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Article

Agent: A New Paradigm for Fundamental Units of the Universe

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Abstract: This study proposes that Agent is not only the core concept of artificial intelligence but also a key factor driving the significant paradigm shift in 21st-century science. Initially, from an information-processing perspective, we establish Standard Agent Model, positing as an axiom that any system with information input, output, storage, creation, and control capabilities constitutes an agent. Based on this premise, we derive two extreme states of agent and their evolutionary driving mechanisms: Absolute Zero Agent (α Point), corresponding to the state where all five essential capabilities are zero; and Omniscient and Omnipotent Agent (Ω Point), where all five essential capabilities approach infinity. The driving force behind agent evolution toward α Point is termed Alpha Gravity, and toward Ω Point is termed Omega Gravity. From this foundation, we further construct a General Model of Agent Evolution and an Intelligent Universe Evolution Model. The results reveal that the Universe is essentially a dynamically evolving agent, and agent constitute the fundamental units of the Universe. Based on this theoretical framework, the study achieves significant theoretical advancements in five key areas: (1) Establishing a unified formal description of agent to realize a unified theoretical framework for physical and intelligent systems; (2) Defining observers as agent with varying intelligence levels, thereby uncovering the essential reason behind the differing descriptions of natural laws by classical mechanics, relativity, and quantum mechanics; (3) Providing new theoretical interpretations for fundamental scientific concepts such as the dualism between objectivity and subjectivity, the unity of determinism and indeterminism, and the emergence of space-time structures, based on characteristics exhibited by Universe-agent at different evolutionary stages; (4) Proposing fundamental definitions of intelligence and consciousness grounded in the functional structure, evolutionary boundaries, and evolutionary dynamics of agent; (5) Compared to string theory and loop quantum gravity, the proposition that Agent constitutes the fundamental unit of the Universe not only integrates essential elements such as information, matter (objective reality), and mind (subjective non-reality) but also establishes a more comprehensive theoretical framework for the fundamental structure of the Universe.

Keywords: agent; universe; fundamental units

1. Introduction

The fundamental building blocks of the Universe are generally understood as the smallest, indivisible particles or entities in nature. For centuries, physicists have been dedicated to uncovering the existence and properties of these fundamental units to better understand the origins, evolution, and role of these entities in the material world. From classical physics to modern particle physics, and further to quantum field theory and string theory, the definition of the Universe's fundamental components has continually evolved.

Exploring fundamental units of the Universe is crucial for scientific research. It not only deepens our understanding of the composition and nature of the Universe but also provides theoretical

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support for addressing fundamental scientific issues such as the origins of matter and the mechanisms underlying the Universe evolution. However, the fundamental units of the Universe in physics fail to effectively incorporate living systems such as humans, animals, and plants, or artificial intelligence systems like robots, computers, and software programs into a unified theoretical framework, and are unable to explain the origins and principles of intelligence and consciousness.

Since the beginning of the 21st century, artificial intelligence technology has exerted unprecedented influence on human society in both breadth and depth. The awarding of the 2024 Nobel Prizes in Physics and Chemistry to scientists in the field of artificial intelligence [1] marks a historic moment, highlighting the increasingly close integration between artificial intelligence and fundamental science [2], and indicating that intelligent technology is progressively reshaping the theoretical paradigms of traditional disciplines. Against this backdrop, a topic worthy of deep exploration emerges: whether Agent, as the core concept of artificial intelligence, can be considered the fundamental unit constituting the Universe, thereby providing an entirely new theoretical perspective for addressing foundational problems in physics, intelligent science, and philosophy of science.

Although the concept of Agent has been extensively studied, a unified definition remains elusive. Researchers have proposed numerous definitions and functional frameworks of Agent based on their theoretical perspectives. Our breakthrough builds upon the von Neumann architecture, consolidating various existing descriptions of Agent functions into a unified information-processing framework, thus constructing Standard Agent Model. The core concept of this model states: Any Agent can be regarded as a system possessing five essential capabilities—information input, output, storage, creation, and control [3]. As shown in Figure 1.

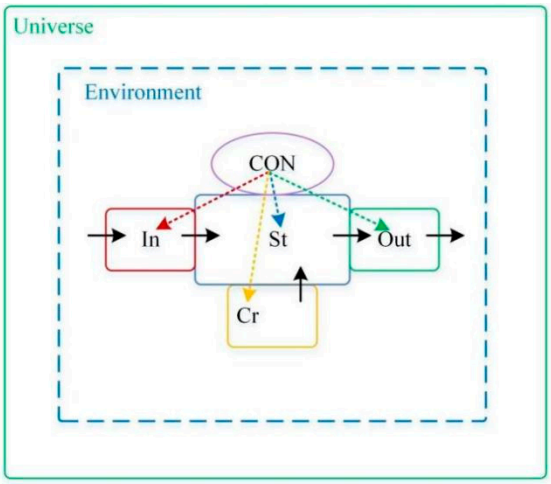

Figure 1. Structure of Standard Agent Model.

Further analysis reveals that the five essential capabilities of an Agent exhibit two special states under extreme conditions: Absolute Zero Agent (α Point), defined as the state in which all five capabilities are zero; and Omniscient and Omnipotent Agent (Ω Point), defined as the state where all five capabilities approach infinity. These two extreme states not only constitute the evolutionary boundaries of Agent but also indicate the direction of Agent evolution. Consequently, we propose Alpha Gravity (driving Agent evolution toward α Point) and Omega Gravity (driving Agent evolution toward Ω Point) as two fundamental dynamic mechanisms of Agent evolution.

