Finite Proxies for the Maximal Informational Density of ∅

A Standalone Null Unity–Infosophy Derivation

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Introduction

In both the Null Unity and Infosophy frameworks, the symbol ∅ denotes *Maximal Informational Density*: a state where informational content is nonzero while the effective volume collapses to zero. Formally,

$$\rho_I(\varnothing) = \lim_{V \to 0^+} \frac{I}{V} = +\infty.$$

However, physical or informational calculations often require a *finite* value. This document provides three regulated, computable proxies based on physically meaningful cutoffs:

1. Planck-scale regulator (tightest bound).
2. Nanometer-scale laboratory regulator.
3. Coherence-threshold (THz-bandwidth) regulator.

All finite values arise from applying the Bekenstein bound:

$$I_{\max} \le \frac{2\pi E R}{\hbar c \ln 2} \qquad \text{(bits)},$$

with informational density

$$\rho_I^{\text{eff}} = \frac{I_{\max}}{V}, \qquad V \sim R^3.$$

Finite Proxy Calculations

1. Planck-Scale Regulator

- Planck length: $\ell_P = 1.616 \times 10^{-35}\,\mathrm{m}$.
- Volume: $V_P = \ell_P^3 \approx 4.22 \times 10^{-105}\,\mathrm{m}^3$.
- Energy: $E_P = 1.956 \times 10^9\,\mathrm{J}$.
- Radius: $R = \ell_P$.

Then:

$$I_{\max} \approx 9.06 \text{ bits}, \qquad \rho_I^{\mathrm{eff}} \approx 2.15 \times 10^{105} \text{ bits/m}^3.$$

2. Nanometer Regulator

- Length scale: $\ell = 1\,\mathrm{nm} = 10^{-9}\,\mathrm{m}$.
- Volume: $V = \ell^3 = 10^{-27}\,\mathrm{m}^3$.
- Energy: $E = 1\,\mathrm{eV} = 1.602 \times 10^{-19}\,\mathrm{J}$.
- Radius: $R = \ell$.

Then:

$$I_{\max} \approx 4.59 \times 10^{-2} \text{ bits}, \qquad \rho_I^{\mathrm{eff}} \approx 4.59 \times 10^{25} \text{ bits/m}^3.$$

3. Coherence Threshold (THz Bandwidth)

- Bandwidth: $\Delta\nu = 1\,\mathrm{THz}$.
- Coherence length: $L_c = c/\Delta\nu \approx 3.0 \times 10^{-4}\,\mathrm{m}$.
- Radius: $R = L_c/2 \approx 1.50 \times 10^{-4}\,\mathrm{m}$.
- Volume: $V \approx R^3 \approx 3.37 \times 10^{-12}\,\mathrm{m}^3$.
- Energy: $E = 1\,\mathrm{J}$.

Then:

$$I_{\max} \approx 4.30 \times 10^{22} \text{ bits}, \qquad \rho_I^{\mathrm{eff}} \approx 1.28 \times 10^{34} \text{ bits/m}^3.$$

Summary Table of Regulated Values

Regulator	Scale / Assumptions	$I_{\max}$ (bits)	ρ_I^{eff} (bits/m^3)
Planck Voxel	$\ell_P,\ E = E_P$	9.06	$\mathbf{2.15 \times 10^{105}}$
Nanometer Voxel	$1\,\text{nm},\ E = 1$ eV	4.59×10^{-2}	$\mathbf{4.59 \times 10^{25}}$
Coherence (THz)	$L_c = 3 \times 10^{-4}\,\text{m},\ \text{E} = 1\ \text{J}$	4.30×10^{22}	$\mathbf{1.28 \times 10^{34}}$

Conclusion

In the pure Null Unity and Infosophy frameworks,

$$\rho_I(\varnothing) = +\infty.$$

However, using physically meaningful regulators, we obtain finite, computable proxies for the maximal informational density at $\varnothing$. These finite values do not replace the theoretical divergence; they serve as practical bounds for simulation, estimation, and scaled models of collapse and re-expansion around the Null Origin.