine observing the coastline of a continent from a distance. At this scale, one perceives only broad outlines and large bays. As one approaches (i.e., zooms in), capes, indentations, and smaller river entrances become apparent. If one continues to zoom in further, finer details, such as pebbles, grains of sand, and even microscopic irregularities on rock surfaces—come into view. This process of revealing increasingly intricate details at smaller scales can continue indefinitely. The length of a coastline can never be measured precisely, as it depends on the length of the measuring unit. The shorter the step (that is, the greater the precision), the longer the measured length becomes, since more details are encompassed. This scale-dependent irregularity across all levels embodies the essence of infinite.

Figure 1. Illustration of infinite complexity in a coastline, presented as a classic example of a fractal structure in nature (Mandelbrot 1983).

2.4. An Exemplification of Infinite Complexity in the Mandelbrot Set

The Mandelbrot set, depicted in Figure 2, stands as one of the most prominent and well-known instances of infinite complexity in mathematics. It is defined by a simple iterative mathematical formula, $Z_{n+1}= Z_n^2 + C$ (Roozitalab 2009), yet its boundaries exhibit extraordinary intricacy. Upon magnifying the borders of the Mandelbrot set, one observes countless layers of detail, including miniature structures and repeating patterns. These patterns often resemble the entire set or specific portions of it, demonstrating a property of self-similarity.

This process of detail discovery is effectively unbounded. The more one zooms in, the more novel and increasingly intricate structures are revealed, thereby emphasizing its infinite nature. The production of this seemingly limitless complexity from a simple mathematical rule represents one of the clearest demonstrations of the generative power underlying fractal geometry.

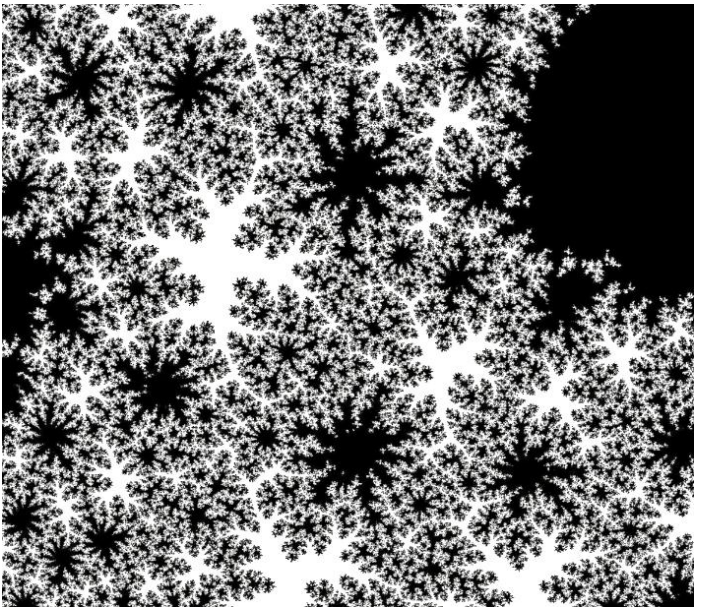

Figure 2. Example of the Mandelbrot Set, illustrating the emergence of infinite complexity from a simple mathematical rule (Mandelbrot 1983).

3. The Miracle of the Qur'an

The term *iʿjāz* (miracle), derived from the Arabic root *ʿ-j-z*, signifies a state of incapacity or inability (Al-Khoei 2006; Zurqānī n.d., 2:227). In a religious context, a miracle refers to an extraordinary event that serves to validate a claim of prophet hood, such that opponents are unable to produce anything comparable (Rezaei Esfahani 2002, 1:68; Al-Khoei 2015; Tabataba'i 1970, 1:86).

There are several approaches to examining the miraculous aspects of the Qur'an (Talebpour 2022). These facets can broadly be divided into two categories: intrinsic and extrinsic aspects. The extrinsic aspect primarily relates to external factors such as preservation, whereas the intrinsic aspects encompass multiple dimensions. These intrinsic dimensions include the following: literary excellence (Arabic rhetoric and eloquence), knowledge of the unseen, influence and persuasive power, aesthetic quality and structural harmony, scientific and factual correspondence, methodology of guidance, psychological considerations, spiritual elements, numerical significance, and universality and permanence (Joudavi et al. 2023).

Notably, among these facets, the dimension concerning scientific truths aligns remarkably with the concept of infinite complexity found in fractals,

particularly due to the evolving and relative nature of human knowledge over time. Therefore, this study focuses on this specific aspect of the Qur'anic miracle and will further explore it through selected examples.

