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# The 3S+3T Model: Temporal and Spatial Skew in a Quasi-Flat Spacetime

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**Abstract**

This essay expands the previously developed three-directional time model by introducing a spatial skew of comparable magnitude to the formerly introduced temporal skew, proposing that both time and space possess subtly tilted planes. The superposition of temporal and spatial skew redefines flatness: the minute tilt of the $\tau$-axis in Time relative to $\theta$ induces temporal anisotropy, just as the mirrored skew of $z$ relative to $x$ adds, in Space, a similar directional bias. Though nearly imperceptible locally, their cumulative effect across cosmological distances not only redefines how events are realised, thus propagating Time, but also how entropy evolves, and how information propagates. Observable consequences may include polarisation rotation in the Cosmic Microwave Background (CMB), anisotropic redshift behaviour, entropy gradients, and alignment patterns in large-scale universal structures. Rather than abandoning flatness, this model retains local orthogonality as it introduces global anisotropy – not through curvature, but through geometric skew. Time and Space are treated not as orthogonal absolutes, but as emergent, directionally biased, interdependent structures – tilted just enough to leave fingerprints in the universe.

**Keywords:** 3S+3T, spacetime anisotropy, non-metric geometry, causal emergence, cosmic microwave background, Planck-scale physics, astrophysics[2]

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# 1. Introduction

The conventional perception of geometry, as applied in physics, tends to over-simplify our view of nature and the universe. Although this 3S+3T model departs from Einstein's strict orthogonality in spacetime and his limitation to a four-dimensional continuum, it still remains consistent with his broader preference for a flat universe. The superposition of the Time and Space dimensions, and the skewed geometry introduced preserves local flatness and zero intrinsic curvature, aligning with Einsteinian principles over large parts – yet offering a refined structure capable of explaining observed anisotropies across different realms of physics.

In this essay, an analogy will be drawn between the presented three-directional time model and Space. The proposed model employs Planck-Time Units (PTUs) to structure its temporal geometry: the linear time axis $t$ is measured in PTUs, defining the resolution of event progression. The $\theta$-$\tau$ plane references the Planck length as the spatial threshold governing event locality, tunnelling, and trace effects. For space, similar conditions are applied when measuring distances along the axes in Planck-Length Units (PLUs). Although this introduces mixed units within the combined 3S+3T model, each operates within a distinct functional domain: temporal versus spatial bounds. It should be recalled that Planck length $l_P$ and Planck time PTU are related by $l_P = c \cdot \text{PTU}$, where $c$ is the speed of light. Thus, the formalism remains consistent – mirroring standard practice in early-universe cosmology and quantum gravity. Further, terms such as *event realisation*, *memory*, and *trace* are used in an operational and geometric sense, referring to persistence and weighting of realised events within the model's causal structure. No psychological, epistemic, or metaphysical interpretation is implied.

Similar approaches by other researchers have sought to generalise time beyond a single axis. However, they typically rely on higher-dimensional field equations and compactification schemes to conceal additional temporal directions, which can generate causality conflicts or instabilities.

As outlined in a previous paper, the present model retains three temporal axes explicitly (Muchow 2020 [1]). It defines their geometry through a Planck-scale apex separation of future and past cones, and a minute skew angle that preserves near-orthogonality. This explicit inclusion of three temporal axes is introduced to maintain causal consistency within the model. It also avoids arbitrary compactification and places the emphasis on cone structure and asymptotic alignment, thereby offering an alternative route to reconcile multiple temporal directions with empirical constraints.

Earlier attempts to accommodate more than one temporal dimension include a two-time physics framework, where physical laws are reformulated to remain consistent despite the presence of an additional temporal axis (Bars 1997a [2a]; Bars 2001b [2b]). Subsequent investigations considered spacetimes with extended metric signatures, examining how familiar dynamical limits arise when more than one temporal direction is permitted (Álvarez 2000 [3]). Another line of work emphasised the role of signature change, interpreting multi-time frameworks through topological and geometric features of spacetime (Pavšič 2001 [4a]; Pavšič 2005 [4b]).