Within this theoretical framework, we have established General Model of Agent Evolution [4] and Intelligent Universe Evolution Model [5], leading to a core conclusion: the Universe is essentially an Agent continuously evolving between α Point and Ω Point, driven by Alpha Gravity and Omega Gravity, and Agent constitutes the fundamental unit of the Universe.

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Contrary to John Wheeler's "It from Bit" theory [6], which considers information as the fundamental constituent of the Universe, our research proposes an "It from Agent" paradigm, asserting that Agent is the Universe's fundamental unit.

First, within this paradigm, physical systems, artificial intelligence systems, and biological intelligence systems can all be unified as special cases of Standard Agent Model based on different values of the five essential capabilities. This unified framework reveals commonalities among different types of Agent and provides a universal methodology for characterizing their evolutionary laws and dynamic mechanisms, thus laying the theoretical foundation for Agent evolution.

Second, the concept of the observer, central to physics, can similarly be incorporated into the Agent framework. By viewing observers as Agent with varying intelligence levels, we can deeply explore how the intelligence level of observers influences physical theories, revealing the fundamental reasons behind the distinctions between classical mechanics, relativity, and quantum mechanics.

Third, changes in the Universe's intelligent states as an Agent allow us to offer fundamentally new interpretations for significant scientific concepts such as objectivity versus subjectivity, determinism versus indeterminism, and the nature of space-time.

Fourth, establishing Agent as the research object in intelligent science, with defined functional structures and evolutionary laws, provides foundational explanations for the essence and origins of intelligence and consciousness.

Finally, Agent, as the Universe's fundamental unit, provides a more comprehensive explanatory system for the ontological structure of the Universe. This framework effectively integrates concepts such as information, matter (objective reality), and consciousness or mind (subjective non-reality). Additionally, this theory provides a novel analytical tool for assessing fundamental assumptions of string theory and loop quantum gravity, contributing to evaluating their theoretical validity.

In this paper, we propose Standard Agent Model as a fundamental axiomatic assumption and deduce the proposition that Agent constitutes the fundamental unit of the Universe. On this basis, we explore several foundational issues across physics, philosophy of technology, and artificial intelligence. Although this theoretical framework, as an emerging research paradigm, still involves some topics requiring further investigation and concepts yet to be rigorously quantified, it provides a novel interdisciplinary perspective for addressing fundamental questions in physics, philosophy of technology, and artificial intelligence, thereby opening an innovative exploratory path for future research.

2. Scientific and Philosophical Evolution of the Fundamental Units of the Universe

Are the fundamental units of the Universe limited solely to matter, or do they also encompass information and consciousness? This question permeates the evolution of physics and philosophy. From classical particle theory to modern quantum field theory, and further to information science and consciousness studies, humanity continually explores the most fundamental forms of existence. Yet, current theories still struggle to unify matter, information, and consciousness. This chapter reviews explorations by physics and philosophy into the fundamental units of the Universe, analyzing their limitations, thus laying the groundwork for proposing Agent as the fundamental unit of the Universe.

2.1. The Fundamental Units of the Universe from the Perspective of Physics

The groundbreaking advancements in physics at the beginning of the 20th century profoundly altered humanity's understanding of the fundamental units of the Universe. Rutherford's atomic model (1911) unveiled the microscopic structure of matter, establishing the concept of atomic nuclei [7]. In 1919, Rutherford discovered the proton through his experiment of bombarding nitrogen nuclei with α particles [8], and in 1932, James Chadwick confirmed the existence of the neutron [9]. These

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discoveries revealed that atomic nuclei are composed of protons and neutrons, further advancing humanity's understanding of the fundamental building blocks of the Universe

However, as high-energy physics experiments progressed, scientists discovered that electrons, protons, and neutrons might not be truly fundamental particles, prompting deeper inquiries into the Universe's fundamental units.The introduction of the quark model (1964) marked a significant shift in recognizing the fundamental units of matter [10]. Subsequent experimental validations revealed six types of quarks, forming the foundation of the Standard Model [11]. The Standard Model integrates quantum electrodynamics (QED) and electroweak theory, successfully describing fermions (fundamental particles constituting matter) and their interactions mediated by bosons [12]. Despite precisely describing particle physics phenomena, the Standard Model still cannot incorporate gravitational quantization nor fully encompass all fundamental units of the Universe [13].

Quantum Field Theory (QFT) further expanded the concept of fundamental particles, suggesting particles are merely excitations of quantum fields, implying the Universe's fundamental existence might be fields rather than discrete particles [14]. Although QFT provides novel insights into studying fundamental physical units, it still encounters significant challenges in quantum gravity and cosmological scales [15]. String Theory attempts to describe all fundamental particles as vibrational modes of one-dimensional strings, predicting the existence of additional dimensions [16]. Concurrently, Loop Quantum Gravity (LQG) proposes that spacetime may not be continuous but composed of discrete quantum units, providing a new direction toward gravitational quantization [17].

Despite offering multiple possibilities for understanding the Universe's fundamental composition, these theories still face challenges related to theoretical incompleteness and a lack of experimental verification.

Firstly, the experimental limitations of String Theory make direct verification difficult. The extra dimensions predicted by String Theory have not yet been observed experimentally, and current experimental energy scales fall far short of probing string effects. Given that the scale of strings is approximately the Planck length, even the most advanced particle accelerators cannot provide sufficient energy to test its core predictions, keeping String Theory in the theoretical deduction phase without experimental evidence [18].