3.1. Scientific Miracle (Justification Based on Science and Truths)

The scientific justification for the miracle of the Qur'an aims to assert the inimitability of the text by emphasizing the alignment between the Qur'an and human knowledge. As time progresses, the Qur'an not only remains relevant but appears to correspond with developments in contemporary science. This dynamic correspondence underscores its uniqueness and distinguishes it from ordinary human productions (Baroomand 2005). This section presents selected examples of the Qur'an's scientific miracles. However, it should be noted that the notion of scientific justification remains a subject of scholarly debate, with both proponents and detractors. Baroomand notes the tendency of some advocates to overlook the external realities of the Qur'an and to become influenced by personal motivations and expectations. He observes that if proponents of the scientific justification defend their stance until the Day of Resurrection, yet lack a genuine connection to the Qur'an and to empirical scientific findings, what benefit can they offer to humanity other than hollow results? How enduring can such constructed connections be? Conversely, if opponents of this theory persist in their rejection, what do they achieve other than alienation from the Qur'an, particularly for those unfamiliar with its message? In such a case, do they not fail both the text and the broader human community?

3.2. Cosmic Expansion

The expansion of the universe is one of the most fundamental and astonishing concepts in modern cosmology. This phenomenon does not simply refer to galaxies moving through space away from one another; rather, it describes the expansion of space itself between galaxies. In other words, the very fabric of space-time is continuously stretching, leading to an increase in distance between cosmic objects that are not gravitationally bound (such as distant galaxies and galaxy clusters). The expansion of the universe is a key feature of the Big Bang cosmological model. This phenomenon can be illustrated through the analogy of an inflating balloon. If points are drawn on the surface of the balloon, the distance between these points increases as the balloon expands, even though the points themselves do not move across the surface. In this analogy, galaxies are analogous to

the points, while the surface of the balloon represents expanding space. Among the key observational evidence for the expansion of the universe, which highlights the evolving nature of scientific understanding and may be interpreted as aligning with the intricate features discussed in relation to the miraculous nature of the Qur'an, the following is particularly significant:

a) Hubble's Law and Redshift: The first compelling evidence for the expansion of the universe was presented in the late 1920s by the American astronomer Edwin Hubble. By combining his own measurements of the distances to galaxies with redshift data obtained by other astronomers, he identified a linear relationship between distance and recessional velocity, now known as Hubble's Law: $V = H_0 \cdot d$

V represents the velocity at which a galaxy is receding. H_0 denotes Hubble's constant, indicating the current rate of expansion of the universe. D represents the distance to the galaxy. The initial evidence for cosmic expansion originated from Hubble's Law, which demonstrated that galaxies at greater distances are receding from us at higher velocities (Hubble 1929).

b) Cosmic Microwave Background (CMB): The existence of the Cosmic Microwave Background radiation, a remnant from the early universe, represents one of the strongest pieces of evidence supporting the Big Bang model and its subsequent expansion. More precisely, the CMB originated approximately 380,000 years after the Big Bang, when the universe had cooled sufficiently for neutral atoms to form, allowing photons to travel freely through space. The CMB is observed as uniform and isotropic radiation in all directions across the sky. Initially, this radiation was exceedingly hot. However, over 13.8 billion years of cosmic expansion, the wavelengths of these photons have been dramatically stretched, a phenomenon known as cosmological redshift, making them detectable today as microwave radiation at approximately 2.73 Kelvin, close to absolute zero. This cooling and wavelength stretching are direct consequences of the universe's expansion (Penzias & Wilson 1965).

c) Abundance of Light Elements: The observed ratios of light elements in the universe correspond closely with predictions from the Big Bang model and the early expansion of the universe. Specifically, the Big Bang theory posits that during the universe's initial moments, extremely high temperatures and densities enabled nuclear reactions (nucleosynthesis), leading to the formation of light elements such as hydrogen, helium, and lithium in precise ratios. The measured ratios of these elements in the current universe are in remarkable agreement with theoretical predictions, providing evidence that the universe was once extremely hot and dense before undergoing expansion and cooling (Kolb & Turner 1990).

3.3. The Phenomenon of Cosmic Expansion in the Qur'an

In verse 47 of Surah Al-Dhāriyāt, the Qur'an states:

وَ السَّماءَ بَنَيْناها بِأَيْدٍ وَ إِنَّا لَمُوسِعُونَ (الذاريات/47)

We have built the sky with might, and indeed it is We who are its expanders (Q. 51:47).

