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COSMIC SMOOTHNESS AS LOGICAL PROJECTION
A PLEM-BASED CRITIQUE OF HOMOGENEITY IN COSMOLOGY

BABAK JABBAR NEZHAD

"TO GÖDEL — FOR SEEING TOO FAR, AND STILL WRITING IT DOWN."

Abstract. The assumption of large-scale homogeneity and isotropy underlies modern cosmology and the FLRW metric derived from general relativity. While this framework has been successful in modeling the expanding universe, it rests on a philosophical compromise: the projection of smoothness from within a system whose deeper structure is neither homogeneous nor isotropic. In this paper, we challenge the cosmological principle through the lens of the Parallel Law of Excluded Middle (PLEM), arguing that cosmic smoothness is not a structural fact but a logical projection relative to the observer's position within subworlds. From this perspective, the smooth geometry of FLRW arises not from fundamental symmetry but from logical alignment across embedded domains. Once the observer's logical horizon shifts, this smoothness collapses, revealing deeper asymmetries. We propose that a structurally honest cosmology must recognize the positional dependence of smoothness and reframe symmetry as an emergent, not foundational, phenomenon.

1. Introduction: The Comfort of Symmetry

Modern cosmology rests on a bold and simplifying assumption: that the universe is homogeneous and isotropic on large scales. This assumption, known as the cosmological principle [8, 9], allows general relativity to yield tractable solutions for the dynamics of spacetime. The result is the celebrated Friedmann–Lemaître–Robertson–Walker (FLRW) metric [7, 9], a cornerstone of the Big Bang model.

This framework has produced remarkable results: it predicts cosmic expansion, aligns with observations of the cosmic microwave background (CMB), and offers a coherent narrative of structure formation. But beneath this coherence lies a philosophical vulnerability: the notion of "large-scale smoothness" is never absolute. It is a product of perspective.

In this paper, we argue that the FLRW symmetry is not a direct reflection of cosmic structure, but a logical projection from within a specific observational layer. When viewed through the lens of the Parallel Law of Excluded Middle (PLEM) [4, 5] — a structural logic in which truth and definability depend on subworld embedding — this projection collapses, revealing that smoothness is not foundational but emergent — as also discussed in critiques of cosmological fitting [1, 2] — and perhaps illusory.

2. What Is "Large-Scale" Homogeneity?

Cosmologists often say the universe is inhomogeneous on small scales — galaxies, clusters, and voids — but homogeneous "on large scales," typically above 100–300 megaparsecs. This scale is justified empirically [6, 8]: when averaging over large volumes, the matter distribution seems uniform, and the angular anisotropy in the CMB drops to very low levels.

Key words and phrases. Cosmological principle; FLRW metric; General relativity; Logical projection; Observer-dependence; PLEM (Parallel Law of Excluded Middle); Cosmic symmetry; Subworld logic.

But what does "large scale" mean? And to whom?

The answer is relative to the embedded observer. Smoothness appears when the observer is treated as a point within the system, projecting outward and averaging over visible matter. But this pointwise projection cannot access the structure of the system as a whole. As soon as the observer shifts logical position — attempting to "step outside" — the illusion of smoothness collapses.

In other words, cosmic homogeneity is not a structural property. It is a visual resonance, valid only from within a narrow logical frame.

3. The FLRW Metric as a Projection

The FLRW metric is derived by applying Einstein's field equations under two symmetry assumptions:

- Homogeneity: every spatial point is equivalent.
- Isotropy: every direction is equivalent.

This leads to a spherically symmetric metric:

$$ds^2 = -dt^2 + a(t)^2 \left[\frac{dr^2}{1 - kr^2} + r^2 (d\theta^2 + \sin^2 \theta \, d\phi^2) \right]$$

The angular term $\sin^2 \theta \, d\phi^2$ ensures rotational symmetry, enforcing isotropy. But this very form — this mathematically satisfying structure — is not a mirror of the universe's actual geometry, but a projection of logical coherence imposed at the observational layer.

The FLRW metric, then, is not a raw output of general relativity. It is the FLRW projection: the result of taking asymmetric substructures (galaxies, voids, filaments) and forcing them into a mathematically consistent global image. This consistency is not discovered — it is declared.

4. PLEM and the Collapse of Smoothness

The Parallel Law of Excluded Middle (PLEM) posits that logical truth is subworld-dependent. A proposition may be decidable in one subworld but undefined or undecidable in another. Similarly, the structure of a system may appear smooth from one logical vantage, and fractured from another.

