

Disappearance of Antimatter in the Context of the Acta Universi Hypothesis

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Introduction

The baryon asymmetry of the Universe remains one of the unresolved fundamental problems in cosmology and particle physics. The observed ratio of baryons to photons,

$$\eta_B = \frac{n_B - n_{\bar{B}}}{n_\gamma} \approx 6 \times 10^{-10},$$

requires a mechanism satisfying Sakharov's conditions: baryon number violation, C and CP symmetry violation, and departure from thermodynamic equilibrium. The Standard Model contains CP violation, but its magnitude is insufficient. Most scenarios (electroweak baryogenesis, leptogenesis, heavy-particle scenarios) introduce new physics beyond already tested energy scales.

The Acta Universi hypothesis offers a different perspective. In it, the primary entity is the entropy field of thought-forms S_Θ , together with the integral information field Φ and a nonlocal kernel $K(x, y)$. All processes, including particle birth and transformation, are acts of recording into a universal information archive. The asymmetry between matter and antimatter is interpreted as a consequence of the asymmetric dynamics of this recording in the early Universe.

The aim of this work is to develop this idea into a coherent model compatible with the already established AU formalism.

1. Matter and Antimatter in AU Ontology

In AU, particles and antiparticles represent conjugate configurations of the field S_Θ . A particle corresponds to a localized excitation with positive coherence (a certain sign of contribution to Φ), while an antiparticle corresponds to a configuration with the opposite coherence sign.

During ordinary annihilation, these configurations mutually annihilate, transferring energy into other modes (photons, gluons, etc.). In the AU picture, another channel is possible: asymmetric

recording, in which the antiparticle configuration is preferentially converted into a state with "negative coherence," increasing the total theta-entropy of the archive, while the particle configuration is preserved as a stable structure.

This process does not violate the laws of energy-momentum conservation in the usual sense, but it breaks the symmetry between particles and antiparticles at the level of information dynamics.

2. Modified Dirac Equation and CP Violation

The effective description of fermions in the presence of the fields S_Θ and Φ leads to a modified Dirac equation of the form

$$(i\gamma^\mu D_\mu - m - g_S S_\Theta - g_\Phi \Phi - i\gamma^5 g_A S_\Theta)\psi = 0.$$

The term with γ^5 generates effective CP violation, the magnitude of which is determined by the local values of S_Θ and Φ . In the early Universe, when the field S_Θ was rapidly growing and undergoing phase rearrangements (associated with inflation, the primary act of recording, and subsequent expansion), this effective CP phase was significantly larger than in the present epoch.

The nonlocal kernel $K(x, y)$ additionally contributes to the asymmetry, since correlations between different regions of the early Universe were not completely symmetric with respect to charge conjugation.

3. Mechanism of Asymmetric Recording

The key process can be schematically described as follows.

In the hot early Universe, particle–antiparticle pairs are created almost symmetrically. However, the probability of irreversible recording of a configuration into the AU archive depends on the sign of coherence and the current state of the field S_Θ . Antiparticle configurations have a higher probability of being "absorbed" by the archive as structures with negative coherence, while particle configurations more often remain as stable excitations, which later form the observed matter.

Effectively, this can be expressed through the difference in recording rates:

$$\Gamma_{\text{rec}}^{(+)} - \Gamma_{\text{rec}}^{(-)} \propto \gamma_{\text{CP}} \dot{S}_\Theta \Phi,$$

where γ_{CP} is a constant associated with CP-odd terms in the Lagrangian. Integrating this difference over cosmological history yields the resulting baryon asymmetry.

Since the recording process is irreversible and linked to the growth of kairos-time τ , the reverse process (conversion of a recorded "negative" configuration back into an antiparticle) is statistically suppressed.

4. Estimate of the Asymmetry Magnitude

A rough estimate shows that, with reasonable values of coupling constants and accounting for rapid changes in S_Θ in the early Universe, one can obtain η_B of order 10^{-10} . A precise

calculation requires knowledge of the dynamics of S_Θ during the epoch of baryogenesis and the magnitude of the effective CP phase, which itself is a function of the AU fields.

An important advantage of the mechanism is that it does not require the introduction of new heavy particles or an extension far beyond the electroweak scale. The asymmetry is generated by the dynamics of the already existing information field.

5. Connection with Other Areas of AU

The proposed mechanism naturally interfaces with previously discussed topics:

- The primary act of recording sets the initial conditions and the direction of kairos-time, which determines the arrow of asymmetry.
- The dynamics of fundamental constants and variations of the CP phase in the early Universe amplify the effect.
- The entropic nature of dark energy receives an additional contribution from the asymmetric recording of antimatter.
- Kairos-time explains why the process is unidirectional.

6. Observational Signatures and Falsifiability

Direct verification of the mechanism is difficult, but indirect indications are possible:

- correlations between the value of η_B and parameters of the inflationary spectrum (through the common dynamics of S_Θ);
- possible subtle effects in CP-violating observables associated with a residual background of S_Θ ;
- consistency with constraints on new sources of CP violation at low energies.

The most stringent test is internal consistency: if the dynamics of S_Θ required to obtain the correct η_B turn out to be incompatible with constraints from atomic physics, dark energy, or variations of constants, the mechanism would have to be modified or rejected.

7. Comparison with Standard Scenarios

Scenario	Source of Asymmetry	New Physics	Connection with AU
Electroweak baryogenesis	SM phase transition	CP amplification	AU can provide additional CP phase

Scenario	Source of Asymmetry	New Physics	Connection with AU
Leptogenesis	Decay of heavy neutrinos	Sterile neutrinos	Not required for the AU mechanism
Asymmetric recording in archive	Dynamics of S_Θ , Φ	Uses already existing fields	

The AU approach does not exclude standard scenarios but offers an alternative (or additional) channel that relies on the information-entropy ontology.

Conclusion

Within the framework of the Acta Universi hypothesis, the baryon asymmetry of the Universe is interpreted as the result of asymmetric irreversible recording of antiparticle configurations into a universal information archive. The modified Dirac equation with entropic and CP-odd terms, the dynamics of the field S_Θ in the early Universe, and the nonlocal kernel together generate the observed asymmetry without introducing new heavy particles.

The mechanism naturally integrates into the overall AU picture (kairos-time, the primary act of recording, entropic dark energy) and retains the possibility of agreement with data on η_B . Further development requires a more precise cosmological solution for S_Θ during the epoch of baryogenesis and a computation of the effective CP phase from first principles of the AU Lagrangian.