One of the criticisms leveled by literary scholars against the Qur'an prior to the discovery of cosmic expansion concerned an alleged temporal inconsistency. Critics argued that the verse begins with *banaynāhā* (We constructed it) and then shifts to *innā lamūsiʿūn* (We are expanding it). They contended that the past tense, *awsaʿnāhā* (We expanded it), should have been used instead. Historically, interpretations from the early Islamic period up to the era preceding the discovery of cosmic expansion rendered *innā lamūsiʿūn* as a reference to abundance, power, and vastness, which was contextually appropriate for contemporary audiences. However, in the modern era, based on established scientific knowledge, the true meaning of the verse becomes more apparent, particularly as external evidence, i.e., verified scientific facts, corroborates it (Baroomand 2005).

Hence, science has demonstrated that the universe is indeed expanding, and the Qur'anic term *mūsiʿ*, linguistically an active participle from the trilateral root *w-s-ʿ*, encapsulates this notion accurately. From a theological perspective, had the phrase been expressed as "We expanded it," it could have implied a limitation in divine knowledge regarding the ongoing expansion of the universe. Interestingly, this complexity does not terminate here; it appears to extend infinitely, reflecting the relative and continuously evolving nature of scientific knowledge. It is plausible to assert that this dynamic and unfolding complexity aligns seamlessly with the characteristics of infinite complexity observed in ideal fractal systems. As previously noted, this ongoing and progressive complexity is further substantiated by contemporary scientific discoveries related to cosmic expansion.

3.4. Unveiling Complexities and Nuances of Cosmic Expansion in Recent Research

Observations of Type Ia supernovae in the late 1990s revealed not only that the universe is expanding, but also that this expansion is accelerating (Riess et al. 1998; Perlmutter et al. 1999). This remarkable discovery led to the introduction of the concept of dark energy. Dark energy is a hypothetical

form of energy that is uniformly distributed throughout space and exerts negative pressure, analogous to a gravitational repulsion. This negative pressure drives an increasing rate of cosmic expansion. The precise nature of dark energy remains one of the greatest enigmas in contemporary cosmology (Lodha et al. 2025). Nonetheless, the most recent and arguably most significant discovery concerning cosmic expansion, particularly from 2019 to 2024, has profoundly engaged the cosmological community and is referred to as the Hubble Tension. This tension arises from a notable discrepancy between the values of H_0 measured from early-universe observations (Planck Collaboration 2020) and those derived from local measurements (Riess et al. 1998).

In 2023 and 2024, extensive efforts were undertaken to resolve or further illuminate the Hubble Tension. The James Webb Space Telescope (JWST) recently confirmed distance ladder measurements, thereby reducing the likelihood of systematic errors in this methodology and sustaining the Hubble Tension. Previously, concerns had been raised regarding potential systematic errors in measurements obtained from the Hubble Space Telescope (HST), particularly those related to Cepheid variables in crowded stellar environments. The SH0ES team and others, utilizing the unprecedented precision of the JWST, confirmed Hubble's measurements in 2023 and early 2024. These observations indicated that measurement errors from the HST were not significant, and thus the Hubble Tension persists (Riess et al. 2023). Consequently, the probability that this tension merely reflects observational error has been markedly diminished.

Recent findings, such as data from the Dark Energy Spectroscopic Instrument (DESI), have further complicated this enigma. DESI, operational in Arizona, provided an independent measurement of H_0 of approximately 80.0 ± 68.53 km/s/Mpc. This value is closer to that measured by Planck and exhibits a 3.4σ tension with SH0ES. These results add another layer of complexity to the Hubble Tension conundrum, suggesting that early-universe methods and distance-based expansion approaches continue to converge on lower H_0 values, whereas local measurements yield systematically higher values (CERN Courier 2025).

Therefore, if this tension is genuine and not a byproduct of measurement error, it may indicate one of the following possibilities: a) New Physics: Our standard cosmological model (ΛCDM) may be incomplete, and there could exist new physical phenomena in the universe yet to be discovered. This may involve modifications to the nature of dark energy, dark matter, or even the laws of gravity during the early universe. b) Unknown Systematic Errors: Although the probability is low, unknown systematic errors in one or both measurement methods could contribute to this discrepancy.

This Hubble Tension is recognized as a crisis in modern cosmology that may point toward new physics (Cooper 2025). It illustrates that, despite monumental advancements, there remain unexplored facets of fundamental physics regarding the universe, resonating with the concept of infinite complexity observed across fractal scales. Thus, within the Qur'an, we may also identify an analogy to a fractal system, wherein infinite complexity manifests across multiple levels and scales, mirroring the ongoing discovery and unfolding of cosmic phenomena.

