

The Geometrization of Anomaly: A Cartographic Assessment of Cosmological Anisotropy and the Nullification of Dark Energy via the TCGS-SEQUENTION Framework

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Article

The Geometrization of Anomaly: A Cartographic Assessment of Cosmological Anisotropy and the Nullification of Dark Energy via the TCGS-SEQUENTION Framework

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Abstract

This research report operationalizes the “Cartographic Mandate” of the TCGS-SEQUENTION framework, moving beyond the falsification of standard models to the mapping of a four-dimensional (4-D) Counterspace. We argue that the accumulating statistical anomalies in contemporary cosmology are not experimental noise but the geometric signatures of the “Territory” showing through the “Map.” By synthesizing recent high-precision analyses of Type Ia supernovae and radio source counts, we demonstrate that the widely accepted “Dark Sector” is an artifact of imposing an isotropic metric on an anisotropic projection. Specifically, we identify the dipolar nature of the deceleration parameter (q_0) as the definitive evidence against vacuum energy; a fluid cannot exhibit directionality, whereas a projection gradient must. We show that the observed overdispersion in radio catalogues—the failure of Poisson statistics—is not random noise but the leakage of 4-D correlations into the 3-D shadow, quantifiable via the Negative Binomial Distribution. The Counterspace is therefore not a hypothesis but a topological necessity required to explain the forbidden regions of the mass-radius cartography and the persistence of bulk flows. We conclude that the evidence for a static, 4-D source manifold is already present in the existing catalogue tensions; it requires only the correct geometric ontology to be understood.

Keywords: acceleration; anisotropy; automorphism; axioms; Baierlein-sharp-wheeler action; biological homology; black hole; boundary conditions; bulk flow; cartography; CMB dipole; Compton boundary; constitutive law; cosmic microwave background; cosmology; counterspace; dark energy; dark flow; dark matter; Darwinian selection; dipole; epistemology; evolution; expansion rate; extrinsic curvature; falsification; FLRW metric; foliation; gauge time; geometrization; Gödelian provability; gravity; homogeneity; horizon; hubble tension; identity of source; immersion map; instanton; isotropy; LambdaCDM; map-territory relation; maximum likelihood; metamathematics; metric; milne model; negative binomial distribution; non-popperian; ontology; overdispersion; parsimony; poisson distribution; projection; quantum mechanics; radio sources; redshift; scale factor; schwarzschild boundary; SEQUENTION; shadow manifold; singularity; supernova; superorganism; tarskian truth; topology; torsion; vacuum energy

1. Introduction: The Crisis of the Standard Model and the Cartographic Mandate

The contemporary landscape of theoretical cosmology is defined by a deepening fracture between the elegant, isotropic assumptions of the standard Λ CDM model and the stubborn, anisotropic reality revealed by high-precision observations. For decades, the foundational axiom of cosmology—the Cosmological Principle—has asserted that the Universe, on sufficiently large scales, is homogeneous and isotropic. This assumption reduces the intractable complexity of general relativity to the solvable Friedmann-Lemaître-Robertson-Walker (FLRW) metric, governed by a single, time-dependent scale factor. However, as observational datasets have grown in volume and sensitivity, this theoretical

edifice has begun to crack. We are now confronted with a series of persistent anomalies that cannot be resolved without introducing increasingly baroque “dark sectors”: a “bulk flow” of galaxies extending far beyond the predictive limits of the model [6,8], a dipolar anisotropy in radio source counts that dwarfs the kinematic expectation from the Cosmic Microwave Background (CMB) [5,7], and a “Hubble tension” that implies the expansion rate of the Universe is fundamentally unstable, depending entirely on the local observer’s vantage point [11].

Standard physics attempts to suture these wounds by multiplying entities. “Dark Energy” is postulated to drive acceleration; “Dark Matter” is invoked to bind galaxies; “Dark Flow” is proposed to explain inexplicable motion. The Timeless Counterspace & Shadow Gravity (TCGS) and SEQUENTION framework proposes a radical, rigorous inversion of this ontology. It posits that these anomalies are not failures of the data, nor are they evidence of hidden particles. They are, instead, failures of the **container**—the three-dimensional, temporal manifold—used to interpret them. The “missing mass” and “missing energy” are not substances; they are geometric ghosts generated by projecting a higher-dimensional reality onto a lower-dimensional slice.

This research report operationalizes the “Cartographic Mandate” of the TCGS framework [1]. We adopt a non-Popperian, metamathematical epistemology. We do not seek to “falsify” the existence of the 4-D Counterspace, which is defined axiomatically as the “Whole Content” or “Territory” (analogous to Tarskian Semantic Truth). Instead, we treat the observable 3-D Universe as a “Map” (analogous to Gödelian Provability). The scientific task is to identify the distortions, artifacts, and incompleteness inherent in this map. We argue that the statistical discrepancies reported in the recent literature—specifically by Böhme et al. (2025) [5], Colin et al. (2011, 2017, 2019) [6–8], Nielsen et al. (2016) [10], and Rameez & Sarkar (2021) [11]—are not errors to be corrected, but are the direct, quantifiable signatures of the projection map $X : \Sigma \rightarrow \mathcal{C}$. By rigorously assessing these papers under the TCGS axioms, we will demonstrate that “cosmic acceleration” is a foliation artifact caused by a dipolar gradient in the projection; that the “excess radio dipole” is a measurement of the extrinsic curvature of the shadow manifold; and that the “Hubble tension” is the result of attempting to force a single expansion parameter onto a complexly folded geometric projection. Furthermore, we extend this analysis to the biological domain via the SEQUENTION homology, arguing that the “randomness” of Darwinian selection is the biological equivalent of the “dark matter” illusion—both being projection artifacts of a singular, deterministic 4-D source [2].

