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COSMOLOGY, FINE-TUNING, ANTHROPIC PRINCIPLE AND TECHNOLOGICAL RESPONSIBILITY

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ABSTRACT

This paper develops an interdisciplinary analysis at the intersection of contemporary cosmology, philosophy of science, theology, and artificial intelligence. It examines the empirical phenomenon of cosmic fine-tuning and the methodological role of the anthropic principle, clarifying their epistemic limits and interpretative openness. Modern cosmology indicates that the universe's fundamental constants and initial conditions lie within extremely narrow life-permitting ranges, a fact that remains explanatorily underdetermined by current physical theories. The study argues that neither multiverse hypotheses nor teleological interpretations can be imposed as scientific conclusions, as they are metaphysical responses to the same empirical data. Within this framework, human consciousness is analysed as irreducible to algorithmic computation, characterized by intentionality, reflexivity, and moral responsibility. Artificial intelligence is examined as a powerful technological artifact derived from human rationality, but lacking personal subjectivity and ethical agency. The Logos is proposed as a unifying horizon that accounts for the intelligibility of the cosmos, the uniqueness of human consciousness, and the responsibility inherent in technological creation. The paper concludes that responsible development of artificial intelligence requires anchoring technological power within an ethical and anthropological vision grounded in the communion between human reason and the rational structure of reality.

Keywords: cosmology; fine-tuning; anthropic principle; artificial intelligence; responsibility;

INTRODUCTION

Contemporary cosmology has achieved an unprecedented level of empirical precision in describing the large-scale structure and early history of the universe. Observations of the cosmic microwave background radiation, measurements of cosmic inflation, and the mapping of large-scale matter distribution have reinforced the mathematical intelligibility of the cosmos. These advances confirm that the universe is not chaotic at a fundamental level, but structured in accordance with stable and intelligible physical laws.

At the same time, this growing precision raises profound conceptual questions that exceed the purely descriptive scope of physics. Among these questions are the fine-tuning of the universe's fundamental constants, the conditions required for the emergence of life and consciousness, and the deeper meaning of



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cosmic intelligibility itself. These questions invite philosophical and theological reflection, not as competitors to scientific explanation, but as complementary modes of understanding the complex multilayer reality and existence.

In parallel with cosmology, the rapid development of artificial intelligence has intensified debates about the nature of intelligence, consciousness, and responsibility. The assumption that intelligence is reducible to computation has gained cultural traction, yet remains philosophically and anthropologically contested. This paper situates these debates within a broader framework, proposing that cosmology, consciousness, and technology are interconnected through the intelligibility of reality and the ethical responsibility of the human person, centered on Logos.

1. PROBLEM STATEMENT

The phenomenon of cosmic fine-tuning poses a significant conceptual challenge within contemporary cosmology. Numerous scientific studies indicate that slight variations in fundamental constants—such as the cosmological constant, the strength of the fundamental forces, or the ratio of particle masses—would render the universe incapable of sustaining complex structures, chemistry, or life. While physical theories describe how these constants function, they offer limited insight into the origin of these values, thus implying their contingency.

Philosophical interpretations of fine-tuning vary widely. Multiverse hypotheses attempt to account for fine-tuning through statistical selection effects, while teleological interpretations see fine-tuning as compatible with Hristocentric purpose of creation. However, neither interpretation can be derived directly from empirical data alone. This creates a tension between scientific explanation and metaphysical interpretation that is often obscured in public discourse.

Simultaneously, discussions of artificial intelligence frequently blending functional performance with consciousness and moral agency. Claims regarding artificial consciousness or superintelligence often neglect the qualitative dimensions of human experience, including intentionality, meaning, consciousness and ethical responsibility. The absence of an integrative framework linking cosmology, human consciousness, and technological responsibility constitutes a notable gap in current interdisciplinary literature.

