

# Two Routes to a Rotating Universe: A Galaxy Spin–Chirality Discriminant between Gödel-Type Fluid Rotation and Topological Counter-Rotation on $\mathbb{RP}^3$

Boris Kriger<sup>1</sup>

<sup>1</sup>Institute of Integrative and Interdisciplinary Research (IIR), Toronto, Canada,  
boriskruger@interdisciplinary-institute.org ORCID: 0009-0001-0034-2903

June 4, 2026

Prepared for submission to *Monthly Notices of the Royal Astronomical Society*

## Abstract

The recent demonstration that a slowly rotating cosmology can relax the Hubble tension (Szigeti, Szapudi, Barna & Barnaföldi 2025) and the independent topological derivation of cosmic rotation within the  $\alpha$ LGQV programme arrive at the same headline conclusion from two structurally different starting points: a Gödel-inspired rotating dark fluid in the first case, and a double counter-rotating Clifford (Hopf) flow on an  $\mathbb{RP}^3 = S^3/\mathbb{Z}_2$  topology in the second. Both yield an intermediate  $H_0$  and neither contradicts present measurements, so the Hubble constant cannot by itself separate them. We argue that the *galaxy spin-chirality field* can. Working from the geometry alone, the equal-amplitude superposition of the two Clifford fields has *pointwise zero kinetic helicity*, which removes the global preferred-handedness signature that would otherwise mark the cosmic microwave background (CMB); the surviving observable is not helicity but the line-of-sight projection of vorticity,  $P = \text{sign}(\boldsymbol{\omega} \cdot \hat{\mathbf{n}})$ . This projection changes sign *transversely across a Hopf fibre*, predicting that galaxies on opposite sides of a cosmic filament spine counter-rotate while remaining coherent along it. Adding the programme’s centrifugal-relaxation dynamics, with  $\omega(a) \propto a^{-2}$  from angular-momentum conservation and  $H(a)$  from the velocity-budget identity  $\dot{R} = v_{\text{time}} = \sqrt{c^2 - v_{\text{rot}}^2}$ , the dimensionful constants cancel in the dynamically relevant ratio  $\omega/H = 1/\sqrt{a^2 - 1}$ , which grows monotonically toward early epochs. Under one stated, load-bearing assumption—that the imprinted chiral excess is proportional to  $\omega/H$  at the epoch a galaxy’s spin decouples from the flow—the chirality-dipole amplitude grows *approximately linearly in*  $(1+z)$ , with the sign fixed by geometry and the amplitude carrying the single coupling  $\alpha_L \approx 0.005$ . We compare these predictions with the JWST/JADES spin asymmetry reported by Shamir (2025) and with the transversely counter-rotating MeerKAT filament of Jung, Tudorache et al. (2026), note honestly the contested status of the spin-asymmetry signal, and tabulate a clean discriminant against single-axis fluid vorticity. The geometric predictions (helicity cancellation, transverse sign reversal) hold without the dynamical assumption; the redshift growth does not. All three are falsifiable.

## 1 Introduction

The discrepancy between local, distance-ladder determinations of the Hubble constant ( $H_0 \simeq 73 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ; Riess et al. 2022) and the value inferred from the CMB under  $\Lambda$ CDM ( $H_0 \simeq 67 \text{ km s}^{-1} \text{ Mpc}^{-1}$ ; Planck 2020) remains the most statistically significant tension in concordance cosmology. Among the responses that do not invoke new microphysics, a striking

recent line revives an old idea: that the Universe rotates. Szigeti, Szapudi, Barna & Barnaföldi (2025) showed that a Gödel-inspired, slowly rotating dark-fluid variant of the concordance model relaxes the tension for a present angular velocity  $\omega_0 \simeq 2 \times 10^{-3} \text{ Gyr}^{-1}$ —close to the maximal rate avoiding closed timelike curves—without conflicting with existing data. The authors note that the natural next step is to identify measurable consequences of such rotation, and single out galaxy spin correlations as the signature to pursue.

Independently, the  $\alpha\text{LGQV}$  programme reaches cosmic rotation not as an added fluid property but as a feature of cosmic *topology* [12]. There the spatial section is the projective 3-space  $\mathbb{RP}^3 = S^3/\mathbb{Z}_2$ , and the global flow is a superposition of the two families of Clifford parallels of  $S^3$ —the two Hopf fibrations of opposite twist—rotating against each other. The same construction yields an intermediate Hubble constant,  $H_0 \simeq 71.7 \text{ km s}^{-1} \text{ Mpc}^{-1}$ , through a centrifugal-relaxation trajectory [8].