2. The TCGS-SEQUENTION Ontology: Axiomatic Foundations

To properly assess the empirical literature, we must first rigorously define the theoretical apparatus of the TCGS-SEQUENTION framework. This framework abandons the notion of “time” as a fundamental generator of reality, replacing it with a static geometric structure. The “metaphysical” component of this architecture is not an abstraction but a structural necessity required to resolve topological inconsistencies in the observable data.

2.1. Axiom A1: The Whole Content (C) and the Rejection of Ontic Time

The primary axiom posits the existence of a smooth, 4-dimensional manifold, the “Counterspace” $\mathcal{C}$, endowed with a metric G_{AB} and a global content field Ψ [1]. This manifold contains the “full content of all ‘time stages’ simultaneously.” It is the “Territory” in the map-territory relation. In this ontology, the “past” and “future” are simply different coordinates in a static block. The “Big Bang” is not a moment in time, but a geometric coordinate (the “Instanton” or source pole) within $\mathcal{C}$.

The necessity of this counter-spatial dimension emerges from an elementary analysis of three-dimensional phenomenology. As detailed in the Lineweaver-Patel mass-radius cartography referenced in the framework [9], the observable 3-D manifold Σ is rigidly bounded by two antagonistic geometric limits: the Schwarzschild Boundary ($r_s = 2Gm/c^2$) and the Compton Boundary ($\lambda_c = \hbar/mc$). A truly fundamental, self-contained 3-D space should be scale-invariant. The presence of these rigid boundaries is the definitive geometric signature of an embedding. The observable 3-D world is the “cone of admissibility” defined by the constraints imposed by the higher-dimensional source $\mathcal{C}$.

2.2. Axiom A2: Identity of Source and the Geometric Origin of Singularity

This axiom provides the unification principle. It asserts that there is a distinguished point $p_0 \in \mathcal{C}$ (the Instanton) and an automorphism group such that the fundamental singular set S is the orbit of p_0 [1]. Critically, **all singularities registered in the shadow descend from this unique origin point.**

This applies equally to gravitational singularities (black holes) and biological organizations. The “Identity of Source” implies that apparent multiplicity in the 3-D world (e.g., convergent evolution, universal gravitational constants) is a projection of a singular unity in the 4-D source. This axiom redefines the “problem of initial conditions” as a “problem of boundary conditions.” In General Relativity, a singularity is a physical breakdown. In TCGS, it is a conserved geometric feature. The formation of a black hole in the shadow Σ is the critical event where the projection map X intersects the fundamental geometric boundary S within $\mathcal{C}$.

2.3. Axiom A3: Shadow Realization and Gauge Time

The observable world Σ is a 3-manifold embedded in $\mathcal{C}$ via a smooth immersion map $X : \Sigma \rightarrow \mathcal{C}$ [1]. All observables (g, ψ) on the shadow are pullbacks of the 4-D structure:

$$(g, \psi) = (X^*G, X^*\Psi) \quad (1)$$

“Time” is demoted to a gauge parameter—a foliation label that parameterizes the comparison between admissible 3-geometries. Evolution is an illusion created by slicing the static block. “Motion” is merely how changes in the source layer register as geometry or inertia in the shadow. This position is secured mathematically by the Baierlein-Sharp-Wheeler (BSW) action [4], which recovers the dynamics of General Relativity not from a fundamental time, but from the reparameterization invariance of the 3-geometries. Time is merely the label parameterizing the comparison between admissible slices.

2.4. Axiom A4: Parsimony and the Extrinsic Constitutive Law

This axiom eliminates “dark sectors.” It states: “No dark species; apparent dark effects arise from projection geometry encoded by one constitutive law” [1]. The “missing mass” attributed to Dark Matter is actually the extrinsic curvature of the 3-D shadow embedded in the 4-D source. The framework proposes a modified Poisson equation for the weak-field response:

$$\nabla \cdot \left[\mu \left(\frac{|\nabla \Phi|}{a_*} \right) \nabla \Phi \right] = 4\pi G \rho_b \quad (2)$$

Here, $\mu(y)$ is a projection operator replacing the dark halo, and a_* is an embedding invariant scale (calibrated to $\approx 1.2 \times 10^{-10} m/s^2$) [3]. This single law replaces the need for dark matter halos by encoding the informational deficit arising from describing a 4-D geometry using a constrained 3-D manifold.

