Planck-Time Anchoring and the Tensional Oscillator: From Discrete Bits to the Soliton Limit

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Abstract

We present a discrete oscillatory framework in which time itself is modeled as a harmonic function of the Planck area A_P and the universal tensional constant $\alpha_U = k_e A_P$. Anchoring the oscillation period τ in multiples of the Planck time t_P naturally discretizes temporal evolution. Each macroscopic event dissipates into minimal toroidal excitations ("bits"), whose energy is proportional to α_U and the underlying frequency. The universe is then described as the sum of such bits, converging towards a maximum filling determined by the ratio $A_{\max}/A_P$. In this limit, dynamics collapse into a self-stable soliton, interpreted as the ultimate particle and possible informational endpoint of cosmology.

1 Oscillatory Time with Planck Anchoring

We define the fundamental oscillation of time as

$$T(t) = \alpha_U \sin\left(\frac{2\pi t}{\tau}\right) + A_P \cos\left(\frac{2\pi t}{\tau}\right). \tag{1}$$

To discretize, let

$$t = m\, t_P, \qquad \tau = M\, t_P, \qquad m, M \in \mathbb{N}. \tag{2}$$

Thus, the discrete temporal sequence is

$$T_m = \alpha_U \sin\left(\frac{2\pi m}{M}\right) + A_P \cos\left(\frac{2\pi m}{M}\right). \tag{3}$$

2 Energy of Minimal Toroidal Bits

The fundamental excitation is a toroidal bit with energy proportional to the oscillation frequency:

$$\varepsilon(\omega) = \alpha_U\, \omega, \qquad \omega = \frac{2\pi}{\tau} = \frac{2\pi}{M t_P}. \tag{4}$$

Thus, the bit energy is

$$\varepsilon_M = \alpha_U \, \frac{2\pi}{M t_P}. \tag{5}$$

3 Bit Counting for Macroscopic Events

For an event of effective energy $E_{\rm evt}$, the number of bits produced is

$$N_{\rm evt} \;\approx\; \frac{E_{\rm evt}}{\varepsilon_M} = \frac{E_{\rm evt}}{\alpha_U} \, \frac{M t_P}{2\pi}. \tag{6}$$

Alternatively, for events dominated by a frequency $\bar{\omega}$,

$$N_{\rm evt} \;\approx\; \frac{E_{\rm evt}}{\alpha_U \bar{\omega}}. \tag{7}$$

4 Global Summation and Saturation

Define the accumulated bit count up to step m:

$$N(m) = \sum_{j=1}^{m} B_j, \qquad B_j \in \mathbb{N}_0. \tag{8}$$

The vacuum energy reservoir is then

$$E_{\rm vac}(m) = \varepsilon_M \, N(m). \tag{9}$$

If each bit corresponds to a minimal area κA_P, the maximum number of bits is finite:

$$N_{\max} = \frac{A_{\max}}{\kappa A_P}. \tag{10}$$

As $m \to \infty$, the monotonic sequence $N(m)$ saturates:

$$\lim_{m \to \infty} N(m) = N_{\max}. \tag{11}$$

5 The Soliton Limit

When $N(m)$ reaches $N_{\max}$, the dynamics collapse to a single configuration:

$$\text{Universe} \;\longrightarrow\; \text{Soliton}, \tag{12}$$

the last particle, a self-stable toroidal excitation, and the informational endpoint of the tensional framework.

6 Conclusion

By anchoring the oscillatory model of time to the Planck scale, we obtain a natural discretization of temporal evolution. Each macroscopic vibration dissipates into minimal toroidal bits of energy $\alpha_U \omega$. The cumulative process is a bounded summation, converging to a soliton state when all accessible Planck areas are filled. This offers a mathematically concise path to interpret time, energy, and force unification within a single geometric-tensional paradigm.

References

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