The two pictures agree on the central claim—the Universe rotates, and this relaxes the Hubble tension—and they agree, within uncertainties, on an intermediate  $H_0$ . They are nonetheless *physically distinct*: one is a rotating matter field on an essentially flat background, the other a stationary geometric flow on a closed, non-orientable-cover topology. The purpose of this note is not to adjudicate between them on grounds of elegance, which would settle nothing, but to identify an observable on which they make *different* predictions, so that data can decide. We argue that the galaxy spin-chirality field is such an observable, and we work out what the topological mechanism predicts for it, separating cleanly the parameter-free geometric content from the one dynamical assumption that the redshift dependence requires.

## 2 Two rotating-universe frameworks

### 2.1 Gödel-inspired rotating dark fluid

In the Szigeti et al. construction the concordance model is supplemented by a rotating dark-fluid component. The rotation is characterised by a single global angular-velocity vector and hence a single cosmic vorticity axis; its magnitude today is  $\omega_0 \sim 10^{-3} \text{ Gyr}^{-1}$ , far too small to detect directly but sufficient to alter the expansion history enough to reconcile the early- and late-time  $H_0$ . The mechanism is dynamical (a property of the cosmic fluid) rather than topological, and the background spatial geometry is not altered.

### 2.2 Double counter-rotating Clifford flow on $\mathbb{RP}^3$

The  $\alpha\text{LGQV}$  spatial section is  $\mathbb{RP}^3 = S^3/\mathbb{Z}_2$ . Identifying  $S^3$  with  $\text{SU}(2)$ , its isometry group is  $\text{SO}(4) = (\text{SU}(2)_L \times \text{SU}(2)_R)/\mathbb{Z}_2$ , and the left- and right-invariant Killing fields are precisely the two families of Clifford parallels—the two Hopf fibrations of opposite handedness. In Hopf coordinates

$$z_1 = \cos \eta e^{i\xi_1}, \quad z_2 = \sin \eta e^{i\xi_2}, \quad ds^2 = d\eta^2 + \cos^2 \eta d\xi_1^2 + \sin^2 \eta d\xi_2^2, \quad (1)$$

the two generators are

$$\boldsymbol{\xi}_L = \partial_{\xi_1} + \partial_{\xi_2}, \quad \boldsymbol{\xi}_R = \partial_{\xi_1} - \partial_{\xi_2}. \quad (2)$$

The cosmic flow is the counter-rotating superposition  $\mathbf{v} = a \boldsymbol{\xi}_L + b \boldsymbol{\xi}_R$ . The rotation lives along the Hopf fibre and is therefore orthogonal to each homogeneous spatial slice, which is the structural reason it does not appear as a large-angle anisotropy in the CMB [9].

### 3 The geometric core (parameter-free)

#### 3.1 Clifford fields are Beltrami eigenfields

On the unit  $S^3$  the Clifford fields are eigenfields of the curl,

$$\nabla \times \boldsymbol{\xi}_L = +2\boldsymbol{\xi}_L, \quad \nabla \times \boldsymbol{\xi}_R = -2\boldsymbol{\xi}_R. \quad (3)$$

The opposite sign of the eigenvalue *is* the handedness: a single Clifford twist carries a definite kinetic helicity and hence a global preferred sense of rotation. A single-twist universe would therefore imprint a net handedness on galaxy spins—a monopole of chirality with a preferred axis—which is exactly the kind of large-scale parity signal that would be visible in the CMB. This is the reason a *simple* rotation is excluded by current isotropy bounds.

#### 3.2 Helicity cancellation and CMB safety

For the superposition  $\mathbf{v} = a\boldsymbol{\xi}_L + b\boldsymbol{\xi}_R$  the vorticity is

$$\boldsymbol{\omega} \equiv \nabla \times \mathbf{v} = 2a\boldsymbol{\xi}_L - 2b\boldsymbol{\xi}_R, \quad (4)$$

and the total kinetic helicity is

$$\mathcal{H} = \int \mathbf{v} \cdot \boldsymbol{\omega} dV = 2(a^2 - b^2) I, \quad I \equiv \int |\boldsymbol{\xi}_L|^2 dV = \int |\boldsymbol{\xi}_R|^2 dV. \quad (5)$$

For equal amplitudes,  $a = b$ , the helicity vanishes *exactly*. Because the Clifford fields have constant norm over  $S^3$  (equidistance of the parallels is their defining property), the helicity density  $\mathbf{v} \cdot \boldsymbol{\omega} = 2a^2|\boldsymbol{\xi}_L|^2 - 2b^2|\boldsymbol{\xi}_R|^2$  vanishes not only in the integral but *pointwise*. There is thus no global preferred handedness at the monopole level, and CMB parity is not violated by the rotation. This is a one-line, parameter-free statement: equality of the two twist amplitudes suffices.