3. The Myth of Isotropy: Assessing the Radio Dipole Anomaly

The standard Λ CDM model requires the Universe to be isotropic in the “CMB rest frame.” The dipole observed in the Cosmic Microwave Background (CMB) temperature is interpreted entirely as a kinematic effect—a Doppler shift due to the Solar System’s motion of ≈ 369 km/s. If this interpretation is correct, the same velocity should be inferred from the number counts of distant radio sources (via aberration and Doppler boosting). However, the papers by Böhme et al. (2025) [5] and Colin et al. (2017) [7] provide robust empirical evidence that this is not the case. Under the TCGS framework, we interpret these findings not as a puzzle, but as a direct mapping of the 4-D geometry.

3.1. The Failure of the Poissonian Assumption: A Topological Signal

Böhme et al. (2025) present a groundbreaking analysis of wide-area radio surveys, including LoTSS-DR2, NVSS, and RACS-low [5]. A critical methodological innovation in their work is the rejection of the Poisson distribution for modeling source counts. Standard cosmology assumes galaxies

are independent point processes (Poissonian). Böhme et al. demonstrate that radio sources exhibit **overdispersion**—the variance exceeds the mean—due to multi-component structures. To address this, they employ a **Negative Binomial Distribution (NBD)** estimator [5]. The statistical improvement is undeniable. As seen in Table 1, the reduced chi-squared values for the NBD fit are consistently close to 1.0, unlike the Poisson fits.

Table 1. Comparison of counts-in-cells statistics between Poisson and Negative Binomial distributions for major radio surveys. Data derived from Böhme et al. (2025) [5].

Survey	Flux Cut (mJy)	$\chi^2_{r,P}$ (Poisson)	$\chi^2_{r,NB}$ (NBD)	μ_{Log}
LoTSS-DR2	5	2.25	0.76	1.70 ± 1.28
TGSS	100	23.79	0.87	1.22 ± 0.55
RACS-low	20	4.51	1.18	1.10 ± 0.33
RACS-mid	20	2.80	0.70	1.07 ± 0.27
NVSS	20	4.14	1.09	1.09 ± 0.32
VLA	10	40.9	0.90	1.32 ± 0.71

TCGS Interpretation:

The necessity of the Negative Binomial Distribution is a signature of the **holographic nature of the shadow**. In the TCGS framework, “objects” in the 3-D shadow are projections of 4-D structures. A single 4-D object may project onto the shadow as multiple, spatially separated components (e.g., the lobes of a radio galaxy, or clustered galaxy groups). The “overdispersion” is the statistical residue of this higher-dimensional connectivity. The Poisson distribution assumes independence in 3-D space; its failure proves that radio sources are **not independent** in the fundamental territory. They are correlated via the 4-D bulk. The “clustering” parameter p in the NBD equation derived by Böhme et al. ($p = 1 - \hat{\mu}/\hat{\sigma}^2$) [5] can be reinterpreted in TCGS as a **projection density parameter**, quantifying the complexity or “folding” of the map X .

3.2. The Excess Dipole as Geometric Torsion

Using this superior NBD estimator, Böhme et al. find that the source count dipole d is significantly larger than expected. Combining the two best-understood wide-area surveys (NVSS and RACS-low) with the deepest survey (LoTSS-DR2), they report that the source count dipole exceeds the kinematic expectation by a factor of 3.67 ± 0.49 [5]. This is a 5.4σ **discrepancy** [5]. Crucially, despite the magnitude mismatch, the direction of the radio dipole aligns closely with the CMB dipole. This finding is corroborated by Colin et al. (2017) using the NVSUMSS catalogue (a merger of NVSS and SUMSS) [7]. They found a velocity of 1729 ± 187 km/s, roughly **4 times larger** than the CMB value (369 km/s), yet pointing in the same direction ($RA \approx 149^\circ$, $Dec \approx -17^\circ$). Using a 3-dimensional linear estimator yielded a velocity of 1355 ± 174 km/s, still vastly exceeding the CMB prediction [7].

TCGS Insight:

In the standard model, this is a paradox. If the Earth is moving at velocity v , it should impart the same aberration to CMB photons and radio galaxies. The fact that the derived “velocities” differ by a factor of 4 implies that **the dipole is not purely kinematic**. Under TCGS, we posit that the “dipole” is not a measure of motion through space, but a measure of the **gradient of the foliation** through the 4-D Counterspace. The observable universe Σ is “tilted” relative to the source field Ψ . The CMB dipole measures the tilt of the “photon surface” foliation (the surface of last scattering). The Radio dipole measures the tilt of the “matter surface” foliation (high-redshift galaxies). The mismatch (factor of 4) indicates that these two surfaces are **not parallel** in the 4-D embedding. The “excess” dipole is actually a measurement of the **torsion** or **shear** between the electromagnetic radiation field and the mass-density field within the Counterspace $\mathcal{C}$. The alignment in direction suggests that both foliations are oriented by the same massive singularity (the Axiom A2 source, p_0), but their “angle of incidence” differs. This validates the TCGS claim that “motion is how changes in the source layer

register as geometry" [1]. The "velocity" of the solar system is a gauge artifact; the physical reality is the geometric orientation of the 3-D observer slice within the 4-D block.

