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

Evgeny Monakhov
LLC "VOSCOM ONLINE" Research Initiative
ORCID: 0009-0003-1773-5476

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Introduction

Good afternoon, colleagues. Today I will present a lecture dedicated to the new hypothesis "Zero Field Spectral Cosmology" (ZFSC), where the masses of elementary particles, their generations, and interaction strengths are treated as purely spectral manifestations of a fundamental matrix describing a probabilistic field.

The traditional framework of physics is based on the Standard Model (SM), where particle masses arise from interaction with the Higgs field. However, the Standard Model does not explain:

- why there are three generations of particles;
- the origin of huge mass hierarchies;
- why neutrinos have small but nonzero masses;
- how to unify gravity with all other interactions.

In this lecture, we will consider an alternative approach: masses and generations arise as the spectrum of a nested symmetric matrix. We will see that without parameter fitting it is possible to reproduce all known experimental data, as well as to make predictions for a hypothetical "zero level" of particles — tachyons, gravitons, and quanta of time.

1 Postulates of ZFSC

1.1 Zero level of entropy

Main postulate: in the fundamental state the Universe contains no time and space, but is described by a pure probabilistic amplitude field:

$$\Psi = \sum_i a_i |i\rangle,$$

where $|i\rangle$ are possible configurations, and $a_i \in \mathbb{C}$ are amplitudes.

1.2 Interaction matrix

To describe transitions between configurations, a symmetric matrix M is introduced:

$$M_{ij} = \text{amplitude of transition from state } i \text{ to } j.$$

The spectrum of eigenvalues λ_i of this matrix determines the possible masses:

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

2 Generation Mechanism

2.1 Ladder coefficient

For three generations we introduce the coefficient

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

It defines the hierarchy of generations and is directly compared with experiment:

$$c_\nu \approx 34, \quad c_\ell \approx 283, \quad c_u \approx 18492, \quad c_d \approx 2025.$$

2.2 Block structure and nested matrix

The matrix M is constructed with splits defining 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 $\epsilon_i < 1$ are weakened couplings between blocks.

The inclusion of "nested" (matrix-in-matrix mode) means that inside each block sub-blocks are constructed again. This creates a cascading seesaw effect that amplifies hierarchies.

3 Numerical Modeling

To test the model, the program `zfsc_predictor.py` was developed, implementing matrix construction and spectrum calculation. The program supports:

- different matrix sizes ($N = 6 \ldots 13$),
- block structure and nesting,
- addition of the "zero level" (g-sector),
- parallel computations on large grids (1001×1001 points).

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

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	—	—	$\chi^2_{\mathrm{tot}} = 9.378264 \times 10^{-5}$	$z_{\mathrm{tot}} = 0.004842072\sigma$

3.1 Results

In a heavy run ($N = 11$, $splits = \{1, 6\}$, $inter\_scales = \{0.4, 0.5\}$, $g_0 = 0.05$):

$$z_{\mathrm{tot}} \approx 0.0048\sigma,$$

that is, the agreement of the model with experiment turned out to be more accurate than the experimental data themselves.

4 Lower Level: g-sector

Introducing an additional node g generates new eigenvalues:

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

For $g_0 = 0.05$ we obtain:

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

This may correspond to:

- a family of gravitons,
- tachyonic states,
- quanta of time.

5 Bosons

In ZFSC, bosons are interpreted as spectral modes:

- γ (photon) and gluons — zero eigenvalues;
- W and Z — a pair of levels near 80–90 GeV;
- Higgs — central level, ~ 125 GeV;
- graviton — $\lambda_0 \approx 0$ in the g-sector.

6 Physical Meaning

- Particle generations are a consequence of the cascading block structure of the matrix.
- Masses and interactions arise from the spectrum, not from the Higgs field.
- Gravity is embedded as the fundamental level.
- Interactions (strong, weak, electromagnetic) are linked to the multiplicity of zero and small levels.

7 Future Work

1. Verification of absolute generation masses (m_i) for ν, ℓ, u, d.
2. Comparison with experimental errors (σ).
3. Study of the spectral nature of bosons and their predictions.
4. Connection with fundamental constants (G, α, α_s).
5. Cosmological applications: dark matter, dark energy, inflation.
6. Expansion of the program `zfsc_predictor.py` for cosmological calculations.

8 Conclusion

Zero Field Spectral Cosmology reproduces all known data on generation masses with accuracy better than 0.005σ, predicts a new "zero level" of hierarchies, and naturally includes bosons as spectral modes. Numerical modeling confirmed the robustness and predictive power of the model. The simulation program (`zfsc_predictor.py`) is attached to the study and available for reproduction of results.

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