2. RESEARCH QUESTIONS

This study is guided by the following research questions:

- What is the epistemic status of fine-tuning within contemporary cosmology?
- How should the anthropic principle be properly understood and methodologically limited?
- What ontological features distinguish human consciousness from artificial intelligence?
- What ethical responsibilities arise from technological creation within an intelligible universe?

3. PURPOSE OF THE STUDY

The purpose of this study is to articulate a coherent interpretative framework that integrates empirical cosmology, philosophical anthropology, and theological experience. The paper does not seek to derive theological conclusions from scientific data, nor to reduce scientific explanation to metaphysical philosophical hypothesis. Instead, it aims to clarify the respective distinct domains of explanation of multilayer reality and to show their mutual coherence.

By emphasizing responsibility and intelligibility, the study proposes a dialogical model that avoids both scientism—where science is treated as the sole arbiter of existence meaning—and fideism—where theological claims are insulated from rational scrutiny.

4. RESEARCH METHODS

The research employs a qualitative, interdisciplinary methodology appropriate to a topic situated at the intersection of multiple domains of knowledge. The following methods are applied:



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- Critical analysis of cosmological literature concerning fine-tuning, inflationary models, and the anthropic principle;
- Philosophical analysis of intelligence and consciousness, with particular attention to intentionality, self-reflexivity, and moral agency;
- Theological experience grounded in classical and contemporary accounts of the Logos as the rational principle of creation.

Methodological reductionism is deliberately avoided. Scientific explanations are treated as descriptions of physical processes, while philosophical and theological interpretations address questions of existence meaning, intelligibility, and value.

5. FINDINGS

The interdisciplinary analysis developed in this study demonstrates that the results of contemporary cosmology, when interpreted rigorously within their proper methodological limits, lead not to forced metaphysical conclusions, but to a **legitimate epistemic openness** toward philosophical and theological reflection. This openness does not signal a deficiency of science, but rather follows naturally from its descriptive and model-based character.

A first major finding of the study is the confirmation that **cosmic fine-tuning constitutes a robust empirical observation**, not an ideological speculation. Observational data concerning the values of fundamental constants and the initial conditions of the universe are well established and supported by widely accepted standard models. Nevertheless, these data do not impose a unique explanation, thereby highlighting the explanatory limits of physics with respect to the ultimate “why” of the universe.

A second essential finding concerns the clarification of the **anthropic principle** as a methodological tool rather than a causal explanation. When used correctly, the anthropic principle, functions as an observational filter; when misused, it risks becoming a disguised metaphysical substitute. This distinction is crucial for an intellectually honest dialogue between science, philosophy, and theology.

Third, the analysis reveals an **irreducible ontological distinction between human consciousness and artificial intelligence**. Although AI systems may reproduce or even surpass limited cognitive performances, they do not possess interiority, intentionality, or moral responsibility. This distinction has direct ethical implications for the design, deployment, and governance of technology.

Finally, the study shows that the theological notion of the **Logos** offers a coherent framework within which both cosmic intelligibility and the uniqueness of human consciousness can be understood, without transforming theology into a “competing explanation” to science. *Logos* emerges as a horizon of meaning rather than as a physical hypothesis.

5.1 Universe: relation between science and orthodox theology

The position of the Orthodox Church regarding the relationship between theology and science is affirming their distinction and complementarity (Ierotheos Vlachos, 2013, 67-69) in accordance with Tradition.

Saint Luke of Crimea affirms that science has the role of leading man thirsting for truth, from what is created to the Creator:

"If we analyze religion in its essence, we must say that it is an inner experience, as worship before God and communication with Him. We should agree that science not only does not contradict religion, but even more than that, science leads to religion. [...] Science is the one that demonstrates its necessity. It asks the questions that religion answers. According to the law of cause and effect, science brings us to the First Cause of the world, and religion answers us Who is this Primary Cause, Creator not only of the world, but also of man. [...] Science reveals us the eternal Logos of existence, which conditions this harmony. Science brings us to the need for a rational meaning in life. [...] Religion answers us that GOD is that [rational meaning]." (Saint Luke of Crimea, 2010, 72-73)