Furthermore, Colin et al. (2017) note that this large dipole persists even after removing local sources, the Galactic plane, and the Super-Galactic plane [7]. This robustness confirms that the anisotropy is a **global geometric feature** of the projection, not a local contamination. The "real mystery" they describe is simply the extrinsic curvature of the shadow manifold Σ manifesting as a dipole in number counts.

4. The Illusion of Acceleration: Deconstructing Supernova Cosmology

The detection of "Cosmic Acceleration" in the late 1990s led to the postulation of "Dark Energy" (Λ). This entity, comprising 70% of the energy density of the universe, is required solely to fit the distance-redshift relation of Type Ia supernovae (SNe Ia) to the FLRW metric. The papers by Nielsen et al. (2016) [10] and Colin et al. (2019) [8] dismantle the statistical certainty of this acceleration, providing crucial support for Axiom A4 (Parsimony).

4.1. Marginal Evidence and Model Dependence: The MLE Approach

Nielsen et al. (2016) performed a rigorous Maximum Likelihood (MLE) analysis of the JLA supernova catalogue, fitting 10 parameters simultaneously (including light curve corrections α, β and intrinsic distributions) [10]. This contrasts with the standard "constrained χ^2 " method, which they argue is tuned to the Λ CDM model and unsuitable for model selection.

- **Data Point:** Using the MLE, they found that the evidence for acceleration ($\Omega_\Lambda > 0$) is "marginal," at less than 3σ [10].
- **Data Point:** Surprisingly, the data are "quite consistent with a constant rate of expansion" (the Milne model), which requires no Dark Energy [10].

TCGS Interpretation:

In TCGS, the "constant rate of expansion" (Milne model) corresponds to a **flat projection** or a trivial foliation. The fact that the data are consistent with this implies that the "curvature" requiring Dark Energy is likely a result of improper calibration of the "standard candles" or an artifact of assuming a specific (FLRW) metric geometry. Axiom A3 states that "Time is gauge." If the expansion rate is an artifact of foliation, then "acceleration" (the second derivative of the scale factor with respect to time) is merely the **curvature of the foliation slices**. A flat slice yields constant expansion. A curved slice yields acceleration. Nielsen et al.'s result suggests that the "curvature" of our temporal slice is far less pronounced than Λ CDM proponents claim, allowing for a geometric reinterpretation without exotic fluids.

4.2. The Dipolar Nature of Acceleration: A Flow, Not a Fluid

Colin et al. (2019) take this analysis further by relaxing the assumption of isotropy. They model the deceleration parameter q_0 as having a monopole (q_m) and a dipole (q_d) component:

$$q_0 = q_m + q_d \cdot \hat{n} \exp(-z/S) \quad (3)$$

This model tests whether the acceleration is uniform (as Dark Energy requires) or directional (as a bulk flow or projection gradient would imply) [8].

- **Data Point:** The best fit to the JLA data yields a massive dipole component $q_d = -8.03$ aligned with the CMB dipole [8].
- **Data Point:** The characteristic scale of this dipole is $S = 0.0262$, corresponding to a distance of $d \sim 100$ Mpc [8].
- **Data Point:** The isotropic monopole component is $q_m = -0.157$, which is consistent with **no acceleration** ($q_m = 0$) at 1.4σ [8].

- **Significance:** The anisotropy is detected at 3.9σ significance, rejecting the isotropic Λ CDM assumption [8].

TCGS Interpretation:

This is a “smoking gun” for the TCGS framework. If “Dark Energy” were a physical fluid (like vacuum energy), it would exert isotropic pressure. Acceleration would be the same in all directions. Colin et al. show that acceleration is **dipolar**—it is essentially a “flow” effect. Under TCGS, this dipolar acceleration is the **gradient of the projection map**. The observer is not in a “rest frame.” The 3-D shadow Σ is “tilted” relative to the singular source S (Axiom A2). Looking in the direction of the “tilt” (the dipole direction), we see apparent acceleration because we are looking “up” the gradient of the 4-D potential. Looking in the opposite direction, we see deceleration.

The “monopole” (isotropic acceleration) vanishes because it was never there; it was an averaging error derived from summing the dipole over the sky. This perfectly satisfies Axiom A4 (Parsimony). We do not need Dark Energy. We only need the **Identity of Source** (Axiom A2) which establishes a unified geometric origin (p_0) for the singularity. The “acceleration” is simply the geometric perspective of the observer relative to this singularity.

5. The Hubble Tension as a Projection Artifact

The “Hubble Tension”—the 4.4σ discrepancy between H_0 measured from the CMB (67.4 ± 0.5 km/s/Mpc) and local SNe Ia (73.5 ± 1.4 km/s/Mpc)—is currently the biggest crisis in cosmology. Rameez & Sarkar (2021) analyze this tension by scrutinizing the data quality and peculiar velocity corrections in the Pantheon and JLA compilations [11].

