0.1 Compaction and Standard Model Particles

In Unified Entropic String Theory (UEST 6.0), the compact dimensions I_1-I_3 serve as the crucible where Standard Model (SM) particles are forged. Picture a tightly coiled spring, its vibrations producing distinct musical tones. Similarly, the compactification of dimensions shapes vibrational modes that manifest as quarks, leptons, and other SM particles. This process, driven by entropic gradients, bridges the quantum world with the macroscopic universe, unifying forces and matter in a 10-dimensional framework.

The compaction of dimensions I_1-I_3 is governed by the entropic potential introduced earlier:

$$\phi_{\text{comp}} = \frac{\nabla S}{k_B} \cdot \frac{\hbar}{T_s},$$

where ∇S is the entropic gradient, $k_B \approx 1.38 \times 10^{-23}$ J/K, $\hbar \approx 1.05 \times 10^{-34}$ J·s, and $T_s = 1.35 \times 10^{-43}$ s/m. The radius of compaction for dimension I_n is:

$$C_{I_n} = \frac{n\hbar}{T_s},$$

yielding $C_{I_1} \approx 7.78 \times 10^{-34}$ m, $C_{I_2} \approx 1.56 \times 10^{-33}$ m, and $C_{I_3} \approx 2.33 \times 10^{-33}$ m. These scales, near the Planck length, define the energy levels of vibrational modes:

$$E_n = \frac{n\hbar c}{C_{I_n}},$$

where $c \approx 3 \times 10^8$ m/s. For I_1:

$$E_1 \approx \frac{1 \cdot 1.05 \times 10^{-34} \cdot 3 \times 10^8}{7.78 \times 10^{-34}} \approx 4.05 \times 10^7 \text{ eV} = 40.5 \text{ MeV},$$

corresponding to the energy scale of light quarks.

The vibrational modes in $I_1 \times I_2$ produce quarks, modulated by the B_2-field, while I_3 hosts leptons, particularly neutrinos, influenced by the H_3-field. The mode equation is:

$$\left(\Box + \frac{\nabla S}{T_s} \right) \psi_n = \frac{E_n^2}{\hbar^2 c^2} \psi_n,$$

where ψ_n represents the fermion wavefunction, and $\Box$ is the d'Alembertian operator. The H_7-field ensures coherence across dimensions, coupling modes via:

$$\mathcal{L}_{\text{mode}} = g_{H_7} \cdot H_7^{\mu\nu\rho\sigma} \cdot \overline{\psi}_n \sigma_{\mu\nu} \psi_n,$$

with $g_{H_7} \approx 0.01$.

Table 1 maps SM particles to their respective dimensions and fields.

These mappings predict specific signatures, such as quark transitions at FCC-hh and neutrino oscillations at DUNE, detailed in later sections. The next subsection explores the role of gauge bosons in this framework.

Table 1: Standard Model Particles in UEST 6.0

Particle	Dimension	Energy (eV)	Entropic Field	Experimental Test
Up quark (u)	$I_1 \times I_2$	2.25×10^6	B_2	FCC-hh 2035
Electron (e^-)	I_3	5.11×10^5	H_3	SQUID-EEG 2028
Neutrino (ν_e)	I_3	< 0.12	H_3	DUNE 2030