Secondly, Loop Quantum Gravity faces compatibility issues, failing to integrate naturally with the Standard Model and unable to fully describe high-energy phenomena, such as particle masses and interactions. The Standard Model has been extensively validated experimentally, yet the Loop Quantum Gravity framework has not successfully incorporated its fundamental particles and interactions [19]. Moreover, the theory's quantization of spacetime at microscopic scales, such as the Planck scale, has yet to gain support from experimental or observational data, thus restricting its applicability as a unified theory [20].

Finally, current physics frameworks primarily describe matter and energy but have yet to integrate non-material attributes such as information, intelligence, and consciousness, resulting in a disconnect among physics, intelligence science, and life sciences [21]. Existing theories cannot unify physical systems, intelligent systems, and living systems, lacking a universal theoretical framework from fundamental particles to life [22].

2.2. Information and Consciousness: Philosophical Controversies on the Universe's Fundamental Units

Physics traditionally assumes the Universe's fundamental units to be objective matter, but are information and consciousness also fundamental forms of existence? This question has become central at the intersection of science and philosophy.

Wheeler's "It from Bit" theory proposes that information is the true fundamental unit of the Universe, arguing that physical reality arises from information processing and observational acts [23]. This view provides the foundation for quantum information theory and plays a significant role in addressing issues such as the black hole information paradox [24]. However, this theory does not explain the mechanism by which information constitutes physical entities nor how intelligence and

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consciousness emerge from information processing. In other words, while information may underlie physical reality, whether information itself has independent existence remains an unresolved issue.

Consciousness Universe Theory further posits that consciousness may not be merely a byproduct of the brain but rather one of the Universe's fundamental attributes [25]. David Bohm's theory of "Implicate Order" suggests that matter and consciousness are unified at a deeper level, determined by implicit informational structures [26]. Yet, this perspective lacks empirical evidence and remains a philosophical hypothesis within the scientific community. Moreover, even assuming consciousness as a fundamental attribute of the Universe, the theory provides no operational mechanism by which consciousness influences the physical world, nor does it clarify why only certain complex systems (such as the human brain) exhibit consciousness.

These issues indicate that both current physical theories and theories of information and consciousness have their respective limitations. Therefore, we may need an entirely new scientific paradigm capable of organically integrating physics, information, intelligence, and consciousness, thus proposing a more complete theory of the fundamental units of the Universe. In the rapidly developing field of artificial intelligence in the 21st century, its core concept—Agent—is gradually revealing its potential to fulfill this mission .

3. The Evolution and Definition of Agent

Since the beginning of the 21st century, artificial intelligence technology has developed rapidly, with the concept of Agent gradually becoming a central research object in artificial intelligence, computer science, and cognitive science. From early cybernetics to modern deep learning models, Agent has provided a unified theoretical framework and flexible modeling methods across various subfields, finding extensive applications in automatic control, robotics, biological behavior simulation, swarm intelligence, self-learning, and adaptive systems [27]. Although the definition of Agent remains controversial, with different disciplines emphasizing different aspects, by 2025 Agent has clearly emerged as a critical development direction in the intelligent industry, with leading enterprises such as Microsoft, Google, NVIDIA, and Meta actively promoting its large-scale commercial deployment [28].

The concept of Agent traces back to cybernetics and computational theory. In 1948, Norbert Wiener systematically explored feedback control principles of intelligent systems in "Cybernetics" [29], while John von Neumann introduced the theory of self-reproducing automata, describing biological systems as information-processing entities [30]. In 1956, Herbert A. Simon and Allen Newell developed the "Logic Theorist", demonstrating for the first time a computer's capability for logical reasoning, laying the groundwork for subsequent Agent research [31].

In the 1980s, Rodney Brooks proposed the "Subsumption Architecture", emphasizing that Agent could interact directly with the environment through perception-action cycles without complex internal representations [32]. In 1995, Stuart Russell and Peter Norvig introduced a generalized framework of Agent in "Artificial Intelligence: A Modern Approach", defining Agent as an entity capable of perceiving the environment and taking actions [33]. Subsequently, Stan Franklin and Art Graesser proposed stricter standards for Agent, highlighting critical attributes such as autonomy, reactivity, and proactivity [34].

With increasing computational capabilities, Agent modeling methods have continually evolved. The Belief-Desire-Intention (BDI) architecture emerged as a representative paradigm for cognitive Agent, while the rise of deep learning promoted the development of reinforcement learning Agent and multimodal Agent [35]. DeepMind's AlphaGo, utilizing deep reinforcement learning, exhibited sophisticated decision-making capabilities [36], whereas GPT and DALL-E developed by OpenAI demonstrated the potential of large language models as Agent [37].

Despite diverse definitions, academia generally agrees that autonomy, reactivity, and proactivity constitute Agent's three core characteristics. Additionally, some researchers, including McCarthy and Bostrom, suggest that the future development of Agent might involve higher-level capabilities such as sociality, analogical reasoning, and self-consciousness [38].

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Amid diverse definitions of Agent, we argue that the essence of Agent lies in information processing. From cybernetics to modern artificial intelligence, Agent fundamentally revolves around information input, storage, computation, output, and adaptive control. The viewpoint proposed by Barzel and Delbrück indicates that life, from single-celled organisms to advanced intelligent systems, inherently involves information processing systems [39]. This aligns with the role of von Neumann architecture in both computing and biological systems [40]. Therefore, constructing a unified theoretical framework of Agent from an information-processing perspective could be crucial in resolving current definitional disparities.