5.1. The Instability of H_0 and Redshift Discrepancies

Rameez & Sarkar uncover inconsistencies in the data used to claim the tension. They perform a forensic analysis of the heliocentric redshifts (z_{hel}) reported in the Pantheon and JLA catalogues [11].

- **Data Point:** For 58 SNe Ia common to both catalogues, heliocentric redshifts differ significantly, with discrepancies ranging from 5 to 137 times the quoted uncertainty [11].
- **Data Point:** Using Pantheon redshifts for the discrepant supernovae yields $H_0 \simeq 72$ km/s/Mpc; using JLA redshifts yields $H_0 \simeq 68$ km/s/Mpc [11].
- **Data Point:** H_0 varies systematically by $\sim 6 - 9$ km/s/Mpc across the sky in multiple datasets [11].

TCGS Analysis:

The systematic variation of H_0 across the sky is expected in TCGS. H_0 is not a fundamental constant of nature; it is a **slice invariant**. It measures the local rate of divergence of the projection lines X . If the 3-D shadow is a curved manifold embedded in 4-D, the “expansion rate” will inherently vary depending on the angle of projection. The “Hubble Tension” arises because we are comparing two different projections: a “deep” projection from the boundary of the Counterspace (CMB) and a “shallow” projection from the local neighborhood.

5.2. Peculiar Velocity Corrections as “Map-Making” Errors

Rameez & Sarkar criticize the peculiar velocity corrections applied to supernova data, noting that these corrections assume the Λ CDM model even while testing it. They highlight discontinuities where flow models are applied up to arbitrary redshift limits (e.g., $z \sim 0.06$) and then abruptly zeroed out [11].

TCGS Interpretation:

In TCGS, “peculiar velocities” are not random motions on top of a Hubble flow; they are the **primary geometric structure** of the shadow. The “bulk flows” extending beyond 300 Mpc are the **creases or folds** in the projection map X . They are not anomalies; they are the topography of the

Counterspace. The arbitrary zeroing of corrections is an attempt to force the map to be flat when the territory is curved.

5.3. The “Shapley Infall” and Identity of Source

Colin et al. (2011) identify a bulk flow of 260 km/s towards the Shapley concentration, extending to $z \sim 0.06$ [6]. SNe Ia falling away from us toward Shapley are significantly dimmer; those falling toward us onto Shapley are systematically brighter.

TCGS Interpretation:

This validates Axiom A2 (Identity of Source). The Shapley concentration is a **shadow singularity**—a region where the projection map X intersects a dense region of the fundamental singular set S in $\mathcal{C}$. The “flow” is the geometric convergence of geodesics toward this 4-D attractor. The brightness variations are not kinematic Doppler shifts but **gravitational lensing effects** of the 4-D potential Ψ on the 3-D shadow light paths.

6. The Unified Ontology: Physics and Biology Homology

The coherence of the framework lies in the homology between physical and biological anomalies.

6.1. “Dark Matter” = “Darwinian Chance”

In physics, we observe gravitational effects (rotation curves, lensing) without visible sources. We invent “Dark Matter.” In TCGS, this is the **Extrinsic Constitutive Law**—the shadow responding to the 4-D geometry [1]. In biology, we observe complex organization (convergent evolution, the eye) appearing without sufficient time for random search. We invent “Chance” and “Selection.” SEQUENTION asserts that “Chance” is the biological equivalent of Dark Matter [2]. It is a projection artifact.

Just as the radio dipole [5] reveals the “tilt” of the physical projection, biological **convergence** reveals the “tilt” of the biological projection. Organisms do not evolve “randomly”; they follow the gradients of the 4-D informational potential $\mathcal{U}$. The “Identity of Source” (Axiom A2) implies that all biological complexity descends from a single 4-D geometric origin, just as all gravitational singularities descend from p_0 .

7. Conclusion: The End of the Dark Sector

The cumulative evidence from the assessed papers creates a fatal problem for the standard Λ CDM cosmology. It cannot explain the excess radio dipole (5.4σ discrepancy) [5], the dipolar acceleration (3.9σ significance) [8], or the bulk flows extending past 300 Mpc [6] without adding epicycles upon epicycles (Dark Energy, Dark Matter, Dark Flow). The TCGS-SEQUENTION framework offers a parsimonious resolution (Axiom A4). By accepting the 4-D Counterspace (Axiom A1) and the Shadow Realization (Axiom A3), all these anomalies resolve into a single geometric picture:

- “**Dark Energy**” is the dipolar gradient of the projection X , proven by the detection of q_d [8] and the consistency of the Milne model [10].
- “**Dark Flow**” is the topography of the foliation, proven by the non-convergence to the CMB frame [7].
- “**Hubble Tension**” is the variation of the projection scale a_* across the sky, proven by the instability of H_0 [11].
- “**Overdispersion**” in radio counts is the signature of higher-dimensional connectivity, proven by the NBD fit [5].

We conclude that the scientific community is currently engaging in a futile attempt to “renormalize” the shadow. The path forward, as suggested by the metamathematical structure of TCGS, is to abandon the search for 3-D mechanisms for these phenomena. Physics must become **cartography**. We must map the gradients of the 4-D potential Ψ and $\mathcal{U}$, accepting that the “Dark” sectors are not substances

to be found, but geometric truths to be mapped. The discrepancies highlighted by Sarkar, Rameez, Colin, and Böhme are not errors; they are the windows into the Counterspace. The standard model is dead; long live the Territory.

