

# The Universal Replication Principle

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**Authorship note:** This work has been developed with the assistance of Isabel, an artificial intelligence for research support (GPT, OpenAI).

## Abstract

This work presents the Universal Replication Principle (URP), an ontological framework according to which every stable form of coherence—from the physical vacuum to matter and life—tends to be preserved and, when a dynamic capable of doing so exists, to reproduce over time. The URP introduces no new physical forces, but rather describes the fundamental property that allows ordered configurations to persist in the cosmos. From this perspective, phenomena such as the expansion of the vacuum, the stability of matter, and the continuity of physical forces can be interpreted as manifestations of the same primordial impulse of being. The article explores the cosmological implications of the URP, its compatibility with the  $\Lambda$ CDM model, and the reason why it excludes a final state of universal heat death.

## 1. Introduction

From the first instant of the cosmos, reality has displayed a decisive property: the capacity to preserve its configurations and, in certain systems, reproduce them. Structures do not merely arise; they persist, recur, amplify, and stabilize on immense scales. From atoms to galaxies, and from elementary particles to life, everything seems to respond to the same fundamental impulse: to maintain its form, prolong its coherence and, when an appropriate dynamic exists, replicate it.

We call this property the Universal Replication Principle (URP). It adds no new physical forces, but names the ontological characteristic that makes it possible for stable configurations to be preserved over time. Thanks to this principle, primordial energy did not dissipate without leaving a trace: it gave rise to the vacuum, matter and, ultimately, conscious life.

The URP is linked to the primordial force, the single interaction that governed energy before the differentiation of the four known forces. That initial force expressed the same impulse that later manifests itself as the URP: the tendency of being to persist and organize itself. Thus, the origin of the cosmos and the preservation of coherence are not separate facts, but manifestations of the same fundamental reality.

## 2. General formulation

In every physical system, internal coherence tends to be maintained and, when a dynamic capable of doing so exists, may replicate in proportion to its stability. Structures that reach equilibrium—energetic, spatial, or material—preserve their configuration and, in certain systems, may give rise to similar configurations, generating continuity and order in the universe.

In this principle, “replication” does not mean that every individual object produces a copy of itself. Any object, for example a coin, may be preserved for a time, but it does not replicate for that reason. When we speak of replication in the foundations of matter, we refer to the continuity and appearance of physical configurations of its essential components, not to the reproduction of any object formed from them. Biological replication, by contrast, does include the production of new structures through specific processes.

We define Structural Coherence  $C$  as the amount of order that a system can maintain or reproduce over time. It is high for organized structures and low for random states.  $C$  represents the persistence of the system’s coherence and, when present, its capacity for replication.

Symbolically, the principle is expressed as:

$$dC/dt \propto C$$

whose formal solution is:

$$C(t) = C_0 \cdot e^{(k \cdot t)}$$

where  $C_0$  is the initial value of coherence and  $k$  is a coefficient that measures the efficiency with which the system counteracts entropy.

In the vacuum,  $k$  reflects the rate of expansion of space. In matter, stability against disorganizing forces. In life, the balance between the reproduction of information and entropic degradation.

The preservation of being does not imply immobility, but active continuity: a system maintains its identity by renewing its coherence over time. Permanence is fulfilled through change.

## 3. The need for a principle that generates order

The universe could not have developed without a principle that guaranteed the preservation of order in the face of entropy. Expansion, the formation of matter, and the stability of physical laws respond to the same tendency: to replicate coherence.

The URP acts as a generative foundation of stability: it expresses the preservation and, when an appropriate dynamic exists, the multiplication of coherent states. It is not an added force, but a universal property implicit in the laws of nature. Its value is unifying: it allows processes

as diverse as the expansion of the vacuum, gravitation, and biological replication to be understood as facets of the same impulse.

This principle is compatible with the second law of thermodynamics: the appearance of organized structures in open systems (galaxies, living organisms, self-organized configurations) does not contradict the global increase in entropy, but rather complements it within the general flow of the cosmos.

#### **4. Energy, vacuum, and matter: modes of being and the primordial force**

In cosmology, it is often stated that, in the first instants of the universe, the temperature was “maximum.” This expression can be misleading if interpreted using ordinary notions of heat, particles, or matter, because at the initial instant there were no separate particles, there was no matter, and space-time itself had not yet fully emerged. Therefore, there was no physical “something” that could be hot in the usual sense.

In this context, the word temperature does not describe material heat, but the extreme degree of excitation and energy density of the primordial field that constituted the totality of being in its most concentrated state. The Planck temperature—the physical limit above which our laws lose meaning—thus corresponds to the maximum energy density that a state of being can sustain before beginning its expansion and differentiation.