Applying this to cosmology:

- The apparent symmetry of the universe is valid only within a subworld — a logical region where averaging operations are permitted.
- Once the observer's logical horizon expands (e.g., by stepping back from GR patches to a meta-logical space), the subworld coherence breaks.
- The illusion of homogeneity is then seen as a layered artifact, not a cosmic constant.

From the PLEM perspective, the universe is composed of logically layered domains, each with its own geometric frame. Symmetry is not global; it is a local equilibrium of logic.

5. Reframing Cosmic Geometry

What if the large-scale geometry of the universe is not spherical or flat, but logically curved — and that curvature resists true isotropy when viewed from a higher logical layer?

- Rotation leads to elliptical deformation (flattening at the poles), breaking isotropy by introducing a privileged axis.

• Expansion, especially in an open universe, takes on a hyperbolic character — stretching space in a way that, while mathematically isotropic in FLRW formalism, carries a directional flavor when visualized or interpreted structurally.

• Yet, standard cosmology treats the elliptical effect of rotation as a violation of isotropy and excludes it, while embracing hyperbolic expansion as consistent with isotropy.

This contrast reveals a deeper contradiction: symmetry is accepted when its asymmetry is embedded in geometry, but rejected when it becomes visibly directional. In other words:

> Rotation is too obviously asymmetric, so it is excluded.
> Hyperbolicity embeds asymmetry invisibly in the metric, so it is accepted.

From a PLEM perspective, this is a logical misstep. Isotropy, in this case, is not structural — it is a projection that survives only within the logic of the subworld. When the observer's logical position shifts — stepping outside the curved frame — the asymmetry of hyperbolic expansion is revealed, just like the visible asymmetry of rotation.

A structurally honest cosmology would therefore embrace:

• Logical curvature, where geometry is shaped by the observer's epistemic position;

• Directional embedding, where hyperbolic or elliptical asymmetries emerge based on how subworlds project into higher logical layers;

• Emergent smoothness, not as universal fact, but as coherent illusion — one that appears only inside resonant subworlds where projection and structure momentarily align.

In standard cosmology, "direction" refers to spatial orientation — such as axes in three-dimensional space. A geometry is considered isotropic if its physical laws behave identically in every direction. Under this assumption, cosmologists often treat direction as irrelevant: once isotropy is assumed, all directions are treated the same. For instance, the FLRW metric — even in a hyperbolic universe — is constructed to be isotropic by definition, so directional differences are suppressed at the level of the metric itself.

But in the framework of the Parallel Law of Excluded Middle (PLEM), the notion of direction takes on a deeper meaning.

Here, direction is not just geometric, but logical. It refers to the direction of projection across logical layers:

• Is a structure being viewed from within a subworld?

• Is it being projected into a higher layer?

• Is the smoothness or symmetry being inferred from a lower layer, or constructed from above?

This distinction is critical. A structure may appear isotropic within a subworld, but once the observer shifts logical position, the symmetry may collapse. In this view, direction matters not just in space, but in logic. Smoothness and symmetry are not absolute traits but coherent illusions shaped by directional embedding.

Thus, when we refer to "directional asymmetry", we are not only pointing to phenomena like elliptical deformation or hyperbolic expansion, but also to the hidden logical direction from which a structure is perceived or projected.

6. Conclusion: Toward a Structurally Honest Cosmology

Cosmology, in its current form, comforts itself with the elegance of symmetry. But elegance, when detached from logical origin, becomes illusion. The FLRW metric, though

powerful, is not a mirror of truth — it is a resonant projection from within a system that is itself asymmetrical in both geometry and logic.

The Parallel Law of Excluded Middle allows us to see beyond this projection. It urges us to ask: what is smooth, and for whom? And more importantly, what is structure, when logic is not absolute, but layered?

We believe a structurally honest cosmology must reject the assumption that the universe looks the same from every direction — not because it does not appear so, but because the appearance itself is position-dependent.

A new cosmology is possible. One that does not begin with a sphere, but with a crack.

> Note. One notable exception to the cosmological principle is Gödel's rotating universe, an exact solution to Einstein's field equations published in 1949 [3]. Gödel's model is homogeneous but explicitly anisotropic: it features global rotation, closed timelike curves, and no universal time function. The presence of a visible axis of rotation introduces a preferred direction — violating isotropy — and the logical structure of time itself breaks down. While mathematically valid, Gödel's universe is often dismissed not due to inconsistency, but because it reveals that global symmetry and causal coherence are not guaranteed by general relativity. From a PLEM perspective, Gödel's solution exposes a transition between subworlds with incompatible logic, where time, causality, and symmetry lose global meaning. Its rejection reflects a deeper discomfort: rotation reveals logical asymmetry too clearly to be smoothed over by geometric formalism.

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