Recent studies have proposed frameworks with more than one temporal dimension, incorporating two compactified time-like dimensions alongside the conventional three spatial and one temporal dimensions, aiming to address the quantum non-locality dilemma, commonly known as the EPR paradox, by suggesting that quantum systems utilize all six dimensions, while classical systems are confined to four. This interpretation is model-based, acknowledging that apparent non-locality emerges from projecting six-dimensional events into four-dimensional spacetime. Consequently, events that are time-like separated in the six-dimensional spacetime may appear space-like separated and non-local when projected into four-dimensional spacetime (Furquan et al. 2025 [5]). In this context, a further contribution was made earlier this year, also advancing a 3T framework with three temporal dimensions, which correspond to quantum-particle-interaction, and cosmological scales (Kletetschka 2025 [6]). In a follow-up, electric charge is interpreted as a topological property of three-dimensional time, with quantisation arising from a temporal winding number (Kletetschka 2025 [7]).

However, these approaches stress scale separation and topological invariants, whereas the presented model derives the existence of skew in the $\tau$-axis in Time from geometric necessity: the geometrically assigned ±1 PTU apex separation of the time-cones enforces a small but finite tilt of $\tau$ relative to $t$ and $\theta$, preserving a near-to-orthogonal framework. Given the intertwinement of time and space – as commonly accepted since Einstein – the structure of the 3S+3T model itself implies a key question: are the space axes truly orthogonal? This question is explored in the light of the skewed $\tau$-axis in Time, and considering the potential consequences of a similar shift of the $z$-axis in Space. The potential observational consequences in cosmology and quantum mechanics, resulting from these proposed alterations will be examined in subsequent sections.

# 2 Skewed $\tau$ and $z$

Minkowski's light cones do not allow any causal interaction between future and past cones; they simply define a geometry consistent with Einstein's special relativity (Minkowski 1908 [8]). In contrast, the introduced 3S+3T framework presented in previous publications relies on interactions between these cones, postulating that no arrow of time exists beyond the steady sequence of events that generate the flow of time. Recently, it has been argued that time is not a primitive parameter but emerges from relations among discrete events (Conti 2025a; Conti 2025b [9]). Resonating with this perspective, the present model assigns temporal skew to the dynamic ordering of events, while spatial skew remains a fixed geometric bias. Long-range anisotropies in both cosmological and quantum domains arise through the ordering and comparison of realised events. The superposed Time and Space dimensions create a framework in which these domains evolve not as isolated grids but as interwoven fabrics subtly tilted in tandem. Realising and non-realising events are influenced by the introduced asymmetry

(Muchow Mar. 2025 [10]). The $\tau$-axis defines the asymptotic structure of the time cones, so any skew introduces a directional bias to trace density, which is amplified when applying an identical tilt to the spatial $z$-axis. In the early universe, fluctuations were extremely sensitive to underlying geometric structures: the proposed $\tau$-skew could have seeded preferential directions of evolution. These introduced components challenge the principle of statistical isotropy assumed in conventional cosmology and suggest that directional memory embedded in time's geometry may shape the visible universe. As a result, large-scale features such as the alignment of galaxy spins, elongated cluster orientations, and filamentary structures may not be stochastic anomalies, but rather fossil evidence of the $\tau$- and $z$-skews in this model (Hutsemékers 2014 [11a]; Tiwari 2015 [11b]).

Earlier essays established a three-directional, probabilistic time model, originally built on orthogonality between the axes $t$, $\theta$, and $\tau$ (Muchow Feb. 2025 [12]). However, introducing a minute skew of the $z$-axis in Space, in alignment with the $\tau$-tilt in Time – both defined by the angle $\kappa = 0.0054°$ – consequently leads to an enhanced anisotropy in the model. Just as Minkowski's independent light cones define causal structure independent of experimental measurement, the proposed tilts define the causal geometry in this 3S+3T framework. The resulting $z\tau$-skewed light-cone structure is illustrated schematically in figure 1.