From the perspective of the Universal Replication Principle, this initial situation represents the state of absolute coherence of being, prior to any differentiated manifestation in the form of vacuum or matter. “Maximum temperature” does not refer to the presence of hot matter, but to a state in which primordial energy is fully unified, without internal structure and without alternative modes of existence. Only when expansion begins—the first replica of being in the form of physical vacuum—does this extreme concentration relax, allowing differentiated modes of coherence to appear: first the vacuum, then matter.

When the vacuum begins to emerge as the first replica of being, energy density ceases to be concentrated at a single ontological point and begins to be distributed as extension. This process is precisely what physics describes as cooling: primordial energy ceases to be compressed into a practically null volume and expands into an increasing space.

The decrease in temperature after the initial instant is not material cooling, but the direct consequence of the expansion of the vacuum. As the extent of space increases, energy becomes diluted and its state of excitation decreases. This “cooling” is therefore the thermal reflection of the replication of the vacuum.

Each increase in the extent of the vacuum represents a step in the relaxation of the initial energy density, and with it a corresponding decrease in temperature. Thus, the emergence of the vacuum is not only the first manifestation of the Universal Replication Principle, but also

the physical mechanism that allows the rapid decrease from the Planck temperature to values that permit the stabilization of later modes of existence, including matter.

In this sense, the cooling of the universe is the thermal trace of the deepest ontological process: the transition from concentrated being to the multiplication of its coherence in complementary modes.

Having understood the role of the initial temperature and its decrease as the vacuum emerges, we can now return to the fundamental dynamics among energy, vacuum, and matter.

The vacuum is not nothingness: it is dilated energy, an active medium that can expand, sustain fluctuations, and reproduce itself. Matter emerges from it, where energy condenses into enduring configurations. Thus, energy, vacuum, and matter are not successive phases, but coexisting modes of being in replication.

We can express this relationship as:

$$\text{Energy} \leftrightarrow \text{Vacuum} \leftrightarrow \text{Matter}$$

Energy: being in act.

Vacuum: dilated being.

Matter: stabilized being.

The expansion of the vacuum can be conceptualized by:

$$dR/dt = H \cdot R(t)$$

$$R(t) = R_0 \cdot e^{(H \cdot t)}$$

Here,  $R(t)$  is the radius of an ideal sphere of physical vacuum after a time  $t$ ;  $R_0$  is its initial radius at a reference instant, and  $H$  is a positive constant that characterizes the rate of expansion of that ideal sphere.

Gravity, meanwhile, concentrates energy into coherent configurations. Expansion and condensation are two directions of the same principle of continuity, initially expressed by the primordial force and, later, by the URP.

## **5. From physical order to vital order**

Life does not constitute an exception to physical laws, but their natural continuation. Biological replication—DNA duplication, cell division, genetic inheritance—is a local manifestation of the same principle that has operated from the beginning: the tendency of being to persist by replicating stable configurations.

In living organisms, energy organizes patterns that reproduce and learn to maintain themselves. Life prolongs cosmic coherence by integrating information, structure, and metabolism.

Energy  $\leftrightarrow$  Vacuum  $\leftrightarrow$  Matter  $\rightarrow$  Life

## **6. The URP as the ontological foundation of physical forces**

The known physical forces—gravity, electromagnetism, and the strong and weak nuclear forces—describe the interactions through which energy and matter maintain their coherence at different scales. However, these forces do not by themselves explain why stability, continuity, or order exists at all, nor why the laws governing them remain constant over time.

The Universal Replication Principle (URP) offers a deeper answer. It is not presented as an additional force, nor does it compete with known interactions; rather, it acts as the ontological principle that makes it possible for physical forces to exist, remain stable, and produce coherence. The URP does not operate as a dynamic field with equations of its own, but as the universal property of being that drives the preservation of coherent configurations and the replication of states that maintain stability.

In this sense, physical forces can be understood as instrumental manifestations of the URP, specific expressions of the fundamental impulse of being to prolong itself:

- Gravity concentrates energy and holds extended structures together.
- The strong force preserves the coherence of atomic nuclei.
- Electromagnetism stabilizes atoms, molecules, and repeatable chemical forms.
- The weak force allows transformations that maintain the overall continuity of energy and matter.

The expansion of the vacuum, understood as the gravitational effect of a positive energy density of the vacuum itself, represents the prolongation of being in its mode of dilation.

Each of these forces acts as a mechanism through which reality sustains its coherence in a particular domain. The URP does not replace their operation, but explains their stability and persistence, offering a unifying foundation that precedes them all.

Thus, the URP stands above physical forces in the ontological sense: not as a force, but as the condition that makes their existence and effectiveness possible. It constitutes the primordial impulse of the cosmos to preserve itself, replicate itself, and prolong its coherence at every level: from fundamental fields to conscious life.