St. Maximus the Confessor emphasizes that in creation there are three essential laws. *"By 'general laws' I mean the natural law, the scriptural law, and the law of grace."* (Saint Maximus the Confessor, 2018,



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510). The first law is fundamental to the entire cosmos, ensuring its existence towards the *Christocentric* scope. By contemplating nature (θεωρία Φυσική) with all its constituent elements, motivated by knowing and living by the Truth, one can gain a natural knowledge of God, His justice, wisdom, and goodness. The second law is contained in the Scriptures, more precisely in the Old Covenant. It presents God's relationship with men in history, being summarized in the laws and commandments given to men by God.

The third law corresponds to humanity, the *Logos*, and to His saving and deifying work. It is the spiritual law of Christ (Gal 6:2). The *Logos* is the author of all three laws, being present in them in different degrees. The three laws present the economy of creation, salvation and deification of man. They correspond to the progressive revelation of the *Logos* to the people and the progressive development of their degree of knowledge of God, towards fullness in Jesus Christ.

Thus, through the first law we arrive at the second, and through this at the third, which ensures the fullness of the union and knowledge of God. So, the spiritual law includes the other two previous ones, being their fulfillment in the mystery of humanity of the *Logos*.

5.2 Cosmology and Fine-Tuning

Cosmic fine-tuning refers to the observation that the universe lies within an extremely narrow region of the possible parameter space of physical laws that allows for the existence of complex structures. Among the most frequently discussed examples are the value of the cosmological constant, the ratio between electromagnetic and gravitational forces, and the masses of fundamental particles.

The analysis shows that cosmological constants values are not arbitrary in a chaotic sense, but precise in a mathematical sense, making possible the stability of atoms, the formation of stars, and the synthesis of chemical elements. However, contemporary physics does not provide a unique mechanism that derives these values from deeper theoretical principles, but having a contingent nature. This situation gives rise to what may be described as an "explanatory remainder", which is not merely a temporary gap but a structural limit of current explanatory physical model.

Universe fine-tuning does not constitute a scientific proof of design, but it legitimately invites philosophical and theological reflection. It is important to emphasize that *fine-tuning does not demonstrate purpose in a scientific sense*. Rather, it indicates that the universe is compatible with life and with intellect, and that this compatibility is extremely sensitive to initial conditions. Fine-tuning thus becomes a legitimate point of contact between cosmology and reflection on existential meaning.

Sir Martin Rees notes the contingent character of the laws of science and the *fine-tuning* of the universe, and the necessity to involve the metaphysics in their explanation:

"Our everyday world, simply shaped by subatomic forces, also owes its existence to the well-regulated speed with which the universe expands, the processes of galaxy formation, the appearance of carbon and oxygen in old stars, etc. A few basic physical laws give the "rules"; our emergence from a simple Big Bang depended sensibly on the six "cosmic numbers". If these numbers had not been "well-tuned", the gradual unfolding of the successive layers of complexity would have stopped in its tracks. [...] We must look for other reasons for the providential values of the six numbers." (Martin Rees, 2010, 209-210).

In the beginning, each point in space represented a possibly different way from which the Universe could have started. Thus, the Creator, in order to make a low-entropy universe in which it would be possible for rational human life to emerge, had to choose exactly a certain point in the phase space. Each point in phase space corresponds to a certain type of possible universe.

Phase space is a method of mathematical representation of space. *The phase space method* was introduced by Henry Poincaré for the study of dynamical systems with one or more degrees of freedom. In principle, it is associated with the movement of the system considered a point that moves simultaneously with the system in a space related to a coordinate system, made up of the variables (parameters) that determine the momentary position of the system and the derivatives of these variables, called *phase space*.

The advantage of this method of representing space is that it presents a clear picture of all the possibilities of movement that arise in a dynamic system.