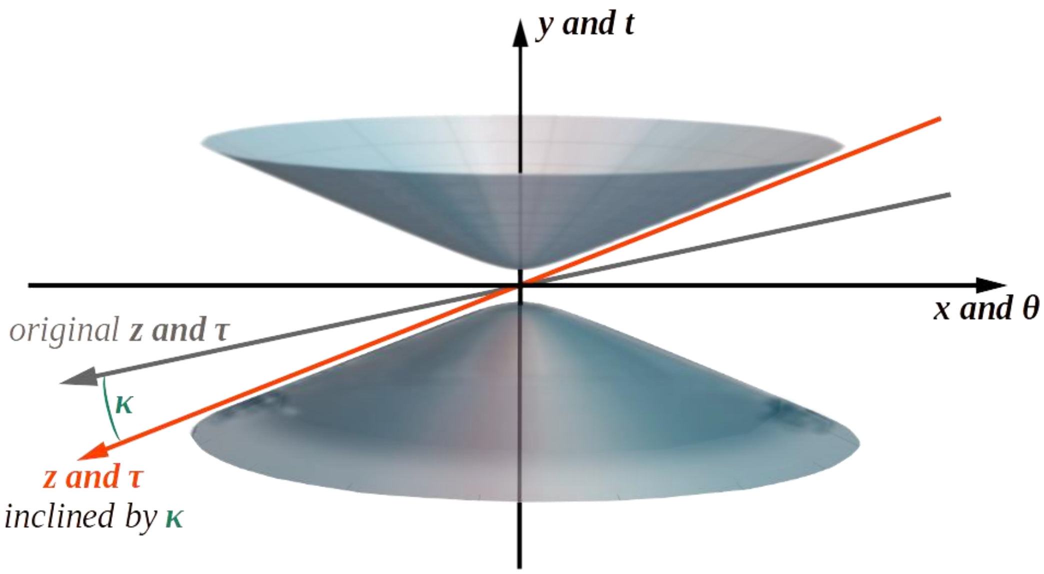


Figure 1: The combined $z\tau$-skew in the quasi-flat 3S+3T model.

The orthogonal axes $y$ and $t$, and $x$ and $\theta$ (in black) are orthogonal to one another; the originally orthogonal axes $z$ and $\tau$ (in gray) are shown to illustrate the shared deviation of the $z$- and $\tau$-axes (in orange) in the model, caused by the tilt-angle $\kappa$ – far exaggerated above the true value of 0.0054°. The cone apexes are ±1 PTU above and below the origin of both the Time and the Space dimension.

## 2.1 Precisions on the Gap Region

Earlier work introduced a connection between future and past cones – contrary to Minkowski's unconnected light cones: a transitional window, allowing realising events to pass from the future into the past cone. This process reinforces the perspective on an Event Arrow of Time, which will be discussed in a future essay. The gap is located at the origin of the 3S+3T model with $x=y=z=t=\theta=\tau=0$, and it extends into the $\theta$-$\tau$ plane. As realising events pass through this gap dynamically, their transition through the gap along the perceptive time axis $t$ defines the perceived temporal passage. The resulting gap region at $t_0$ is shown schematically in figure 2.