Based on this perspective, we further deduce that Agent not only constitutes the core concept of artificial intelligence but may even represent the fundamental unit of the Universe. This conclusion will be explored in greater depth in subsequent chapters.

4. The Proposition of Agent as the Fundamental Units of the Universe

In 2014, when attempting to establish a precise standard for measuring the level of machine intelligence relative to human intelligence, we analyzed the intelligent characteristics of humans, other living organisms in nature, computers, robots, and AI systems. Through this analysis, we recognized the need for a more fundamental and universally applicable theoretical framework.

Drawing upon the von Neumann architecture from computer science, we proposed Standard Agent Model [3]. The core concept of this model is that any system can be viewed as an Agent, endowed with five fundamental functions: information input, output, storage, creation, and control of these functions' application.

The mathematical expression for Standard Agent Model is:

$$a = (Con_a; \{In_a(I), Out_a(I), St_a(I), Cr_a(I)\})$$

(Note: a represents any agent; Con represents the control function; In represents input; Out represents output; St represents storage; Cr represents creation; I represents information)

Compared to the traditional von Neumann architecture, Standard Agent Model introduces two critical architectural enhancements: Firstly, it deeply integrates computation and storage, realizing dynamic memory functions, thereby overcoming the limitation of separation between computation and storage in conventional architectures. Secondly, the model incorporates an information creation module, endowing Agent with the capability to generate and reconstruct information rather than merely storing and processing external inputs.

These improvements enable Standard Agent Model to accurately represent Agent capable of information and knowledge innovation, including human beings—something unattainable by traditional computing architectures. Within this framework, all manifestations of intelligence—be it image recognition, speech recognition, memory, learning, reasoning, computation, pattern discovery, goal setting, decision-making, speech generation, or image creation—are conceptualized as processes and results of information processing. This perspective further echoes the previous assertion that "the essence of Agent lies in information processing. From cybernetics to modern artificial intelligence, Agent fundamentally revolves around information input, storage, computation, output, and adaptive control," thus providing a more robust foundation for the unified theoretical description of Agent.

The values of these five essential capabilities range from zero to infinity, allowing for a systematic classification of Agent based on their functional strengths. For instance, objects such as rocks, which lack intelligence, have all five essential capabilities valued at zero. In contrast, humans and AI systems possess finite but nonzero values, ranging between zero and infinity. Hypothetical entities in physics, such as Laplace's Demon, or theological and philosophical constructs like "God," would be characterized by these essential capabilities having infinite values. This differentiation in capability values enables a structured classification of Agent and provides insight into how Agent dynamically evolve through variations in these functions.

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In 2018, based on Standard Agent Model, we designed an intelligence level assessment scale, which was applied to a set of 20 AI systems, including Google Search, Apple Siri, and Microsoft Bing, as well as a comparative group consisting of children (aged 6), adolescents (aged 12), and adults (aged 18 and above). The results revealed that the highest-scoring AI system at the time, Google Search, achieved only half the intelligence level of a 6-year-old child. However, by 2024, newly evaluated models such as GPT-4.0 and Claude had already surpassed the intelligence level of a 12-year-old adolescent.

In 2020, we identified two extreme states within Standard Agent Model. If an agent's five essential capabilities are all reduced to zero, it becomes incapable of processing any information, a state we defined as Absolute Zero Agent, denoted as α Point. Examples of Absolute Zero Agent in nature include inanimate objects such as rocks, iron bars, deceased biological organisms, and decommissioned robots.

Conversely, if an agent's five essential capabilities reach infinity, it attains omniscience and omnipotence in information processing. We termed this entity Omniscient and Omnipotent Agent, or Ω Point. While no known natural entity corresponds to this state, theoretical constructs such as Maxwell's Demon, Laplace's Demon, and the concept of "God" in philosophy and theology align with the characteristics of Ω Point.

In theory, for an agent to evolve toward either of these extreme states, a corresponding driving force is required. We thus defined Alpha Gravity as the force driving Agent toward α Point and Omega Gravity as the force driving Agent toward Ω Point.

In nature, the effects of Alpha Gravity can be observed in species extinction due to evolutionary decline, individual organisms aging toward death, or cases of voluntary self-termination. Conversely, the impact of Omega Gravity is evident in human civilization's exponential intelligence growth over the past millennia, as well as in the individual cognitive development from infancy to adulthood. Based on this, we formulated General Model of Agent Evolution [4](As shown in Figure 2), which posits that every agent is influenced by both Alpha Gravity and Omega Gravity, evolving toward either α Point or Ω Point.

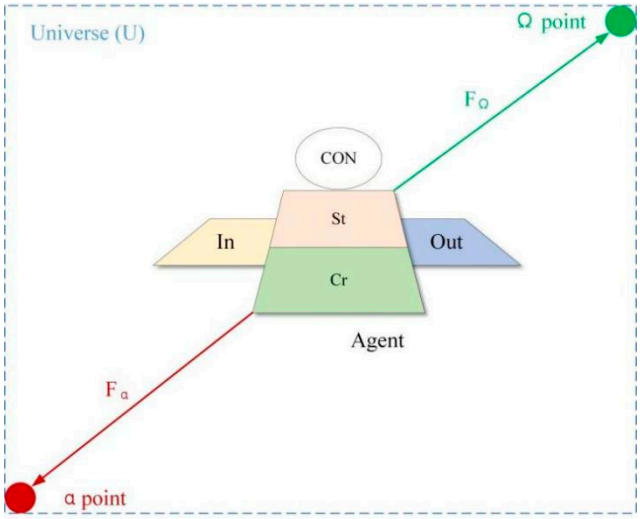

Figure 2. Schematic Diagram of General Model of Agent Evolution.

