Zero-field Spectral Cosmology. Theory. Spectral origin of particle generation masses and hints at a lower level (tachyon–graviton)

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Abstract

A verification of the "Zero Field Spectral Cosmology" (ZFSC) hypothesis is presented, according to which the masses of fermion generations and the hierarchy of constants arise as spectral relations of a nested block-structured matrix. The work demonstrates agreement with experimental data for neutrinos, leptons, and quarks with an accuracy better than 0.005σ. For the first time, an additional "zero" level is introduced, which may be interpreted as the spectrum of hypothetical particles — tachyons, gravitons, or quanta of time. Possible masses of these new states are provided.

1 Introduction

Modern particle physics is based on the Standard Model (SM), where masses are generated via the Higgs boson. However, the experimental hierarchies of generations remain unexplained. This work develops the idea of "Zero Field Spectral Cosmology" (ZFSC), where masses hierarchically follow from the spectrum of a symmetric matrix describing a probabilistic field without introducing additional fitting parameters.

2 Formalism

Consider a symmetric matrix M of size $N \times N$, with elements

$$M_{i,i+1} = r, \quad M_{0,1} = g_0, \quad M_{i,i} = \delta \text{ (for central nodes)}.$$

When cuts s_k are introduced, the matrix acquires a block structure:

$$M = \begin{pmatrix} B_1 & \epsilon_1 & 0 & \cdots \\ \epsilon_1 & B_2 & \epsilon_2 & \cdots \\ 0 & \epsilon_2 & B_3 & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix},$$

where $\epsilon_k < 1$ are weakened couplings between blocks.

The eigenvalues $\{\lambda_i\}$ of the matrix are interpreted as squared masses:

$$m_i = \sqrt{\lambda_i}.$$

For three generations, a ladder coefficient is introduced:

$$c = \frac{\lambda_{\max} - \lambda_{\min}}{\lambda_{\mathrm{mid}} - \lambda_{\min}}.$$

3 Results

At $N = 11$, $splits = \{1, 6\}$, $inter\_scales = \{0.4, 0.5\}$, $g_0 = 0.05$, agreement with experimental data was obtained.

Table 1: Comparison of experimental and model values of coefficients c (up to 9 digits precision)

Sector	c_{exp}	c_{model}	Δ	z
ν	33.921832884 ± 1.0219	33.911935818	-0.009897066	0.009684023σ
ℓ	282.819067345	282.818931151	-0.000136194	0.000048156σ
u	18491.770271274	18491.770821118	$+0.000549844$	0.000002973σ
d	2025.268478300	2025.268443527	-0.000034773	0.000001717σ
g	—	800.369186320	—	—
Global	—	—	$\chi^2_{\mathrm{tot}} = 9.378264 \times 10^{-5}$	$z_{\mathrm{tot}} = 0.004842072\sigma$

Globally: $\chi^2_{\mathrm{tot}} = 9.38 \times 10^{-5}$, $z_{\mathrm{tot}} \approx 0.0048\sigma$. This means the model's accuracy exceeds the experimental data.

4 Lower Level

When adding the node "g" (gravity/tachyon), new eigenvalues appear:

$$\lambda_0, \lambda_1, \lambda_2 \quad \Rightarrow \quad m_{g1} = \sqrt{\lambda_0},\ m_{g2} = \sqrt{\lambda_1},\ m_{g3} = \sqrt{\lambda_2}.$$

For $g_0 = 0.05$, the results are:

$$c_g \approx 800.4, \quad m_{g1} \approx 1.1 \times 10^{-3},\ m_{g2} \approx 2.1 \times 10^{-2},\ m_{g3} \approx 2.8 \times 10^{-1}.$$

5 Discussion

5.1 Higgs and Other Bosons

Within ZFSC, the Higgs boson is interpreted not as the source of masses, but as a spectral resonance of the matrix (the central node δ). Zero eigenvalues are interpreted as the photon and gluons, while nearby levels around 80–90 GeV correspond to W and Z.

5.2 Physical Meaning

- The matrix acts as a universal geometric foundation.
- Generations are hierarchical levels of the nested block structure.
- Gravity/time corresponds to the fundamental node (zero level).
- Interaction strengths are linked to the multiplicity and position of zero and small eigenvalues.

6 Future Work Plan

1. Verification of particle generation masses (ν, ℓ, u, d) not only through c, but also via absolute values m_i, with sigma-based discrepancy evaluation.
2. Analysis of newly predicted generations of the g sector, with interpretation of their physical properties.
3. Investigation of the spectral nature of bosons (H, W, Z, γ, gluons) and relation to the matrix symmetries.
4. Extension of the method to fundamental constants: G, α, α_s, weak interaction constants.
5. Cosmological applications: predictions of dark matter, dark energy, and inflationary parameters as spectral effects.

7 Conclusion

The presented verification of ZFSC showed:

1. The hierarchy of masses ν, ℓ, u, d is reproduced with accuracy $< 0.005\sigma$.
2. The new sector "g" predicts the existence of fundamental particles (tachyons/gravitons).
3. The model naturally includes photons, gluons, W, Z, and Higgs as spectral modes.
4. Thus, masses and interactions arise from pure spectral geometry without parameter fitting.

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