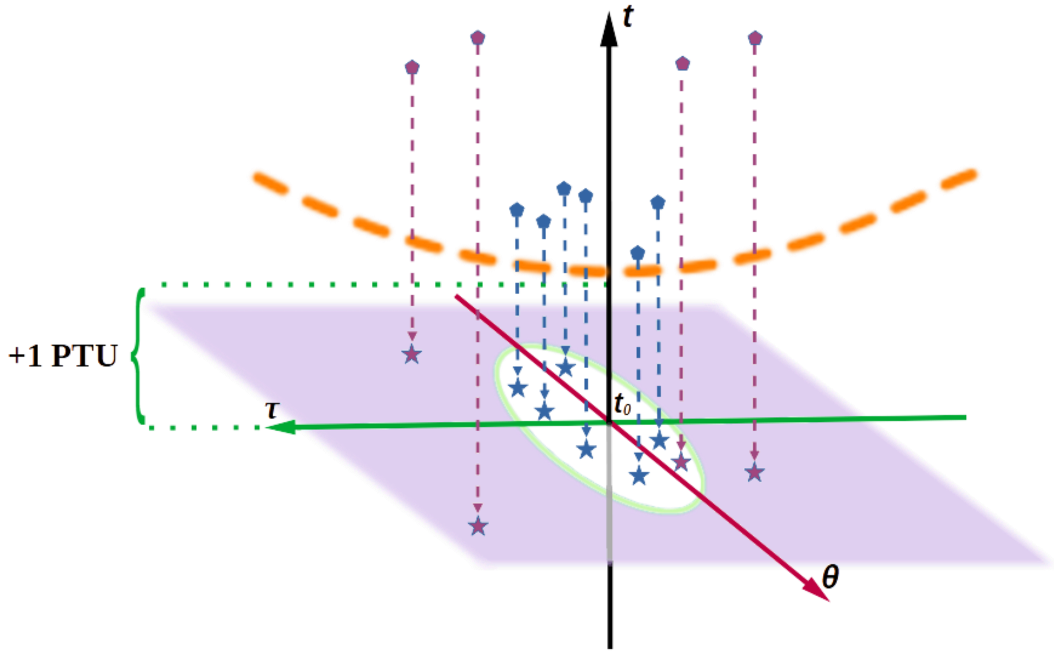


Figure 2: Gap region ($\Delta t$ = 1 PTU) at $t_0$ within the skewed $\theta$-$\tau$ plane.

In the above figure, the arc designed in a dashed orange line symbolises the future cone's apex at +1 PTU, from where events pass the gap – for clarity, the past cone's apex situated at –1 PTU is not shown. The lower ends of the vertical arrows, marked with stars, indicate the instant at which events intersect the $\theta$-$\tau$ plane. All events pass into the past cone eventually: whereas realising – true, countable – events incur lasting traces in the past cone (blue dashed arrows), non-events (arrows in magenta) with a few of them also passing the gap leave only very short-lasting traces. For clarity only a few non-events are shown, although they outnumber events largely.

Based on the proposed probability profile of event realisation, the following specifications are introduced:

$t$ = 1–1.5 PTU: $P_{real} \gg 99\%$, essentially all events realise

*t* = 1.5–2.5 PTU: $P_{real}$ > 95%, defining the main transition region $\Delta t_{gap}$ = 1 PTU along *t*
*t* = 2.5–3 PTU: $P_{real}$ drops below 95%, marking a gray zone where the event probability still may increase or decrease.

For the main gap region 1.5–2.5 PTU, the expected number of realised events per PTU is N ≈ 2 · $10^{25}$, based on model-based reasoning using fluctuation estimates, which yield approximately $10^{35}$ per cubic metre, when counting vacuum modes up to the Planck scale. The previously used figure of ≈ $10^{25}$ events per PTU referred to a configuration with a smaller effective cross-section. In the present treatment, the same temporal gap is considered with a larger cross-section, naturally implying a higher total number of realised events while keeping the flux per PTU consistent.

In order to evaluate the event-density, a 4-volume (V4) of the gap must be defined:
$V4 = A \cdot \Delta t_{gap}$ (equ. 1)
where $\Delta t_{gap}$ = 2 PTU is the temporal thickness along *t*, i.e. real distance of the apexes of future and past cones from one another. A is the cross-section area in the *θ-τ* plane. Solving for A:
$A = N / (\rho \cdot \Delta t_{gap}) \approx 10^{25} / (3 \cdot 10^{22} \cdot 2) \approx 167\ PTU^2$ (equ. 2)
with $\rho \approx 3 \cdot 10^{22}$ events/$PTU^4$.