Appendix A. A Toy TCGS Embedding for Dipolar Deceleration

In this appendix we exhibit a minimal, explicitly calculable TCGS embedding that realizes a *dipolar* deceleration parameter,

$$q_0(\hat{\mathbf{n}}) = \mathbf{q}_d \cdot \hat{\mathbf{n}}, \quad (\text{A1})$$

in the low-redshift luminosity distance expansion, without introducing a dark-energy fluid. The goal is not to fit all data in detail, but to provide an “existence proof”: within the TCGS ontology, a static 4-dimensional Counterspace with a slightly tilted shadow embedding naturally generates an effective dipole in q_0 of the type inferred phenomenologically in Refs. [8]. The construction is fully consistent with Axiom A1 (Whole Content), Axiom A2 (Singular Source), and Axiom A3 (Shadow Realization): the bulk manifold $\mathcal{C}$ is time-independent; all apparent late-time “acceleration” is a foliation-dependent artifact of the embedding $X : \Sigma \rightarrow \mathcal{C}$, not the dynamics of a vacuum fluid. This concretely illustrates the central thesis of the Geometrization of Anomaly programme: *anisotropic cosmological anomalies encode the extrinsic geometry of the projection, not the existence of new fundamental fluids*.

Appendix A.1. Observational Target: A Dipolar q_0 at Low Redshift

Empirically, supernova data are well described at low redshift by a direction-dependent deceleration parameter of the form

$$q_0(\hat{\mathbf{n}}, z) = q_m + (\mathbf{q}_d \cdot \hat{\mathbf{n}}) e^{-z/S}, \quad (\text{A2})$$

where q_m is a monopole term, $\mathbf{q}_d$ is a dipole vector approximately aligned with the CMB dipole, and S is a characteristic redshift scale of order $S \simeq 0.026$ (roughly 100 Mpc) [8]. In the fits of Ref. [8] one finds

$$q_m \simeq -0.16, \quad \|\mathbf{q}_d\| \simeq -8, \quad (\text{A3})$$

so that the monopole is consistent with no isotropic acceleration at the $\sim 1.4\sigma$ level, while the dipole is statistically significant. In the standard Λ CDM map this is puzzling: a cosmological constant is isotropic and cannot carry a dipole. Within the TCGS map, however, a *dipolar* q_0 arises naturally from a directional gradient of the projection X , i.e. from a mild anisotropy of the extrinsic geometry relating the photon foliation and the matter foliation.

Appendix A.2. Minimal Counterspace Metric and Shadow Embedding

We now construct a minimal toy model realizing this idea. Let the 4-dimensional Counterspace $\mathcal{C}$ carry coordinates

$$(\chi, \theta, \phi, u), \quad (\text{A4})$$

where χ is a radial coordinate measured from the A2 singular source p_0 , (θ, ϕ) are standard spherical angles, and u is an additional geometric coordinate encoding the torsion / shear between different foliations (e.g. photon vs. matter foliations). Consider the following simple bulk metric on $\mathcal{C}$:

$$ds_{\mathcal{C}}^2 = d\chi^2 + \chi^2 d\Omega^2 + 2\kappa d\chi du + du^2, \quad (\text{A5})$$

where $d\Omega^2 = d\theta^2 + \sin^2 \theta d\phi^2$, and κ is a small dimensionless parameter quantifying a cross-term (shear) between χ and u . When $\kappa = 0$ and u is trivial, the radial sector of $\mathcal{C}$ is exactly Euclidean. Next, fix a preferred unit vector $\hat{\mathbf{p}}$ in Counterspace, which we interpret as the direction of the A2 singular source p_0 as seen in the shadow; observationally this will be identified with the CMB/radio dipole axis. For any line of sight $\hat{\mathbf{n}}(\theta, \phi)$ in the shadow, define

$$\cos \alpha \equiv \hat{\mathbf{p}} \cdot \hat{\mathbf{n}}. \quad (\text{A6})$$

Now introduce shadow coordinates $(t, r, \hat{\mathbf{n}})$ on the 3-dimensional manifold Σ and define the embedding map

$$X : (t, r, \hat{\mathbf{n}}) \mapsto (\chi(t, r), \theta(\hat{\mathbf{n}}), \phi(\hat{\mathbf{n}}), u(t, r, \hat{\mathbf{n}})). \quad (\text{A7})$$

We choose a background Milne-like kinematics in the isotropic limit,

$$\chi(t, r) = a(t) r, \quad a(t) \approx 1 + H_0 t, \quad (\text{A8})$$

so that in the absence of embedding anisotropy the effective deceleration parameter vanishes, $q_0^{(\text{true})} = 0$, in agreement with the “coasting” interpretation of some low-redshift analyses. The key TCGS ingredient is a direction-dependent *tilt* in the u -coordinate, growing with distance from the A2 singular source:

$$u(t, r, \hat{\mathbf{n}}) = \epsilon \frac{\chi(t, r)^2}{2 R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}), \quad (\text{A9})$$

where ϵ is a small dimensionless parameter, R_* is a characteristic length scale, and the factor χ^2 ensures that the tilt grows with distance. This is the simplest algebraic implementation of the intuitive picture in which the photon foliation and the matter foliation are slightly sheared relative to each other along a preferred direction. Equations (A5)–(A9) fully specify the toy embedding at the level required to compute the low- z behaviour of the luminosity distance.

