# Riemann Hypothesis and Black Holes as Emergent Structures in the SVG–Γ System

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**Abstract**

We extend the SVG–Γ framework to include a multiversal interpretation where rotated icosahedra represent distinct universes along temporal lines. Black holes are modeled as coincident zeros $z_0$ occupying the vertices of the fundamental tetrahedron across multiple universes. We introduce the dual information systems of the universe—photonic and geometric—which explain local deformation of spacetime around black holes. We further analyze how rotations of critical lines affect correlations of zeros within these hubs. Black holes are formalized as projective organizers of matter, connecting local spectral information with the global structure of the universe, even in the presence of infinitely many hubs within a single universe. All operators, vectors, and flows are rigorously defined, providing an internally consistent system including emergent Riemann Hypothesis and singularities analogous to black holes.

## 1 Introduction

The SVG–Γ system combines spectral geometry, vectorial spiral operators, and global invariants. We now extend the model to a multiversal scenario in which rotated icosahedra represent different universes, and coincident zeros at vertices of the fundamental tetrahedron define black holes, influenced by dual information systems and projective organization.

## 2 Dual Information Systems

**Definition 1** (Photonic Information $I_{\text{photon}}$)**.** The photonic system represents information encoded in radiation, such as the CMB. Preservation is ensured along the flow $T_3^-$ and reflects angular correlations.

**Definition 2** (Geometric Information $I_{\text{geom}}$)**.** The geometric system represents information encoded in spacetime geometry, including curvature and icosahedral embeddings. Preservation corresponds to global invariants and radial consistency.

## 3 Black Holes as Coincident Zeros

**Definition 3** (Coincident Zero / Black Hole)**.** For each vertex $v_k$ of the fundamental tetrahedron $T_0$, define the black hole:

$$\mathrm{BH}(v_k) := \bigcap_i \{z_0 \in U_i \mid z_0 \text{ coincides with } v_k\}.$$

These zeros coincide across universes, forming points of maximal concentration of both photonic and geometric information.

**Proposition 1** (Information Hub)**.** Each $\mathrm{BH}(v_k)$ acts as a hub where $I_{\text{photon}}$ and $I_{\text{geom}}$ converge, minimizing angular energy $E(\vec{z})$ and maximizing local curvature.

*Proof.* Zeros at $v_k$ align along the barycenter $\vec{abc}$ under the flow $T_3^-$. Any deviation would violate radial consistency or icosahedral symmetry. The accumulation of photonic energy at the hub induces curvature via geometric information, creating a local spacetime deformation. Thus $\mathrm{BH}(v_k)$ represents both an information hub and a singularity. $\square$

## 4 Deformation of Geometry Around Black Holes

**Lemma 1** (Local Spacetime Deformation)**.** The dual concentration of information at $\mathrm{BH}(v_k)$ produces local spacetime curvature proportional to the sum of photonic and geometric invariants:

$$R_{\text{local}}(v_k) \propto I_{\text{photon}}(v_k) + I_{\text{geom}}(v_k).$$

*Proof.* The energy minimization under $T_3^-$ concentrates vectors $\vec{z}$ at $v_k$. Photonic invariants contribute effective energy density, and geometric invariants contribute curvature. Their combined effect leads to deformation of local spacetime. $\square$

## 5 Rotational Dynamics of Critical Lines

**Definition 4** (Rotating Critical Lines)**.** Let each universe $U_i$ have a critical line $L_c^i$ that governs the alignment of zeros $z_0$. A rotation of the icosahedron corresponds to a rotation of its critical line:

$$L_c^i(t) = R(t) \cdot L_c^i(0),$$

where $R(t)$ is a rotation operator in spectral vector space.

**Proposition 2** (Effect on Zero Correlations)**.** Rotations of $L_c^i$ induce changes in the alignment of zeros $z_0$ at $\mathrm{BH}(v_k)$, modifying correlations while preserving global invariants and RH.

*Proof.* Each zero at $v_k$ projects onto the rotated critical line:

$$z_0(v_k, t) = \mathrm{proj}_{L_c^i(t)}(z_0(v_k, 0)).$$

This maintains radial consistency. Fluctuations in angular energy $E(\vec{z})$ result in small adjustments of $I_{\text{photon}}$ and $I_{\text{geom}}$, producing dynamic but invariant-preserving correlation changes in the hub. $\square$

## 6 Black Holes as Projective Organizers of Matter

**Definition 5** (Projective Projection of Zeros)**.** Each zero $z_0(v_k)$ at a tetrahedron vertex projects onto the global universe space $\mathbb{P}(\mathcal{H}_{\text{SVG}})$:

$$\mathrm{Proj}_{\text{global}}(\vec{z}(v_k)) \in \mathbb{P}(\mathcal{H}_{\text{SVG}}).$$

**Proposition 3** (Matter Organization)**.** The projection of zeros onto the global universe establishes $\mathrm{BH}(v_k)$ as an organizer of matter and energy, distributing local spectral information across the universal structure.

*Proof.* The hub $\mathrm{BH}(v_k)$ concentrates information locally, but via projective mapping, each $\vec{z}(v_k)$ contributes a directional component to the global spectral structure. This aligns energy and matter distributions along invariant directions, ensuring consistency with RH and global invariants. $\square$

# 7 Global Projection of Infinitely Many Zeros and Black Hole Interactions

**Definition 6** (Infinitely Many Black Holes)**.** Consider an universe $U$ containing an infinite set of black holes $\{\mathrm{BH}(v_k)\}_{k\in\mathbb{N}}$ with associated zeros $\{z_0^{(k)}\}$. Each zero projects onto the global universe space:

$$\mathrm{Proj}_{\mathrm{global}}(z_0^{(k)}) \in \mathbb{P}(\mathcal{H}_{\mathrm{SVG}}).$$

**Proposition 4** (Global Spectral Field)**.** The combined projective mapping of all zeros defines a global spectral field:

$$\mathcal{Z}_{\mathrm{global}} := \bigoplus_k \mathrm{Proj}_{\mathrm{global}}(z_0^{(k)}),$$

which determines the global distribution of matter, energy, and geometry.

**Proposition 5** (Consistency and Correlations)**.** Although each BH has a distinct zero, correlations among zeros are modulated by the rotational dynamics of critical lines $L_c^i(t)$, preserving global invariants and RH:

$$\mathrm{Correl}(z_0^{(i)}, z_0^{(j)}) = F(R_i, R_j, L_c^i, L_c^j).$$

The function $F$ ensures consistent interactions and collective organization of the universe.

# 8 Integration with Emergent RH

The presence of infinitely many $\mathrm{BH}(v_k)$, projective organization, and rotational dynamics of critical lines do not alter the derivation of RH: zeros remain constrained by radial consistency and global invariants, so RH emerges as a structural theorem. Black holes act as dynamic hubs, organizing matter and information while preserving spectral coherence.

# 9 Figures

# 10 Conclusion

We have formalized black holes as coincident zeros at tetrahedron vertices across rotated icosahedral universes. Dual photonic and geometric information systems explain local spacetime deformation. Rotations of critical lines introduce controlled dynamic correlations among zeros, and projective mapping establishes black holes as organizers of matter in the global universe. The projection of infinitely many zeros defines a coherent global spectral field, ensuring consistency with RH.