Notes:

- The *τ*- and *z*-axes' tilt is fixed at *κ* = 0.0054° for all calculations. Inclusion of the high-realisation region *t* = 1 → 1.5 PTU, or the gray zone *t* > 2.5 PTU does not significantly alter N or D.
- Non-events and tunnelling: Non-events generally do not traverse the gap. Certain non-events tunnel from the region just above the gap from the future cone apex, but their realisation probability is very low, and they do not contribute to the count of realised events. Thus, the gap size and 4-volume calculations consider only events that actually realise.
- Given the probabilistic and quantum nature of events, and Heisenberg uncertainty limitations, the above values are approximate rather than exact.

Using the observed polarisation birefringence from Planck 2018 (α = 0.35° ± 0.05°), the corresponding model parameter calculates to $\kappa = \alpha \cdot \pi / 180 \approx 0.0061$ rad. Likewise, the CMB temperature anisotropy $\Delta T/T \approx 1.0 \times 10^{-5}$ (Planck 2018, cosmological parameters) translates via the model calibration $\kappa \approx 10^{-3}$, corresponding to $\Delta T/T \approx 10^{-5}$, into $\kappa \approx 0.001$ rad (≈ 0.057°). The observations are fully consistent with the proposed range for *κ* values – see Tables 1 and 2 in the following section.

# 2.2 The *κ value*

To promote the passing of events from the future to the past cone, the apexes of their cones are postulated to be separated along the *t*-axis by ± 1 PTU each from the $x=y=z=t=\theta=\tau=0$ point – the origin in both space and time axes. This distance represents the smallest possible separation between the apexes in temporal coordinates. Given that realising events pass through a finite area around $t = \theta = \tau = 0$ in the $\theta$-$\tau$ plane, a geometrical evaluation of the $\tau$ tilt becomes feasible (Muchow, Apr 2025). To preserve a near-to-orthogonal framework, this tilt must remain small.

The parameter $\kappa$ is introduced as a dimensionless skew quantity; when interpreted geometrically, it corresponds to a small rotation angle, so that $\kappa$ may be expressed numerically in radians or degrees. Using a reference length $L_0$ of approximately 21,000 PTU along the $\tau$-axis, and a 2 PTU separation between future and past cones, the illustrative skew satisfies the small-angle relation

$\tan\kappa \approx \kappa$ for $\kappa \ll 1$, in radians (equ. 3)

to give

$\kappa \approx 9.524\times10^{-5}$ rad $\approx 0.0054°$(equ. 4)

Further considerations support a conservative range of $\kappa$, within which orthogonality is locally preserved:

$\kappa \in [0.005°, 0.03°]$.

Thus, the specific value presented here – applied similarly to the $z$-axis of Space for consistency – serves as a provisional fit parameter. The chosen $\kappa$-range reflects a minimal but non-negligible deviation from orthogonality, preserving the quasi-Euclidean character of the 3S+3T framework. Whereas the lower limit ensures that the combined $z$- and $\tau$-skew effects remain physically meaningful rather than purely mathematical, the upper bound is set by observational constraints. For $\kappa$-values larger than about $10^{-3}$ rad, the predicted asymmetry from the combined $z$- and $\tau$- skews would imply directional variations exceeding what current observations report. In other words, the Planck satellite and comparable CMB studies have established that the anisotropy of the cosmic microwave background is at the level of $\Delta T/T \approx 10^{-5}$, which sets the order of magnitude for directional variations consistent with observation. A $\kappa > \sim10^{-3}$ (corresponding to a rotational angle of about 0.057°) would be expected to generate structural anisotropies that, when projected over cosmological distances, surpass this empirical tolerance. Within the chosen range, near-orthogonality is maintained, yet the skew remains sufficient to allow cumulative structural effects across cosmological scales. For $\kappa \ll 1$, as is the case here, cross-terms in the metric appear linearly, and higher-order effects are negligible; no non-tensorial transformation is implied, ensuring consistency with standard tensor calculus. The proposed skew of 0.0054° corresponds to $\kappa \approx 10^{-4}$ rad, which actually lies below current experimental bounds on Lorentz invariance violation (Kostelecký 2011 [13a]).