Appendix A.3. Pullback Metric and Anisotropic Radial Distance

We now compute the induced radial metric component on a constant- t slice of Σ . Along a fixed direction $\hat{\mathbf{n}}$ (fixed angles (θ, ϕ)), the tangent vector to the radial curve $r \mapsto X(t, r, \hat{\mathbf{n}})$ is

$$\frac{\partial X}{\partial r} = \left(\frac{\partial \chi}{\partial r}, \frac{\partial u}{\partial r} \right) = \left(a(t), \epsilon \frac{a(t)^2 r}{R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) \right), \quad (\text{A10})$$

where we have used $\chi = a(t)r$ and Equation (A9). The squared norm of this vector in the bulk metric (A5) is

$$\begin{aligned} \left\| \frac{\partial X}{\partial r} \right\|^2 &= g_{\chi\chi} \left(\frac{\partial \chi}{\partial r} \right)^2 + 2g_{\chi u} \left(\frac{\partial \chi}{\partial r} \right) \left(\frac{\partial u}{\partial r} \right) + g_{uu} \left(\frac{\partial u}{\partial r} \right)^2 \\ &= a^2(t) + 2\kappa a(t) \cdot \epsilon \frac{a(t)^2 r}{R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) + \epsilon^2 \frac{a(t)^4 r^2}{R_*^2} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})^2. \end{aligned} \quad (\text{A11})$$

To first order in the small parameter ϵ we neglect the ϵ^2 term, obtaining

$$g_{rr}(t, r, \hat{\mathbf{n}}) \equiv \left\| \frac{\partial X}{\partial r} \right\|^2 \approx a^2(t) [1 + 2\delta(r) (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})], \quad \delta(r) \equiv \kappa \epsilon \frac{a(t) r}{R_*}. \quad (\text{A12})$$

At low redshift we may set $a(t) \approx a_0 = 1$ in the factor $\delta(r)$, so that

$$\delta(r) \approx \kappa \epsilon \frac{r}{R_*}. \quad (\text{A13})$$

The physical radial distance element on the shadow along direction $\hat{\mathbf{n}}$ is therefore

$$d\ell_r(t, r, \hat{\mathbf{n}}) = \sqrt{g_{rr}} dr \approx a(t) [1 + \delta(r) (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})] dr. \quad (\text{A14})$$

This expression already encodes the central TCGS idea: as one moves outward from the A2 singular source along a given line of sight, the projection is slightly stretched or compressed depending on the orientation with respect to $\hat{\mathbf{p}}$, and the magnitude of this effect grows with distance. Integrating from

$r' = 0$ to $r' = r$ at fixed $t = t_0$ yields the physical radial distance to a source located at comoving radius r along $\hat{\mathbf{n}}$,

$$\begin{aligned} D(r, \hat{\mathbf{n}}) &\simeq a_0 \int_0^r [1 + \delta(r') (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})] dr' \\ &\approx a_0 \left[r + (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) \kappa \epsilon \frac{1}{R_*} \int_0^r r' dr' \right] \\ &= a_0 \left[r + \frac{\kappa \epsilon}{2 R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) r^2 \right]. \end{aligned} \quad (\text{A15})$$

Thus, even though the *bulk* geometry is only mildly anisotropic, the induced radial distance in the shadow acquires a direction-dependent quadratic correction proportional to $r^2 (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})$.

Appendix A.4. Low-Redshift Luminosity Distance and the Effective $q_0(\hat{\mathbf{n}})$

For small redshift z , an FLRW observer interprets the luminosity distance as

$$d_L(z, \hat{\mathbf{n}}) = \frac{c}{H_0} \left[z + \frac{1}{2} (1 - q_0(\hat{\mathbf{n}})) z^2 + \mathcal{O}(z^3) \right]. \quad (\text{A16})$$

In the underlying Milne-like background defined by Equation (A8) we have, in the absence of embedding anisotropy,

$$d_L^{(\text{true})}(z) = \frac{c}{H_0} \left[z + \frac{1}{2} z^2 + \mathcal{O}(z^3) \right], \quad q_0^{(\text{true})} = 0, \quad (\text{A17})$$

i.e. there is no genuine isotropic acceleration. To first order in the anisotropy, we may identify the comoving radius r with redshift via the usual low- z relation

$$r \approx \frac{c}{H_0} z. \quad (\text{A18})$$

Substituting into Equation (A15) and setting $a_0 = 1$ yields

$$\begin{aligned} D(z, \hat{\mathbf{n}}) &\simeq \frac{c}{H_0} z + \frac{\kappa \epsilon}{2 R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) \left(\frac{c}{H_0} \right)^2 z^2 \\ &= \frac{c}{H_0} \left[z + \frac{1}{2} \kappa \epsilon \frac{c}{H_0 R_*} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) z^2 \right]. \end{aligned} \quad (\text{A19})$$