#### 3.3 The observable is the vorticity projection, not the helicity

It would be tempting to read a galaxy spin dipole directly off the helicity, but the previous result forbids it: the scalar helicity density is identically zero. The correct observable is the *line-of-sight projection of the vorticity vector*, which is what torques a forming galaxy and fixes whether it is seen rotating clockwise or counter-clockwise from Earth:

$$P(\mathbf{x}, \hat{\mathbf{n}}) = \text{sign}(\boldsymbol{\omega}(\mathbf{x}) \cdot \hat{\mathbf{n}}), \quad \boldsymbol{\omega} = 2a\boldsymbol{\xi}_L - 2b\boldsymbol{\xi}_R. \quad (6)$$

At  $a = b$  the vorticity vector is nonzero and spatially structured even though its helicity with  $\mathbf{v}$  cancels. The dipole arises from  $P$ , and it is geometric: its *axis* is set by the relative orientation of the two Clifford generators (the two independent SU(2) axes), and its *sign* is fixed by geometry without free parameters [10, 11].

#### 3.4 Transverse sign reversal across filaments

A Hopf fibre is a vortex line of  $\boldsymbol{\omega}$ . The vorticity circulates around it, so its transverse component reverses sign on the two sides of the line. Galaxies on opposite sides of a filament spine should therefore counter-rotate, while galaxies along the fibre rotate coherently with the filament as a whole. This is the “teacup ride” pattern: each galaxy is a spinning cup, the filament is the rotating platform, and cups on opposite edges turn opposite ways. A single-axis fluid vorticity does not generically produce this transverse reversal around a line; the topological flow does, as a direct consequence of its vortex-line structure.

## 4 Dynamical amplitude and redshift dependence

### 4.1 Vorticity and expansion from centrifugal relaxation

The programme’s centrifugal-relaxation dynamics fixes the time dependence. A rotating membrane begins at the Banach point  $R_0$  (the Kriger limit) with the full rotational speed  $v_{\text{rot}} = c$ . Conservation of angular momentum,  $L = MR^2\omega = \text{const}$ , gives

$$v_{\text{rot}} = \omega R = c \frac{R_0}{R} = \frac{c}{a}, \quad a \equiv \frac{R}{R_0} \geq 1, \quad (7)$$

and hence the local vorticity amplitude

$$\omega(a) = \frac{v_{\text{rot}}}{R} = \frac{c}{R_0 a^2} \propto a^{-2}. \quad (8)$$

The velocity budget is split between rotation and expansion through  $v_{\text{time}} = \sqrt{c^2 - v_{\text{rot}}^2} = c\sqrt{1 - 1/a^2}$ , with  $\dot{R} = v_{\text{time}}$ , so that

$$\dot{a} = \frac{\dot{R}}{R_0} = \frac{c}{R_0} \frac{\sqrt{a^2 - 1}}{a}, \quad H(a) = \frac{\dot{a}}{a} = \frac{c}{R_0} \frac{\sqrt{a^2 - 1}}{a^2}. \quad (9)$$

No new parameter has been introduced;  $R_0$  and  $c$  are fixed.

### 4.2 The dimensionless driver $\omega/H$

The strength of any chiral imprint is governed not by  $\omega$  alone but by its competition with the disrupting expansion, i.e. by the ratio

$$\frac{\omega}{H} = \frac{c/(R_0 a^2)}{(c/R_0)\sqrt{a^2 - 1}/a^2} = \frac{1}{\sqrt{a^2 - 1}}. \quad (10)$$

The dimensionful constants  $c$  and  $R_0$  cancel: the driver is parameter-free in  $a$ . It decreases monotonically with  $a$  and therefore *increases monotonically toward early epochs*. This is the “freezing” channel: spins fixed early carry a stronger imprint because  $\omega/H$  was larger then.

### 4.3 The chirality-dipole amplitude $A(z)$

**Load-bearing assumption (stated explicitly).** We assume the imprinted chiral excess of galaxy spins is proportional to  $\omega/H$  at the epoch the spin decouples from the ambient flow—coherent winding set against disruptive expansion, in the spirit of tidal-torque acquisition in a vortical background. This is a physical modelling premise, not geometry; the geometric results of §3 do not depend on it, but the redshift dependence below does. A referee is entitled to press exactly here, and the assumption is flagged accordingly.