4. The Convergence of Scientific Miracles in the Qur'an and the Infinite Complexity of Fractals

The primary basis for relating the scientific miracle (*iʿjāz*) of the Qur'an to the characteristics of infinite complexity in fractal geometry lies in the Qur'anic concept of the infinity of Divine words. Verse 109 of Surah Al-Kahf explicitly illustrates this point:

قُل لَّوْ كَانَ الْبَحْرُ مِدَادًا لِّكَلِمَاتِ رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ أَن تَنفَدَ كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا (الكهف/109)

Say, "If the sea were ink for the words of my Lord, the sea would be spent before the words of my Lord are spent, though We brought another like it for replenishment" (Q. 18:109).

This verse indicates that the Divine Word, like the details of a fractal, possesses a depth and scope that cannot be fully encompassed or exhausted by any material measure. Consequently, this inherent endlessness provides a conceptual framework for modeling infinite generative complexity, a model in which each new scientific discovery represents not the culmination of knowledge but merely an iteration in the unfolding of the endless details latent in both the text and the universe, thereby strengthening the analogy with fractals.

Although references to this topic have appeared in previous sections, it is beneficial to address it independently. Based on the points already stated, one may observe a correlation among science, the Qur'an, and fractals. However, as frequently emphasized, the alignment is specifically between the scientific miracles of the Qur'an and the infinite complexity inherent in fractals, warranting a more detailed exploration of this subject. Before delving further, it is imperative to consider a crucial point raised by Baroomand (2005): The justification for the scientific miracle does not require mentioning all discovered or undiscovered phenomena. Rather, it suffices to highlight examples pertinent to the specific advancements of each

era. Those who adopt an exaggerated stance must provide substantiation for their claims. It is virtually impossible to encapsulate all new discoveries across diverse fields within a single text. Who among us possesses the capacity to identify them all?

Thus, for the scientific miracle in the Qur'an to manifest and gain universal recognition, the scientific topic must be validated within its respective scientific framework, and the Qur'anic implications of the topic must be unequivocal. It is widely acknowledged that certain subjects in the Qur'an present propositions that remain unverified scientifically, and conversely, some scientific discoveries are not explicitly mentioned in the Qur'an. This observation closely aligns with the premise discussed in this research, thereby strengthening the foundation for this convergence.

Building upon the aforementioned considerations, we can discern the definitive nature of the scientific evidence regarding cosmic expansion and its unequivocal implications in the Qur'an. Consequently, one can observe the infinite complexity present both in the Qur'an and in scientific discovery, which aligns with the principles of fractal geometry. Notably, this complexity, reflected across various segments of the Qur'an, is manifest in themes such as cosmic expansion, where both the scientific validation and Qur'anic relevance are conclusive. Thus, by engaging with recent findings, we deepen our understanding of infinite complexity in science, which resonates harmoniously with the Qur'an. This convergence not only aligns with the relative nature of scientific knowledge but also corresponds with the Qur'anic implications, framing the Qur'an as a fractal system. In simpler terms, the infinite complexity observed in fractals parallels the infinite complexity in scientific discovery, which aligns with the teachings of the Qur'an.

It is important to note that this research focuses specifically on the characteristic of infinite complexity from the perspective of generative capacity. In fractal geometry, infinite complexity is achieved through the repeated application of a simple rule or generator to an initial shape. This concept is directly applicable to modeling the relationship between the Qur'an and science. In this framework, the Qur'anic verses and comprehensive expressions serve as the Initial Generator, while each new scientific discovery throughout history, for example, the proof of cosmic expansion, represents an Iterative Step, revealing new and infinite layers of semantic detail and complexity. This process of infinite iterative generation elevates the Qur'an's scientific miracle from a mere "evolutionary understanding" to an "infinite generative structure," the mathematical description of which is confirmed by the fractal model (emphasizing infinite dimension and iteration). This demonstrates the coherence of the Qur'an as a fractal system, were divine knowledge and natural phenomena interconnect across infinite scales of complexity.

5. Conclusion

In light of the concepts and discussions presented, the following conclusions can be drawn:

- Scientific justifications grounded in knowledge and truth, given the relative and evolving nature of understanding over time, can be effectively associated with the infinite complexity observed in fractals.
- The close relationship between the infinite complexity inherent in fractals and the scientific miracles of the Qur'an is elucidated through their convergence under the broader concept of infinite complexity in science, exemplified by phenomena such as cosmic expansion.
- To classify a scientific topic as a Qur'anic miracle, it is essential that both the Qur'anic implications and the corresponding scientific validation are definitive and unambiguous.
- Through the established correlations, we gain insight into the nature of infinite complexity and appreciate how our comprehension of various scientific and natural phenomena evolves over time.
- By examining the scientific miracles in the Qur'an and their alignment with the characteristics of infinite complexity in fractals, we develop a deeper understanding of the operational nature of the Qur'an as a fractal system.

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