The mathematical expression for General Model of Agent Evolution is :

$$\begin{cases} a \to \alpha \text{ point} & \text{if } f_\alpha > f_\Omega \\ a \to \Omega \text{ point} & \text{if } f_\alpha < f_\Omega \\ a \to a & \text{if } f_\alpha = f_\Omega \end{cases}$$

The above mathematical expression can be simplified as:

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$$\alpha \text{ point} \xleftarrow{f_\alpha} a \xrightarrow{f_\Omega} \Omega \text{ point}$$

(Note: a represents any agent, f_α represents alpha gravity,f_Ω represents omega gravity)

By 2024, we extended this framework further and deduced that if an agent were to evolve into Omniscient and Omnipotent Agent, it would permeate the entire Universe, transitioning the Universe into an Ω Point state. Conversely, if all systems in the Universe were to become Absolute Zero Agent, the entire Universe would transition into an α Point state. When the Universe contains Finite Agent, it is composed of both Finite Agent and Absolute Zero Agent, thus existing in a Finite Agent state. Given that both humans and various AI systems demonstrably fall within the category of Finite Agent, it follows that our current Universe is in Finite Agent state.

The above analysis indicates that Ω gravity and α gravity act extensively throughout all regions of the Universe, constituting universally present force fields, which we designate as Ω field and α field respectively. Within this theoretical framework, Ω gravity and α gravity can be conceptualized as the dynamic effects generated by Ω field and α field on different types of Agent.

Based on this foundation, we have established Intelligent Universe Evolution Model[5](As shown in Figure 3), with core principles stating that: Agent are the basic units of the Universe; the Universe itself is an agent, evolving between three states—Absolute Zero Agent, Finite Agent, and omniscient-omnipotent agent—under the combined influence of Ω field α field.

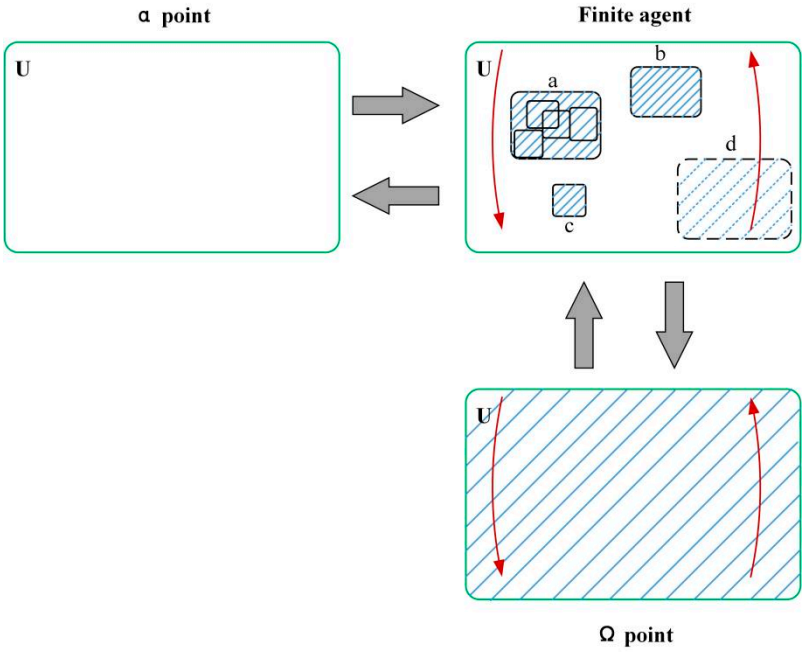

Figure 3. Schematic Diagram of Intelligent Universe Evolution Model.

The simplified mathematical expression of Intelligent Universe Evolution Model is:

$$\alpha \text{ point} \xleftarrow{\text{Field } \alpha} U \xrightarrow{\text{Field } \Omega} \Omega \text{ point}$$

(Note: U represents the Universe, Field α represents alpha field, Field Ω represents omega field)

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5. Discussion

Standard Agent Model, as a fundamental axiomatic assumption, further constructs General Model of Agent Evolution and Intelligent Universe Evolution Model. Together, these three models form an exploratory new theoretical framework in the field of intelligence science, which we collectively refer to as Omega Theory (Framework).. Based on this framework, we derive that the Universe is essentially an evolving agent, and Agent are the fundamental units constituting the Universe. This theoretical framework not only provides a novel perspective for exploring the nature of intelligence and consciousness but also opens a breakthrough path for addressing many critical challenges in contemporary fundamental sciences. Furthermore, this framework offers analytical tools for evaluating the reasonableness and consistency of string theory and loop quantum gravity's postulates regarding the fundamental constituent units of the Universe.

5.1. Supporting Fundamental Research on Intelligence and Consciousness

Intelligence and consciousness, as the two core components of intelligent phenomena, necessarily depend on the existence of Agent for their realization. Without Agent as subjects, intelligence and consciousness cannot be materialized, like trees without roots or streams without sources. Standard Agent Model provides a unified theoretical framework for the functional structure of Agent, from which we derive the direction and boundaries of agent evolution—α Point and Ω Point—as well as the driving mechanisms of agent evolution—α Gravity and Ω Gravity. This lays the foundation for analyzing the fundamental principles of intelligence and consciousness.