However, considerations concerning the chosen reference length and calculations with selected values from the range of $\kappa$ indicate that the effects on polarisation of the cosmic background radiation may entirely be observable today (Planck Collaboration 2018 [14a]; Minami et al 2020 [14b]). The following table illustrates this:

| $L_0$ (PTU) | $\kappa$ (°) | Observational status |
|---|---|---|
| **10,000** | 0.0027 | Local orthogonality preserved |
| **21,000** | 0.0054 | Reference case; small cumulative effect |
| **30,000** | 0.0077 | Noticeable skew; directional effects |
| **50,000** | 0.0128 | Upper reference limit |

Table 1: Illustrative $\tau$-skew angles for selected reference lengths

Thus, for minimal $\kappa$, local orthogonality is effectively preserved and directional effects are negligible. At the reference scale $L_0 \approx 21{,}000$ PTU, orthogonality is only weakly perturbed and cumulative effects remain small. Larger reference lengths correspond to increasingly noticeable skew, providing an upper illustrative range in which anisotropic effects may approach current observational sensitivity.

Additional observed anisotropies, namely redshift and entropy, follow the trends summarised below:

| Effect | Estimate / Trend | Relevant Dataset |
|---|---|---|
| **Redshift anisotropy** | $\Delta z/z \propto \kappa$ | Planck, Euclid |
| **Entropy anisotropy** | qualitative trend | Planck, Simons Observatory |

Table 2: Redshift and entropy anisotropies in light of recent data.

The redshift constraints summarised in Table 2 draw on CMB and large-scale structure observations (Planck Collaboration 2018; Euclid Collaboration 2022 [15a]). Entropy-related considerations follow standard cosmological treatments (Liddle & Lyth 2000; Penrose 2010 [15b]). As can be deduced from table 2, the framework is falsifiable in principle: tightening isotropy and birefringence limits below $\kappa \approx 10^{-4}$ rad would directly exclude the proposed range. The introduced skew angle $\kappa$ must not be seen as an adjustable post hoc parameter, but as a structural parameter constrained jointly by causal consistency and observational upper bounds. Thus, $\kappa$ enters as a global geometric relation between subspaces which cannot be reduced to a coordinate-dependent metric artefact.

Recent analyses used effective quantum-gravity energy-scale measurements to constrain anisotropic Lorentz invariance violation, indicating that $\kappa$ within the value range as above remain below current empirical limits (Guerrero 2025 [16]). Observations of high-energy gamma-ray bursts provided further stringent bounds on Lorentz violation, reinforcing these limits (Cao 2024 [17]). Additional research using GRB time-of-flight measurements and atomic spectroscopy further tighten SME coefficient constraints, reinforcing that the possible $\kappa$ values remain below actual empirical limits (Dreissen et al. 2022 [18]). In a complementary low-energy test, high-precision Ramsey spectroscopy on trapped ions was employed, and likewise reported no detectable Lorentz-violating effects within their sensitivity (Franco 2006 [19]).

Alternative formulations of Lorentz transformations, such as the vectorial treatment proposed, demonstrate that consistent extensions remain mathematically viable without violating the established tensor framework (Minami & Koyatsu 2018 [20a]; Gluscevic & Kamionkowski 2010 [20b]).

## 2.3 Skew induced polarisation

One major consequence of temporal skew is a possible reorientation of electromagnetic wave polarisation vectors across cosmological distances, as illustrated schematically in figure 3 for the $\tau$-skew only.