With  $1 + z = a_0/a_e$  (where  $a_0 = R_{\text{now}}/R_0 \gg 1$  and  $a_e$  is the scale factor at the freezing epoch),

$$A(z) \propto \alpha_L \left. \frac{\omega}{H} \right|_{a_e} = \alpha_L \frac{1}{\sqrt{a_e^2 - 1}} = \alpha_L \frac{(1 + z)}{\sqrt{a_0^2 - (1 + z)^2}}. \quad (11)$$

Because  $a_0 \gg (1 + z)$  throughout the observed window, the denominator is  $\approx a_0 = \text{const}$  to leading order, giving

$$\boxed{A(z) \approx \frac{\alpha_L}{a_0} (1 + z)} \quad (12)$$

—an *approximately linear growth of the chirality-dipole amplitude in  $(1 + z)$* , curving upward only as  $(1 + z) \rightarrow a_0$ , i.e. at the very earliest epochs. The sign is geometric and parameter-free; the amplitude carries the single coupling  $\alpha_L \approx 0.005$ . Crucially, the naive worry that the line-of-sight projection of  $\omega$  should *oscillate* (pass through nodes) as the comoving distance  $\chi(z)$  grows is removed by the freezing channel: the observed quantity is the imprint *at fixation*, not the instantaneous projection integrated along  $\chi(z)$ .

## 5 Observational status

**JWST/JADES spin asymmetry.** Shamir (2025) reports that among spiral galaxies with identifiable rotation in the JWST Advanced Deep Extragalactic Survey, roughly two-thirds rotate in one sense, with the asymmetry organised as a dipole near the Galactic pole and growing with redshift. The monotonic increase with  $z$  is qualitatively what Eq. (14) predicts. We note honestly that this signal is *contested*: several analyses (Iye & Sugai; Land et al.; Hayes et al.; Stiskalek & Desmond) find distributions consistent with isotropy, and a mundane systematic—a Doppler/Milky-Way-motion brightness bias—has been proposed by Shamir himself as an alternative. The prediction here is offered as a test to be applied to improved, bias-controlled data, not as a claim that the asymmetry is established.

**Counter-rotating cosmic filament.** Jung, Tudorache et al. (2026), using MeerKAT neutral-hydrogen kinematics combined with DESI and SDSS optical data, find a razor-thin chain of galaxies inside a slowly rotating filament in which the member galaxies spin coherently with the filament, and—most relevant here—galaxies on opposite sides of the central spine move in opposite directions. This transverse counter-rotation across a filament line is precisely the pattern of §3.4 and is not a generic feature of single-axis fluid vorticity.

## 6 A spin-chirality discriminant

Table 1 collects the predictions that separate the two rotating-universe mechanisms.

Observable	Gödel-type fluid rotation	Topological counter-rotation on $\mathbb{RP}^3$
Global kinetic helicity / CMB handedness	Single global vorticity axis; a net handedness in principle available to large-angle CMB statistics	Pointwise zero ( $a = b$ ); no preferred handedness at the monopole; CMB-safe by construction
Transverse spin reversal across a filament spine	Not generic for a single-axis vorticity	Predicted: opposite sides of a Hopf fibre counter-rotate; coherent along the fibre
Chirality-dipole amplitude $A(z)$	Model-dependent; not fixed by the construction	$A(z) \approx (\alpha_L/a_0)(1+z)$ ; sign parameter-free, amplitude $\propto \alpha_L$
Origin of the dipole axis	Direction of the assumed cosmic angular-velocity vector	Relative orientation of the two SU(2) Clifford generators

Table 1: Predictions distinguishing the two mechanisms. The first two rows are parameter-free in the topological model; the third depends on the freezing assumption of §4.3.

We stress that this is a discriminant, not a verdict. In particular, the fluid model’s entries in rows 2 and 3 are marked as “not generic” and “model-dependent” because, to our knowledge, its galaxy-spin-chirality field has not yet been computed. We would welcome that computation by Barna and collaborators: if the rotating-fluid model can be shown to produce a transverse reversal around filament lines and a specific  $A(z)$ , the discriminant sharpens further, and either outcome is informative.

## 7 Falsifiability

The predictions fail, and the topological mechanism is excluded, under any of the following:

- the galaxy spin-chirality dipole is measured, in bias-controlled data, to be consistent with zero;
- the dipole amplitude is found to be *non-monotonic or oscillatory* in  $(1+z)$  rather than near-linear;
- well-resolved filaments show *no* transverse reversal of spin sense across their spines.