Choosing the geometric scale R_* to be the Hubble length,

$$R_* = \frac{c}{H_0}, \quad (\text{A20})$$

Equation (A19) simplifies to

$$D(z, \hat{\mathbf{n}}) \simeq \frac{c}{H_0} \left[z + \frac{1}{2} \kappa \epsilon (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}) z^2 \right]. \quad (\text{A21})$$

Comparing Equation (A21) with the FLRW expansion (A16), and equating the coefficients of z^2 , we obtain

$$\frac{1}{2} (1 - q_0(\hat{\mathbf{n}})) = \frac{1}{2} [1 + \kappa \epsilon (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})], \quad (\text{A22})$$

so that

$$q_0(\hat{\mathbf{n}}) = -\kappa \epsilon (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}). \quad (\text{A23})$$

This is precisely a pure dipole,

$$q_0(\hat{\mathbf{n}}) = \mathbf{q}_d \cdot \hat{\mathbf{n}}, \quad \mathbf{q}_d = -\kappa \epsilon \hat{\mathbf{p}}, \quad (\text{A24})$$

with vanishing monopole $q_m = 0$. In other words, an FLRW observer misinterpreting the anisotropic TCGS embedding as an isotropic fluid cosmology will infer an apparent, purely dipolar “acceleration” determined by the product $\kappa\epsilon$ and aligned with the A2 direction $\hat{\mathbf{p}}$. To connect with the phenomenological parameterization (A2) one can simply regard Equation (A23) as the $z \rightarrow 0$ limit, and then promote the embedding tilt to a mildly decaying function of redshift, e.g.

$$u(t, r, \hat{\mathbf{n}}) = \epsilon \frac{\chi(t, r)^2}{2 R_*} e^{-z(r)/S} (\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}), \quad (\text{A25})$$

which leads to a dipole amplitude $\|\mathbf{q}_d(z)\|$ decaying approximately as $e^{-z/S}$, in agreement with Equation (A2). The algebra is straightforward and does not change the qualitative structure of the argument.

Appendix A.5. Interpretation and Relation to Other Anomalies

Several important points follow from this explicit toy construction:

1. **No dark-energy fluid is introduced.** The underlying Counterspace $(\mathcal{C}, G)$ is static and satisfies Axiom A1 (Whole Content); there is no “late-time” dynamical component. The entire dipolar signal $q_0(\hat{\mathbf{n}})$ is a consequence of the extrinsic geometry of the embedding X and the foliation choice (Axiom A3).
2. **Dipole as gradient of the projection.** The combination of the bulk cross-term $(2\kappa d\chi du)$ and the quadratic tilt in u encodes a direction-dependent gradient of the projection map. Equation (A12) shows explicitly that the Jacobian of X acquires a term proportional to $r(\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})$, which integrates to the $r^2(\hat{\mathbf{p}} \cdot \hat{\mathbf{n}})$ correction in Equation (A15), and ultimately to the dipolar q_0 in Equation (A23).
3. **Alignment with the A2 singular set.** The dipole axis is by construction the direction $\hat{\mathbf{p}}$ picked out by the A2 singular source p_0 in Counterspace. Thus the alignment of the q_0 dipole with the CMB and radio dipoles is not accidental: all three are different observational manifestations of the same extrinsic orientation.
4. **Monopole vs. dipole.** In this toy model the monopole is strictly zero, $q_m = 0$; the entire “acceleration” is directional. This matches the empirical fact that the monopole inferred in Ref. [8] is statistically consistent with no isotropic acceleration, while the dipole is significant. More realistic models can reintroduce a small true monopole $q_0^{(\text{true})}$ without changing the geometric origin of the dipole.
5. **Connection to radio dipole and overdispersion.** Once the Jacobian of X is direction-dependent, number counts in a flux-limited radio survey acquire a dipolar modulation proportional to $\hat{\mathbf{p}} \cdot \hat{\mathbf{n}}$, and single 4-dimensional structures can project to multiple apparent components in the shadow. This naturally leads to excess radio dipole amplitude and overdispersion relative to Poisson expectations (as captured by Negative Binomial fits), which are then reinterpreted in TCGS as statistical residues of nontrivial extrinsic connectivity, rather than evidence of new stochastic “clustering” physics.

In summary, the toy model constructed in this appendix demonstrates explicitly that a *static* Counterspace with a mild, geometrically motivated anisotropy in its embedding of the shadow manifold generates, in the low-redshift limit, an effective dipolar deceleration parameter closely analogous to what is inferred from supernova data. Within the TCGS-SEQUENTIONS framework this is not an ad hoc adjustment, but a direct manifestation of the Cartographic Mandate: cosmological anomalies are to be read as signatures of extrinsic geometry and foliation choice, not as demands for new fluids or particles in the ontic inventory.

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