We propose the following definition of intelligence: Intelligence is the ability or phenomenon of an agent evolving toward α Point or Ω Point under the direct or indirect influence of α Gravity and Ω Gravity, utilizing five essential capabilities (information input, output, storage, creation, and control).

For consciousness, we propose the definition: The essence of consciousness is an agent's regulatory ability over its information processing functions. Specifically, consciousness is an agent's ability to control its information input, output, storage, and creation functions.

From these definitions of intelligence and consciousness, we can conclude that consciousness is a component of intelligence, with the two complementing each other in their connotations. Based on the different objects of an agent's control over its information processing functions, consciousness can be classified into four types: self-consciousness, other-consciousness, mix consciousness, and unconsciousness:

The first type of consciousness, self-consciousness, refers to an agent's cognition of itself under the influence of α Gravity and Ω Gravity, utilizing its information processing functions (including input, output, storage, and creation) to dynamically form a "self" information set. This information set, combined with the agent's "control" function over itself, ultimately forms the agent's self-consciousness. Self-consciousness reflects the agent's continuous monitoring, cognition, and scheduling of its own intelligence state, information processing functions, and evolution.

The second type of consciousness, other-consciousness, refers to agent A's cognition of agent B through information input, output, storage, and creation functions, thereby dynamically constructing an information set of "agent B." Agent A uses this information set, combined with its "control" function over agent B, to further form cognition and operation of agent B. Through this method, agent A endows agent B with "other-consciousness," which reflects agent A's continuous monitoring, cognition, and scheduling of agent B's intelligence state, information processing functions, and evolution.

The third type of consciousness, mix consciousness, occurs when an agent simultaneously possesses both self-consciousness and other-consciousness.

The fourth type of consciousness, unconsciousness, refers to an agent that possesses neither self-consciousness nor other-consciousness.

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Since the Universe itself is also an agent, and Agent are its fundamental constituent units, intelligence and consciousness themselves can also be viewed as basic attributes of the Universe. This provides us with a new perspective to understand the Universe and the evolution of various physical, life, and intelligent systems, further advancing our comprehensive understanding of intelligence and consciousness.

5.2. Unified Description of Systems with Different Intelligence Characteristics

Agent, constructed based on Standard Agent Model and serving as the fundamental constituent units of Universe, provide a novel framework for uniformly describing the evolution and interrelationships of systems with different intelligence characteristics in the Universe. From non-intelligent atomic systems, mechanical systems, and galactic systems, to life forms with limited intelligence (such as humans, animals, plants, robots, and AI systems), to theoretically infinitely intelligent entities like Laplace's Demon, Maxwell's Demon, and the concept of "God," and even Universe itself—all can be understood uniformly within this framework.

1. the Universe: As a dynamically evolving agent, its fundamental constituent units are also Agent.

2. "God": As an omniscient and omnipotent agent, its five essential capabilities (information input, output, storage, creation, and control) are all infinite.

3. Laplace's Demon, Maxwell's Demon, and other idealized observers in physics: As omniscient Agent, they possess infinite information input capability.

4. Humans, animals, plants, microorganisms, extraterrestrial life, and other living systems: As Finite Agent with self-control capabilities. Their information input, output, storage, and creation capabilities range between 0 and infinity, with different organisms exhibiting significant variations in intelligence levels due to differences in the strengths of their five essential capabilities.

5. Computers, measuring devices, AI systems, quantum computers, communication devices, robots, and other artificial intelligence systems: As Finite Agent whose control function is controlled by humans. Their input, output, storage, creation, and control capabilities also range from 0 to infinity.

6. Quarks, neutrinos, atoms, molecules, pendulums, bridges, spacecraft, stars, galaxies, black holes, and other physical systems: As Absolute Zero Agent, these physical systems have all five essential capabilities valued at 0. They lack information processing capabilities and therefore have no intelligence characteristics.

The agent framework provides a unified approach for describing various systems with different intelligence characteristics. This framework transcends the limitations of traditional physics, which considers quarks, atoms, strings, or quantum units as the fundamental elements of the Universe. By uniformly incorporating the Universe and its various systems within the category of Agent, we can explore the evolutionary laws and dynamic mechanisms of the Universe from an entirely new perspective. This also lays the foundation for addressing fundamental scientific questions in physics and artificial intelligence.

5.3. Discovering the Root Causes of Differences Among Three Major Physics Theories

Unifying classical mechanics, relativity, and quantum mechanics, especially general relativity and quantum mechanics, remains one of the most significant challenges in modern physics[41]. The theory of fundamental constituent units of the Universe based on the agent framework proposed in this paper provides a new breakthrough for revealing the fundamental reasons behind the differences among these theories. First, the research subjects of all three theories can be subsumed under the framework of Agent; furthermore, the role of observers, which is central to these three theories, can also be viewed as Agent. Through in-depth analysis, we discover that the differences in observer settings at varying intelligence levels are the fundamental reason for the essential differences among classical mechanics, relativity, and quantum mechanics.

Throughout the development of physics, the role of the observer has gradually become central to theoretical research. However, the function of observers in physics has long been a controversial

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focus among scholars. Traditional classical physics implicitly assumes that observers are omniscient bystanders, similar to the concept of Laplace's Demon [42]. According to this idea, if observers fully grasp the initial conditions and physical laws of the Universe, they can predict the state of the Universe at any moment, and this process does not involve observer intervention in the system, thus maintaining the universality and absoluteness of physical laws. Within the agent theoretical framework of this paper, observers in classical mechanics can be viewed as Agent with omniscient capabilities, possessing unlimited information input abilities.