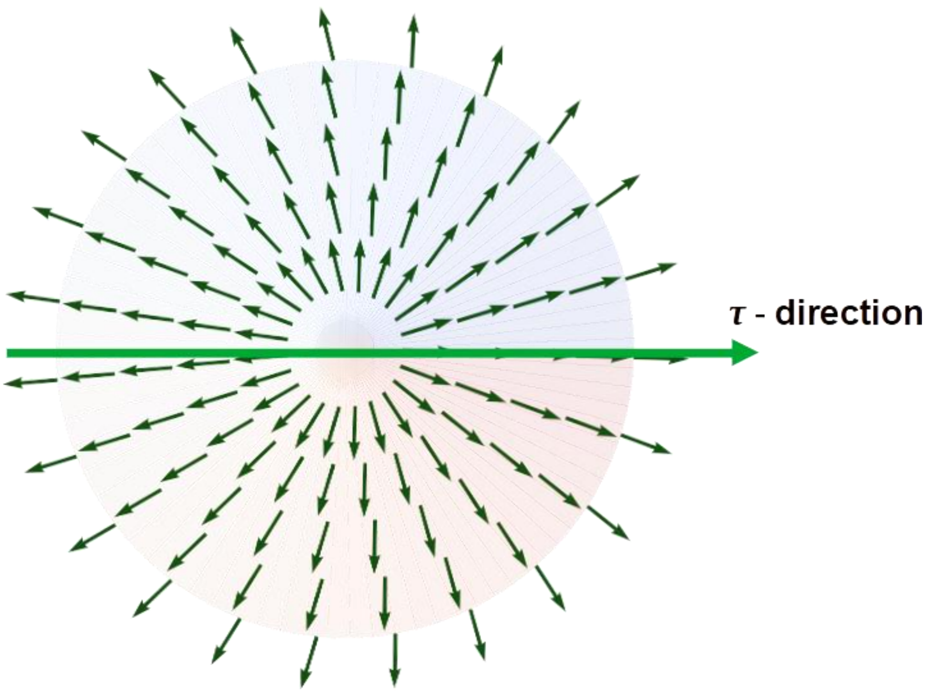


Figure 3: Schematic representation of polarisation reorientation; arrows denote polarisation vectors. For clarity, the effect is shown with $\kappa$ exaggerated by a factor of 5.

The spiral pattern in figure 3 reflects how a small temporal skew alone may induce a systematic rotation of polarisation across the sky. When both spatial and temporal skews are considered, their combined effect is expected to amplify this reorientation across cosmological distances. Thus, a deviation from isotropy in the $z$- and $\tau$-directions would manifest as cosmic birefringence, subtly rotating the polarisation of electromagnetic waves emitted during the last scattering epoch. Since the CMB retains signatures from this era, the combined minute $z$- and $\tau$- skews could imprint a systematic rotation in the observed E-mode and B-mode polarisation patterns. These shifts, while small, are cumulative and may already be detectable in high-resolution CMB datasets (Planck Collaboration 2018).

Although the per-detector angle repeatability in some modern instruments is better than 0.02°, map-level systematics, such as beam effects, T→P leakage, foreground angle uncertainty and pipeline self-calibration, dominate global-rotation inference. This is why the proposed 0.078° rotation remains below robust detection thresholds for published map products without dedicated re-analysis. A focused end-to-end injection and cross-experiment reanalysis – avoiding blind EB self-calibration and including foreground-angle marginalisation – would be necessary to evaluate whether the predicted rotation could be recovered with current technology.

Therefore, $\kappa$ is considered a theoretically well-motivated value that currently lies below reliable map-level detectability without dedicated re-analysis and improved calibration. However, if confirmed, such directional polarisation anomalies would strongly suggest the presence of a temporal asymmetry embedded in the large-scale structure of spacetime.

The expected long range polarisation impact, and other effects discussed in the following paragraphs, can be connected to the combined $z$- and $\tau$-tilts, which contribute with a static and a dynamic component, respectively. Whereas the static $z$-tilt defines the geometric background orientation of the temporal manifold, the dynamic $\tau$-tilt describes minute, time-varying deviations. These are caused by local event distributions and/or energy concentrations, reinforcing the asymmetry between the future and past cones. However, these transient fluctuations do not significantly alter the overall geometry but they modulate the passage rate of realising events through the gap, introducing short-term variations in persistence and trace density.

# 2.4 Entropy

The $\theta$-$\tau$ asymmetry along with the tilted $z$-axis in this skewed model also introduces a subtle but persistent directional bias in entropy evolution. Entropy may accumulate or dissipate along specific temporal and spatial orientations, leading to directional thermodynamic gradients across the universe (Padmanabhan 2005 [21]). This, in turn, can affect the timing and distribution of structure formation, the anisotropic decay of information in large-scale systems, and even the thermal history of cosmic voids and galaxy clusters.