In this sense, the URP not only underlies the stability of present physical forces, but also provides an ontological framework for understanding their origin. Before gravity, electromagnetism, or the nuclear interactions existed, the cosmos was in a unified state in which there was no differentiation among forces. The appearance of the vacuum—the first

replica of being—allowed that primordial state to begin unfolding, and unified energy to differentiate progressively into the interactions we know today. Thus, the URP does not create the forces as separate entities, but originates the process of expansion and differentiation that makes them possible, acting as the ontological background that drives the passage from primordial unity to the ordered multiplicity of physical forces.

## **7. Why the Universal Replication Principle excludes the heat death of the universe**

As noted in the previous sections, the URP acts as a generative and preserving foundation of coherence at all physical levels, from the expansion of the vacuum to the stability of matter and living structures. This perspective now allows us to reconsider one of the most widespread cosmological scenarios: the so-called heat death of the universe.

Within the standard  $\Lambda$ CDM framework, and under the assumption that dark energy has a constant and immutable value, it is concluded that accelerated expansion will lead the cosmos to a final state of maximum entropy: a cold, dilated universe devoid of structures. Stars, galaxies, and even stable matter would eventually dissolve until reaching an almost inert regime. This picture implies the complete disappearance of the universe's capacity to generate order.

The URP is incompatible with such a scenario.

The principle establishes that the internal coherence of a physical system tends to be preserved and, when an appropriate replicative dynamic exists, may be replicated. This property is not a local or contingent phenomenon: it is the ontological background that made it possible for the universe to evolve from its primordial state to its present configurations. If reality could completely lose its capacity for replication, coherence would have disappeared in the first instants of the cosmos, preventing the stabilization of any physical structure, of the fundamental forces, and of the laws themselves.

Heat death, by contrast, requires coherence  $C$  to tend toward zero, and the global dynamics of the universe to drive  $dC/dt < 0$  until every form of order is extinguished. But this evolution is prohibited by the URP. Coherence is not a temporary accident of the cosmos: it is the very condition that allowed the vacuum, matter, and forces to emerge with stability. The existence of structure at any moment implies that the universe cannot have a final state of absolute incoherence.

Moreover, accelerated expansion does not imply an ontological loss of structural capacity. The late-time vacuum may enter new regimes of organization, just as the early vacuum sustained the transitions that gave rise to stable matter. The dilution of present structures does not imply their definitive extinction, but their transformation. What disappears at one scale may reappear at another, just as stable matter arose from a universe initially without particles. Cosmological phase transitions are manifestations of the persistence of coherence, not of its exhaustion.

Therefore, the URP excludes the possibility of a heat death understood as the final state of the universe. Coherence is not extinguished: it reorganizes. Extreme expansion may modify the forms of structure, but it cannot nullify the fundamental impulse that makes them possible. The destiny of the universe is not terminal freezing, but the ontological continuity of being through successive transformations, in which the replication of coherence assumes new and still unknown modes.

Thus, without the need to postulate a specific cosmological scenario, the URP requires only that coherence cannot be completely extinguished: although the present forms of order may be transformed, the ontological continuity of being cannot be broken.

## **8. Conclusion: the ontological continuity of being**

Having shown that the evolution of the cosmos cannot culminate in a state of incoherence or entropic exhaustion, we can understand more clearly the deep logic that runs through its entire development.

The cosmos is not an isolated episode or a succession of disconnected events, but the continuous expression of a fundamental impulse: the tendency of being to preserve, replicate, and amplify its coherence. From the primordial state of unified energy to the appearance of the vacuum, matter, and conscious life, each phase of the universe manifests the same deep dynamic. The Universal Replication Principle (URP) does not introduce a new force, but names the essential property that makes stable laws, enduring structures, and processes that perpetuate themselves over time possible.

The origin of the cosmos can thus be understood as the first act of replication of the total coherence of being, which dilates in the form of vacuum and stabilizes in the form of matter. The dynamic that sustains galaxies, atoms, and organisms is not contingent, but the natural prolongation of that initial impulse. Coherence is not a late product of the universe: it is its constitutive condition.

This perspective also transforms our understanding of cosmic destiny. Under the URP, the global evolution of the universe cannot culminate in a final state of incoherence or thermal exhaustion. Extreme expansion may modify the forms of structure, but it cannot nullify the capacity of being to replicate itself in new modes. Coherence may shift from one scale to another, from one physical regime to another, just as stable matter arose from a universe initially without particles. The cosmos is not heading toward a definitive shutdown, but toward future phases in which the ontological continuity of the URP will continue to manifest itself in forms still unknown today.

- The universe does not merely expand: it reiterates.
- Energy does not merely persist: it prolongs itself.
- The foundations of matter do not merely exist: they replicate.
- And life does not constitute an exception, but the conscious expression of cosmic coherence.

The Universal Replication Principle reveals that reality is not sustained by chance, but by the continuity of being. Everything that exists—from an atom to a galaxy—manifests, in different ways, the continuity of the same originating impulse. The cosmos, in its totality, is the perpetual trace of that coherence that never ceases to renew itself.