0.1 Gauge Bosons and Higgs Field as Entropic Resonances

In Unified Entropic String Theory (UEST 6.0), gauge bosons and the Higgs field emerge as resonant modes of entropic fields within the compact dimensions I_1-I_3. Imagine a cathedral bell, its rich tones arising from precise vibrations. Similarly, the photon, W/Z bosons, gluons, and Higgs boson are vibrational harmonics shaped by entropic fields, orchestrating the fundamental interactions of the Standard Model (SM). This section formalizes their roles and interactions, mediated by the H_7-field, within the 10-dimensional framework.

Gauge bosons—mediators of electromagnetic, weak, and strong forces—are entropic resonances primarily in $\mathbb{R}^{3+1}$ and I_1-I_3. The photon (γ), a massless spin-1 boson, arises from H_3-field fluctuations in I_3:

$$A_\mu^{\text{EM}} = \frac{1}{T_s} \cdot H_3^{\nu\rho\sigma} \cdot \nabla_{[\nu} S \cdot \epsilon_{\mu\rho\sigma]},$$

where $T_s = 1.35 \times 10^{-43}$ s/m, ∇S is the entropic gradient, and $\epsilon_{\mu\rho\sigma}$ is the Levi-Civita tensor. Its energy scale is effectively zero ($E_\gamma \approx 0$ eV), consistent with its massless nature, testable via IAXO 2030 for dark photon couplings.

The W and Z bosons, mediating weak interactions, are resonances in I_3, coupled to H_3:

$$W_\mu^\pm, Z_\mu = \frac{g_{H_3}}{T_s} \cdot H_3^{\mu\nu\rho} \cdot \psi_{\text{lepton}} \gamma_\nu \psi_{\text{lepton}},$$

with $g_{H_3} \approx 0.1$ and energies $E_W \approx 80.4$ GeV, $E_Z \approx 91.2$ GeV. Gluons, responsible for strong interactions, resonate in $I_1 \times I_2$ via the B_2-field:

$$G_\mu^a = \frac{1}{T_s} \cdot B_2^{\mu\nu} \cdot F_{\nu\rho}^{\text{QCD}} \cdot t^a,$$

where t^a are SU(3) generators, and $E_G \approx 1$ GeV.

The Higgs boson, a scalar field in I_3, emerges as an entropic condensate:

$$\phi_H = \frac{\langle \phi_H \rangle}{\sqrt{T_s}} \cdot e^{-\phi_{H_7}},$$

with $\langle \phi_H \rangle \approx 246$ GeV and energy $E_H \approx 125$ GeV. Its interaction with the H_7-field is:

$$\mathcal{L}_{\text{Higgs}} = \frac{g_{H_7}}{T_s} \cdot H_7^{\mu\nu\rho\sigma} \cdot \partial_\mu \phi_H \partial_\nu \phi_H \cdot \epsilon_{\rho\sigma},$$

where $g_{H_7} \approx 0.01$. This coupling predicts subtle deviations in Higgs decay rates, testable at FCC-hh 2035.

The H_7-field, operating at 142.7 Hz, synchronizes these resonances:

$$\mathcal{L}_{\text{gauge}} = \frac{1}{T_s} \cdot H_7^{\mu\nu\rho\sigma} \cdot \left(F_{\mu\nu}^{\text{EM}} + F_{\mu\nu}^{\text{Weak}} + F_{\mu\nu}^{\text{QCD}} \right),$$

ensuring coherence across SM interactions. These resonances anchor the SM within UEST's entropic framework, with experimental signatures in high-energy collisions and low-energy quantum processes, detailed in later sections. The next subsection completes the SM integration by addressing neutrino oscillations and flavor dynamics.