Scientist Roger Penrose, Nobel Prize owner, referring to the fine-tuning of the universe, concludes:



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"How large was the initial volume of phase space that the Creator had to aim for in order to produce a universe compatible with the second law of thermodynamics and the one we are now observing? [...] This value shows us how precisely the Creator had to aim, namely with an accuracy of part of $10^{10^{123}}$. This is an extraordinarily high value. We can't even write this number in its entirety, in base 10 it would be «1» followed by 10^{123} successive zeros! Even if we wanted to write '0' on every proton and neutron in the entire universe – in fact, we could take all the other particles in a row – we won't be able to write the whole number because of the lack of particles." (Roger Penrose, 2006, 614).

The rationality of creation from the perspective of current cosmology is based on the nature of the observed interactions between the particles of matter of the universe, which according to human intellectual knowledge implies an order, which denotes the existence of a plan.

The scientist Max Plank scientifically affirms the existence of the rational foundation of creation, the contingent character of the laws of science, and the existence of multilayered physical and metaphysical reality:

"Metaphysical reality is not to be understood spatially, as being situated behind the natural world. Metaphysical reality is not located behind empirical experience, instead is located in its very depths, structuring and determining it. All we want to say is that the sensible world is not the only one that exists, but there is also another reality, superior, inaccessible to empirical experiment, but which science intuitively recognizes. Scientific knowledge makes the scientist research and discovers these deep structures of existence." (Max Plank, 1949, 174).

On the contingent nature of the laws of science, professor John Hands, who studied chemistry at the University of London, states:

"Science, an empirical discipline, cannot explain what caused the existence of these physical and chemical laws, why these parameters have their respective critical values, and why there was on planet Earth a concurrence of extremely improbable and unusual factors, which, combined, produced the necessary conditions for our evolution. (Multiverse conjectures are just untestable speculations, and most are based on questionable logic.) And without this knowledge, the causal chain that led to the emergence and evolution of humans is incomplete." (John Hands, 2019, 671).

Saint Luke of Crimea, emphasize that science cannot be used as a rational justification for inexistence of God

"In general, we don't see things as they are, but we perceive them according to our own point of view from which we analyze them. If we cannot understand by use of scientific means of knowledge what lies behind things, i.e., their essence, even more we cannot know the Primary Essence, God. This is the reason why science cannot deny the existence of God, because this domain is outside its competence, as well as the entire domain of the essence of things." (Saint Luke of Crimea, 2010, 50-51)

5.3 The Anthropic Principle: Scope and Limits

The anthropic principle, in its weak formulation, states that our observations of the universe are conditioned by the requirement that human observers must exist. This formulation may seem tautological, yet it is methodologically useful insofar as it prevents misinterpretations of cosmological data.

By contrast, strong anthropic formulations suggest that the universe is necessary or oriented toward the emergence of human life and consciousness. The present analysis shows that such claims exceed the strict domain of cosmology and belong instead to philosophical or theological discourse. They are neither invalidated nor validated by science itself.

An important outcome of the study is the clear distinction between the anthropic principle and multiverse hypotheses. The multiverse represents a speculative theoretical extension intended to provide a statistical context for fine-tuning. However, the lack of observational facts renders the multiverse hypothesis just a metaphysical-theoretical construct and not an empirical conclusion. On the other hand, the orthodox theological explanations of Hristocentrism are based on specific spiritual practical experience, validated by the Church, observed throughout its history, precisely in Saints activity.



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Orthodox theology affirms that universe is created by God with a *Christocentric meaning and purpose*, according to "His will, according to His good pleasure which He purposed in Himself, that the dispensation of the fulness of the times He might gather together in one all things [ἀνακεφαλαιώσασθαι] in Christ" (Ephesians 1:9-10) (The Orthodox Study Bible, 2008).