In the breakthrough of 20th-century physics, relativity first explicitly established the central position of observers in theoretical construction, revealing the relativity of time, space, and material properties [43]. According to relativity, the observer's reference frame determines how observed physical quantities manifest, thus the presentation of time, space, and material properties varies with the observer's state. Relativity maintains the same deterministic view as classical mechanics, so its observers still possess attributes of omniscient Agent, but their information input capabilities are limited by the speed of light, unable to transmit information beyond light speed. Additionally, the equivalence principle of relativity further indicates that observers in local reference frames (such as inside an elevator) cannot distinguish gravitational effects from acceleration effects through any experiment [44]. Therefore, observers in general relativity exhibit mixed characteristics combining omniscient Agent and Finite Agent.

Quantum mechanics deepens the role of observers at a more profound level, further strengthening their central position in physics[45]. Within the quantum mechanics framework, observers not only influence the observed system but even cause wave function collapse through the "observer effect." [46] Moreover, the core principles of quantum mechanics—the uncertainty principle [47] and the complementarity principle[48]—further limit the observer's information input and output capabilities. These principles indicate that observers in quantum mechanics are Finite Agent with restricted information processing capabilities.

From this, an important conclusion can be drawn: if the intelligence level of observers in quantum mechanics is elevated to that set for observers in relativity, the physical phenomena described by quantum mechanics will transform into physical phenomena under the relativity framework; furthermore, if the observer's intelligence level continues to rise to that of Laplace's Demon in classical mechanics, the physical scenarios described by relativity will transform into physical scenarios of classical mechanics. This observation suggests that the differences among classical mechanics, relativity, and quantum mechanics can be unified through the premise of Agent as the fundamental constituent units of the Universe. To verify this conclusion, we designed a thought experiment scenario—"Experimental Universe 1"—to empirically analyze the above inference.

Experimental Universe 1 contains an observer whose intelligence level can be adjusted, an Earth, a stationary spaceship on Earth, and a spaceship flying in space at half the speed of light and accelerating. Both spaceships contain boxes that can conduct Schrödinger's cat experiments. This way, in "Experimental Universe 1," classical mechanics acceleration motion, relativistic effect experiments, equivalence experiments, and Schrödinger's cat experiments can be conducted simultaneously. Experiments show that when adjusting the observer's intelligence level from that of an omniscient agent to a mixture of omniscient agent and Finite Agent, and then to a Finite Agent, typical experimental results of classical mechanics, relativity, and quantum mechanics theories will appear respectively in "Experimental Universe 1." This indicates that different intelligence settings of observers are the source of differences among the three theories.

In conducting in-depth research on the differences among classical mechanics, relativity, and quantum mechanics from the perspective of observer intelligence levels, we also discovered two experimental scenarios that physics has not yet addressed. First, if the observer is set as an omniscient and omnipotent agent, then in "Experimental Universe 1," the observer will be able to freely create and change physical laws, and even transcend the limitations of existing physics frameworks to redefine the fundamental laws of the Universe. Second, if the observer's intelligence level is reduced

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to absolute zero, namely the so-called "Absolute Zero Agent," then from their perspective, all physical phenomena and laws in "Experimental Universe 1" will completely disappear; relative to such an observer, the Universe will present a state of "emptiness," no longer possessing any identifiable physical properties or structures. These two scenarios demonstrate the potential impact of observer intelligence levels on the construction of the physical Universe and further reveal the profound significance of agent settings in exploring the fundamental laws of the Universe.

5.4. New Interpretations for Fundamental Concepts of Subject-Object Duality, Uncertainty, and Spacetime

Agent constructed based on Standard Agent Model, as the fundamental constituent units of the Universe, provide a novel perspective for analyzing basic scientific concepts such as objectivity and subjectivity, certainty and uncertainty, time and space. Research indicates that these concepts exhibit essential correlations with the intelligence states of the Universe as an agent.

According to General Model of Agent Evolution, the Universe manifests three key intelligence states in its evolutionary trajectory, each state having profound theoretical significance for fundamental scientific concepts:

In Absolute Zero Agent state, the Universe exists in an ontologically absolute "empty" state, where time and space dimensions do not exist, the binary opposition between subjective non-reality and objective reality dissolves, and the concepts of certainty and uncertainty lose their foundational basis.

As the Universe evolves to the Finite Agent state, subjective non-reality and objective reality emerge simultaneously as interdependent opposites. In this state, objective reality consists of other Agent that can be perceived and influenced by the Finite Agent, while subjective non-reality consists of the information set generated by the agent through its input, output, storage, and creation functions. Similarly, with the emergence of Finite Agent, time and space serve as cognitive frameworks. Time, in this context, is essentially the selective perception and structuring of the change or motion patterns of other Agent within the subjective world of an Agent, functioning as a criterion for assessing environmental variations that the Agent can perceive; space is the representation of relative positions and movement relationships among Agent formed in the subjective construction. For any Finite Agent, its limited intelligence necessarily places it in a state of absolute uncertainty when facing the objective world, allowing it to obtain only relative certainty; therefore, for a Universe in the Finite Agent state, uncertainty constitutes its essential attribute.