The first and third tests probe the geometric content of §3 directly and do not depend on any dynamical assumption. The second test probes Eq. (14) and therefore also tests the freezing assumption of §4.3; a failure there would falsify the assumed  $A(z)$  scaling without, by itself, excluding the geometric helicity-cancellation and transverse-reversal results.

## 8 Conclusion

Two independent routes—a Gödel-inspired rotating dark fluid and a topological double counter-rotation on  $\mathbb{RP}^3$ —converge on the same conclusion that the Universe rotates and that this relaxes the Hubble tension, and they agree on an intermediate  $H_0$ . Because they agree there,  $H_0$  cannot separate them. The galaxy spin-chirality field can. The topological mechanism makes three predictions: exact (pointwise) helicity cancellation, hence CMB safety; a transverse reversal of spin sense across filament spines; and an approximately linear growth of the chirality-dipole amplitude in  $(1+z)$ . The first two are parameter-free; the third rests on a single, explicitly stated freezing assumption. Each is falsifiable, and current data—the JADES spin asymmetry and the transversely counter-rotating MeerKAT filament—already bear on them, with the honest caveat that the spin-asymmetry signal remains contested. The cleanest way to advance the question is for both frameworks to publish their predicted spin-chirality fields side by side and to confront them with the next generation of bias-controlled rotation catalogues.

## Acknowledgements

The author thanks the authors of the rotating-universe analysis whose work motivated this comparison; the convergence of independent approaches on cosmic rotation is the premise of this note rather than a point of contention.

## References

- [1] B. E. Szigeti, I. Szapudi, I. F. Barna, G. G. Barnaföldi, *Can rotation solve the Hubble Puzzle?*, Mon. Not. R. Astron. Soc. **538**(4), 3038–3041 (2025), DOI:10.1093/mnras/staf446; arXiv:2503.13525.
- [2] L. Shamir, *The distribution of galaxy rotation in JWST Advanced Deep Extragalactic Survey*, Mon. Not. R. Astron. Soc. (2025), DOI:10.1093/mnras/staf292.
- [3] L. Jung, M. Tudorache, et al., *A coherently rotating cosmic filament traced in neutral hydrogen with MeerKAT*, Mon. Not. R. Astron. Soc. (2026). [MeerKAT + DESI + SDSS; exact volume/DOI to be inserted on publication.]
- [4] K. Gödel, *An example of a new type of cosmological solution of Einstein’s field equations of gravitation*, Rev. Mod. Phys. **21**, 447 (1949).
- [5] A. G. Riess et al., *A comprehensive measurement of the local value of the Hubble constant...*, Astrophys. J. Lett. **934**, L7 (2022).
- [6] Planck Collaboration, *Planck 2018 results. VI. Cosmological parameters*, Astron. Astrophys. **641**, A6 (2020).
- [7] DESI Collaboration, *DESI DR2 results: baryon acoustic oscillations and cosmological constraints* (2025).

- [8] B. Kriger, *Cosmic expansion as centrifugal relaxation: an analytical model on  $\mathbb{RP}^3$  with predictions for the Hubble parameter and large-scale structure*,  $\alpha$ LGQV programme, IIR Cosmology and Theoretical Physics (2026). ResearchGate publication 404181253.
- [9] B. Kriger, *Why the universe must rotate despite current CMB observations*,  $\alpha$ LGQV programme, IIR Cosmology and Theoretical Physics (2026), DOI:10.13140/RG.2.2.26353.85608.
- [10] B. Kriger, *Galaxy spin chirality, rotation curves, and CMB parity from double counter-rotation on  $\mathbb{RP}^3$ : frame-dragging as the origin of the dark sector*,  $\alpha$ LGQV programme, IIR Cosmology and Theoretical Physics (2026), DOI:10.13140/RG.2.2.27247.60323.
- [11] B. Kriger, *A unified origin of bulk flows, spin chirality, and cosmic dipoles from rotating  $\mathbb{RP}^3$  topology*,  $\alpha$ LGQV programme, IIR Cosmology and Theoretical Physics (2026), DOI:10.13140/RG.2.2.33885.58088.
- [12] B. Kriger, *Dynamic topology of the universe:  $\mathbb{RP}^3$  with double counter-rotation as a complete physical model*,  $\alpha$ LGQV programme, IIR Cosmology and Theoretical Physics (2026), DOI:10.13140/RG.2.2.20020.62086.