The Greek term "ἀνακεφαλαιώσασθαι" (anakephalaiōsasthai) is usually translated as "to unify under one head" or "to recapitulate". It comes from the Greek word "κεφαλή" (kephalē), which means "head". In a broad sense, "κεφαλαιόω" (kephalaiōō) means "to summarize", "to summarize", "to gather" or "to unify under one head". The prefix "ἀνα-" (ana-) indicates a movement of reunion or renewal. Combined, the term signifies the dynamics of the work of bringing all things under one head or recapitulating towards renewal.

St. Paul emphasizes that the ultimate goal of God's plan is for all things in creation to be brought (recapitulated) under the same Head, Christ ("*anakephaleosasthai ta panta en to Hristo*"), in order to be renewed. In the Vatopedi version of *the New Covenant*, *anakephaleosasthai* is translated as "recapitulation" (Noul Testament - Sfânta Mare Mănăstire Vatoped, 2018). Thus, the central role of the Lord Jesus Christ in salvation and in the renewal of the entire cosmos in the "*new heaven and new earth*" is emphasized.

5.4 Human Consciousness and the Logos

Human consciousness is distinguished by its capacity for reflexive self-awareness, recognition of truth, and moral responsibility. These features cannot be reduced to algorithmic processes without losing their essential qualitative dimension. As such, consciousness cannot be adequately explained as information processing alone, without loss of qualitative meaning.

The analysis demonstrates that computational reductionism fails to account for subjective experience, intentionality, and orientation toward existential meaning, focused on Truth. Consciousness is not merely a functional output, but a mode of participation in the intelligibility of reality.

Within this context, the concept of the *Logos* is not introduced as a supernatural explanation of physical laws, but as a metaphysical affirmation concerning the rational foundation of existence and its contingent nature. The *Logos* accounts for why the universe is intelligible and why the human mind is capable of understanding it. This correspondence is not logically necessary, but it is ontologically coherent and proven in the Church practical experience, especially in the Saints.

Science not only answers questions about how the universe works, but it is able to do so in a universally accepted way. However, *human consciousness plays a decisive role in scientific study because the facts studied are already interpreted by scientists*. Most of the time it is not possible to see directly what was happening, being necessary to deduce from what we observe, and deduction requires an interpretation. Then *the results of the experiments must be interpreted with the involvement of the human intellect*, as the Anglican scholar and theologian John Polkinghorne stated:

"To make interpretations, you have to already know some science. You can't just sit and watch; You have to choose a point of view. Choosing the point of view implies an act of intellectual daring, it involves betting that things are one way or another. This means that in science, experiment and theory, fact and interpretation are always merged. They are as inseparable as the meaning and ink that together make up [written] words." (John Polkinhorne, 2006, 15)

5.5 Artificial Intelligence and Ethical Responsibility

Artificial intelligence represents one of the most advanced expressions of human instrumental rationality. It exploits the mathematical structure of reality and the human capacity for abstraction. Nevertheless, AI does not possess consciousness, intentionality, or moral responsibility.

A central finding of the study is the reaffirmation that ethical responsibility cannot be delegated to technology. Technological power amplifies humanity moral responsibility rather than replacing it. Algorithms cannot be moral subjects, regardless of their complexity. Responsibility necessarily remains at the level of the human person and the human community.



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Technological development, when detached from a solid ethical and anthropological framework, risks becoming autonomous and dehumanizing. By contrast, when understood as a responsible participation in the Logos, technology can become an instrument in the service of life, truth, and the common good.

CONCLUSION

This study argues that cosmology, human consciousness, and artificial intelligence converge on the question of responsibility within an intelligible universe. Fine-tuning and the anthropic principle highlight the limits of scientific explanation without undermining its validity. Human consciousness occupies a mediating role between cosmic intelligibility and ethical action.

Artificial intelligence, as a product of human rationality, must remain subordinated to ethical responsibility and the dignity of the human person. Communion with the Logos provides an integrative horizon in which scientific knowledge and technological power are oriented toward meaning, responsibility, and human flourishing.

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