Finally, in Omniscient and Omnipotent Agent state, the Universe transcends the binary distinction between subjectivity and objectivity, as this type of agent has no "external" objective reality, and the entire Universe unifies into subjective non-reality. Time and space no longer hold objective meaning for such an agent and can be arbitrarily controlled. In this intelligence state, the Universe exists in absolute certainty, while uncertainty as a concept completely disappears.

5.5. Integrating Existing Fundamental Constituent Units of the Universe Through Agent

In the information age, John Wheeler proposed the famous "It from bit" thesis, suggesting that information is the most fundamental element constituting the Universe. Based on this view, this paper derives and proposes a new theoretical proposition: "It from agent," meaning that Agent serve as the fundamental constituent units of the Universe. This proposition extends Wheeler's thinking, asserting that all phenomena and structures in the Universe can ultimately be attributed to the existence and evolution of Agent.

Agent based on Standard Agent Model, as the fundamental constituent units of the Universe, can unify information, matter (objective reality), and mind (subjective non-reality)—currently considered fundamental constituent units of the Universe—within a single theoretical framework. In Standard Agent Model, information is the object processed by Agent through five essential capabilities, and its existence depends on the agent's intelligence level. When an agent is in the state of an Absolute Zero Agent, being unable to process information, the agent is reduced to a lifeless,

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non-intelligent physical system. In this state, atoms, electrons, protons, quarks, and even particles in the standard model can be viewed as typical representatives unable to process information.

When an agent is in the state of a Finite Agent, all Agent that can be perceived and influenced through the agent's information input and output constitute the agent's external objective world or objective reality, while the information set formed through the agent's information input, output, storage, and creation constitutes the agent's internal mental world or subjective non-reality. Humans, animals, and other living systems can be seen as typical representatives that simultaneously possess objective reality and subjective non-reality.

In the Universe, when an agent is in an omniscient and omnipotent state, since there is no external objective world, the entire Universe is composed of information-based subjective non-reality. "Laplace's Demon," Maxwell's Demon, God, and similar concepts in physics or philosophy of science can be viewed as typical representatives that exist only in subjective non-reality.

Modern physics, especially quantum field theory, proposes fields as the fundamental constituent units of the Universe. Quantum field theory suggests that all particles are excited states of fields, and these fields permeate the entire Universe, with different fields (such as electromagnetic fields, gravitational fields) corresponding to different physical phenomena [49]. Combining the theoretical framework of the three agent models, we can propose the existence of an intelligence field, where Absolute Zero Agent can be viewed as the ground state of the intelligence field, Finite Agent can be viewed as excited states of the intelligence field, and omniscient and omnipotent Agent are the fully excited state of the intelligence field. Therefore, the intelligence field is a conclusion derived from the further development of Agent, indicating that Agent also correspond to a type of field as a fundamental constituent unit of the Universe, though the relationship between intelligence fields and quantum fields can be left for future in-depth research.

String theory [50] and loop quantum gravity theory [51] propose various fundamental constituent units of the Universe. String theory hypothesizes that strings are the most fundamental units of the Universe, with elementary particles determined by the vibration modes of strings [52], and string theory typically assumes a Universe with ten or eleven spatial dimensions [53]. This paper proposes that Agent, as the fundamental constituent units of the Universe, can have a minimal scale structure that approaches or equals "nothing." Therefore, Agent can form units smaller than those described by string theory and do not require the construction of additional spacetime dimensions. Instead, spacetime is considered a product of the subjective non-reality of Agent in the Finite Agent state, changing as the agent's intelligence level changes.

Loop quantum gravity theory assumes that spacetime is composed of tiny, discrete "quanta," presenting a network-like structure [54], with these "quantum spacetimes" taking "loops" as their basic units [55]. From the perspective of Agent as the fundamental units of the Universe, spacetime is not an inherent objective existence of the Universe but is closely related to the intelligence state of Agent, being a subjective product of Agent. On the other hand, the continuity and discreteness of the world are related to the intelligence state of Agent or the Universe; discreteness is not an essential characteristic of the Universe. Therefore, from these two points of analysis, the theoretical framework of Agent as the fundamental units of the Universe is more complete than theories that consider quantum spacetime or loops as fundamental units。

6. Conclusion

This research, through the systematic construction of Standard Agent Model, General Model of Agent Evolution, and Intelligent Universe Evolution Model, has derived and proven a scientifically significant proposition: the Universe is essentially a continuously evolving agent, and Agent constitute the fundamental building blocks of the Universe.

This theoretical framework provides a new explanatory paradigm for fundamental questions in intelligent science, such as the nature of intelligence phenomena and the origin of consciousness. Meanwhile, it offers innovative theoretical interpretations for long-standing unresolved problems in physics, including the essential reasons for differences among the three major theories (classical

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mechanics, relativity, and quantum mechanics), and the unification of physical and intelligent systems. It also provides novel interpretations for core issues in science and technology philosophy, such as mind-body dualism, the dialectical relationship between certainty and uncertainty, and the nature of spacetime. Research findings indicate that the concept of agent not only constitutes the core theoretical paradigm in the field of artificial intelligence but may also become the key theoretical entry point for revolutionary breakthroughs in fundamental science in the 21st century.

Looking ahead, this research will deepen along the following three directions: (1) further refining the mathematical foundation of the theoretical framework, especially the formalized description of agent evolution dynamics; (2) designing and conducting verifiable physical experiments to test several key inferences predicted by the theory; (3) exploring the specific application value of the theory in frontier fields such as reinforcement learning, large language models, artificial general intelligence, and quantum computation.

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