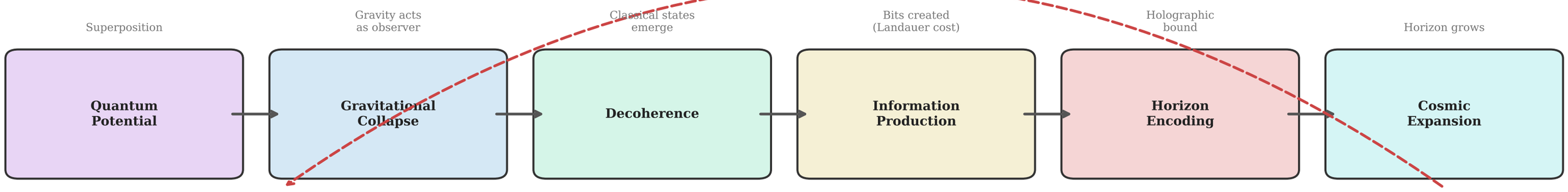
The Informational Actualization Mechanism



Feedback: expansion dilutes matter, weakening collapse

Two Sources of Information

i_{vac} — Vacuum Baseline (Constant)

Virtual particle pairs constantly appearing/disappearing

Zero-point quantum fluctuations of all fields

Always present, independent of structure formation

Maps to: Cosmological constant Λ

$i_{\mathrm{struct}}(t)$ — Structural Complexity (Growing)

Gravitational collapse produces bound states and decoherence

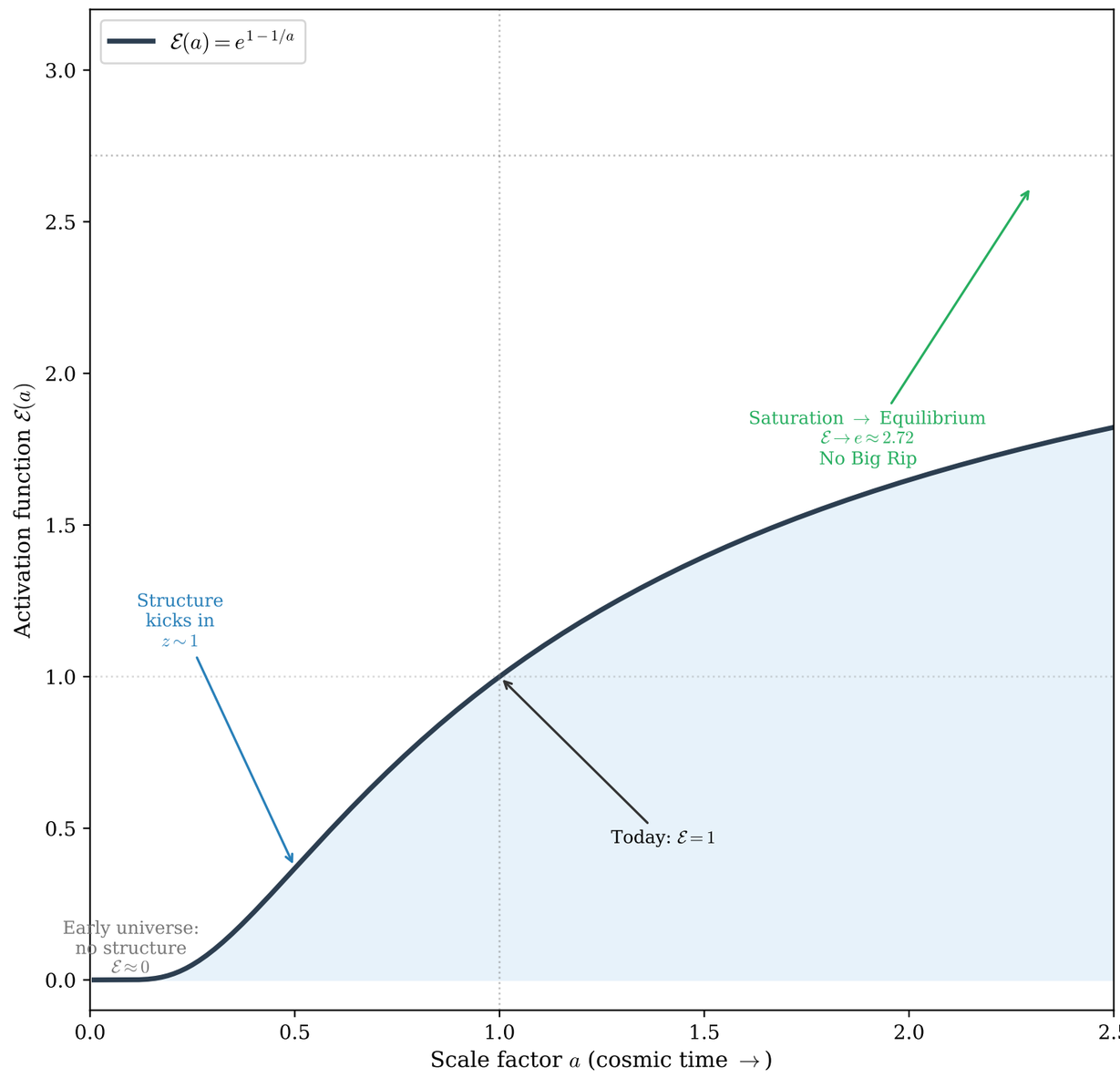
Stars, galaxies, cosmic web forming over cosmic time

Zero in early universe, grows with structure formation

Self-regulating: expansion weakens future collapse

Maps to: $\beta \cdot \exp(1 - 1/a)$ — the activation function

The Activation Function



Why Two Sectors: Matter vs Photons

MATTER	PHOTONS
Forms bound states	Free-stream through space
Collapses gravitationally	Do not form bound states
Decoheres irreversibly	Do not decohere gravitationally
Produces information	**No information produced**
Sees extra expansion from informational pressure	**Sees standard expansion (vacuum baseline only)**
$H_0^{\mathrm{matter}} \approx 72.5$ **km/s/Mpc**	$H_0^{\mathrm{photon}} \approx 67.4$ **km/s/Mpc**
$\mu(a) < 1$: weakened effective gravity	$\Sigma(a) = 1$: standard light deflection

This IS the Hubble tension — resolved.

Origin of the Activation Function

The cosmic horizon has finite area
$A_H = 4\pi/H^2$

↓

Information must encode on this surface
(holographic bound)

↓

What matters is surface density:
bits per unit horizon area

↓

Surface density $\propto D(a)/A_H(a)$
$\propto a/a^3 = 1/a^2$ (matter domination)

↓

Integrate: $\int 1/a^2\, da = -1/a + C$

↓

Exponentiate: $\mathcal{E}(a) = \exp(1 - 1/a)$

The 1/a emerges from physics — not assumed.

The Modified Friedmann Equation

$$H^2(a) = H_0^2 \left[\Omega_m\, a^{-3} + \Omega_r\, a^{-4} + \Omega_\Lambda + \beta \cdot e^{1 - 1/a} \right]$$