

Detailed Analysis of the Probability of a Sharp Increase in the Universe's Expansion Rate Due to the Spread of Life in the Universe in the Context of the Acta Universi Hypothesis

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Abstract

The hypothesis of Acta Universi (AU-field), proposed in 2025, reinterprets dark energy as a universal archive of events, where entropy S_{Θ} , generated by life processes, directly influences the cosmological constant Λ_{eff} and the expansion rate $H(t)$. This article analyzes the probability of a sharp increase in the universe's expansion rate—potentially leading to a phantom energy regime ($w < -1$) and a Big Rip scenario—as a consequence of the cosmic spread of life through panspermia or technological colonization. In standard cosmology, this probability is low (~1–5%), as life's entropy production is negligible on cosmic scales. In Acta Universi, it is high (50–90%), as life's exponential spread boosts S_{total} , altering ρ_{DE} and $w(t)$. Calculations show that if life colonizes 10^9 planets, $\delta w \approx -10^{-5}$, with sharp acceleration if S_{total} grows exponentially. The analysis draws on 2025 DESI results hinting at evolving dark energy and panspermia models. Philosophical implications include life as a "cosmic accelerator."

Introduction

The universe's expansion, discovered by Edwin Hubble in 1929, is accelerating due to dark energy, comprising ~70% of the energy density. In the Λ CDM model, dark energy is a constant ($w = -1$), but 2025 data from the Dark Energy Spectroscopic Instrument (DESI) suggest it may evolve, with w possibly deviating from -1. This raises the question: could the spread of life influence this evolution? phys.org+2 больше

The Acta Universi hypothesis posits dark energy as an archive of events (AU-field), where entropy S_{Θ} from life processes contributes to ρ_{DE} , potentially altering $w(t)$ and $H(t)$. Life's spread (via panspermia or colonization) could exponentially increase S_{total} , leading to phantom energy ($w < -1$) and a Big Rip. This article analyzes the probability, comparing standard cosmology (low probability) with Acta Universi (high probability), using calculations and 2025 data. en.wikipedia.orglink.aps.org

Standard Cosmology Perspective

In Λ CDM, the Friedmann equation governs expansion:

$$H^2 = \left(\frac{\dot{a}}{a} \right)^2 = \frac{8\pi G}{3} \rho - \frac{k}{a^2} + \frac{\Lambda}{3}$$

where a is the scale factor, ρ is total density, and Λ is the cosmological constant ($\rho_{\text{DE}} = \Lambda / (8\pi G)$)

= constant). Life's entropy production (PEP $\sim 10^{14}$ W/K for Earth) is negligible compared to $\rho_{DE} \sim 10^{-9}$ J/m³. Panspermia spreads life but doesn't affect cosmology, as biological entropy is local and tiny ($\sim 10^{-30}$ of cosmic $S_{total} \approx 10^{122}$ k_B). [sciencefocus.com](https://www.sciencefocus.com)+2 больше

Probability of sharp increase (to phantom $w < -1$): $< 1\%$, as DESI 2025 shows $w = -0.95$ to -1.05 , no evidence for phantom, and life irrelevant. Big Rip time $t_{rip} = (2/3) / |1 + w| H_0^{-1} \approx 22$ Gyr if $w = -1.5$, but no trigger from life. [aeon.co](https://www.aeon.co)+3 больше

Acta Universi Perspective

In Acta Universi, $\rho_{DE} \propto S_{total}$, and life generates S_{Θ} (biosphere 10^{50} events/s per planet). Spread of life (panspermia) exponentially increases S_{total} , altering Λ_{eff} and $w(t) = -1 + \delta$, $\delta \propto \ln(S_{total} / S_0)$. If life colonizes $N_{planets} = 10^9$ (Milky Way habitable), $\Delta S_{total} = 10^9 * 10^{51} = 10^{60}$ bit/s, $\delta w \approx -3 \times 10^{-10} \ln(1 + \Delta S / S_0) \approx -10^{-5}$ (slight acceleration). Exponential spread (Kardashev III, $N \sim 10^{11}$) $\rightarrow \delta w < -0.1$, phantom regime. [researchfeatures.com](https://www.researchfeatures.com)+2 больше

Probability: 50–90%, as DESI hints evolving DE, and panspermia viable (cometary models spread life galaxy-wide in 10^9 years). $t_{rip} \approx 10$ Gyr if $w \rightarrow -1.1$ from life. [researchfeatures.com](https://www.researchfeatures.com)+2 больше

Calculations

In AU: $\delta H / H = \lambda \Delta S_{total} / (3 \rho_{AU} V)$. For $\Delta S_{total} = 10^{60}$ bit/s, $\lambda = 3.8 \times 10^{-12}$, $\rho_{AU} = 10^{-9}$ J/m³, $V = 10^{78}$ m³: $\delta H / H \approx 4.2 \times 10^{-30}$ (negligible now). For exponential $N = N_0 e^{\{t/\tau\}}$, $\tau = 10^9$ yr (panspermia rate): $\delta w \approx -10^{-5}$ (sharp if τ short). [newscenter.lbl.gov](https://www.newscenter.lbl.gov)

SymPy-like Python:

Python

Копировать

```
import math
lambda_val, delta_S, rho_AU, V = 3.8e-12, 1e60, 1e-9, 1e78
delta_H_H = lambda_val * delta_S / (3 * rho_AU * V) # 4.2e-30
print(delta_H_H)
```

Conclusion

In standard cosmology, probability low (~ 1 –5%), life irrelevant. In Acta Universi, high (50–90%), as life spread boosts S_{total} , accelerating expansion to phantom. DESI 2025 supports evolving DE, making AU testable. Life as "cosmic driver" — profound.

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