Each skewed plane introduces anisotropy within its respective domain: in Space, $z$ deviates from $x$, which remains orthogonal to $y$, creating anisotropic structure formation, infers on light propagation, and redshift accumulation (Zeh 2007 [22]). In Time, $\tau$ is a direction that deviates from $\theta$, which in turn remains orthogonal to $t$, creating biased memory traces and entropy flow (Rovelli 2014 [23]).

Such effects – while at present presumed, but unconfirmed – may result in non-uniform entropy densities over cosmological scales, thereby modifying how energy distribution unfolds, how radiative cooling operates within asymmetric geometries, and how information degrades or persists. These distortions would not only shape local thermodynamic processes but could also affect how thermal disequilibria propagate, how entropy clusters in certain regions, and how information-theoretic boundaries evolve over time. Instead of flowing isotropically outward from initial conditions, entropy exhibits a preferred directional component, governed by the $\theta$-$\tau$ skew. Since the trace structure of past events is uneven, entropy itself becomes a geometric imprint – not merely a scalar field, but a tensor-like memory of the universe's asymmetric temporal fabric.

In standard models, entropy gradients would be radial, smooth, symmetric. This changes significantly when we consider entropy in the proposed superposition of Space and Time, illustrated schematically in figure 4:

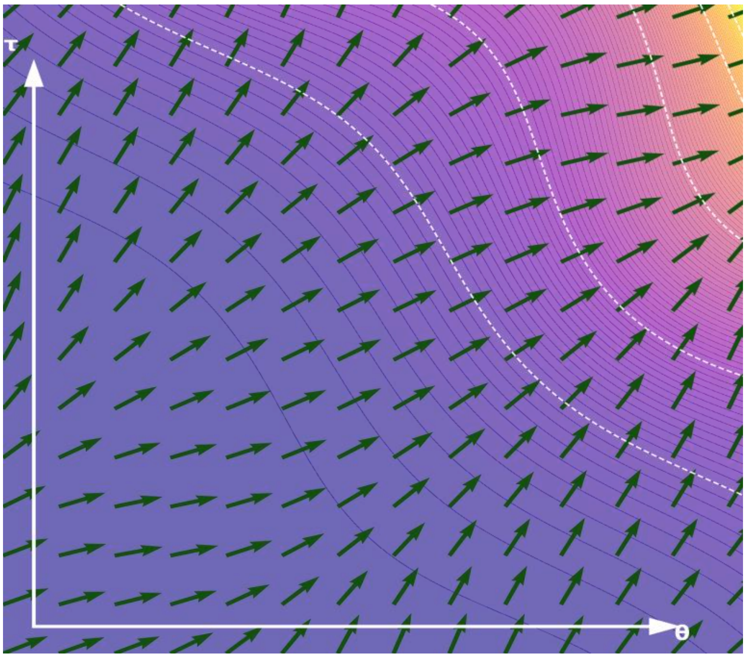


Figure 4: Impact of skewed Time-Space geometry on entropy.

The entropy flow vectors (green) bend along the curvature of the underlying manifold, here extended five times, and not perpendicular to the equipotentials any longer. The curved dashed lines in the figure are entropy "contours", where entropy remains constant. Their bend shows that symmetry is broken: because of the temporal skew of $\tau$ and the spatial skew of $z$, entropy is oriented along a direction neither purely in $\tau$ nor in $z$, but along a combination of the two (Bousso 2002 [24]).

## 2.5 Anisotropic redshift

Another observational consequence of the $z$- and $\tau$- skews concerns the anisotropic accumulation of redshift. According to standard cosmology, redshift arises from cosmic expansion and local motion, assumed to occur within a statistically isotropic background. In this model, the subtle skew of the $z$- and $\tau$-axes introduces a directional asymmetry in temporal evolution. Light propagating through a temporally skewed geometry will accumulate redshift differently, depending on its orientation relative to $z$ and $\tau$ as illustrated in figure 5:

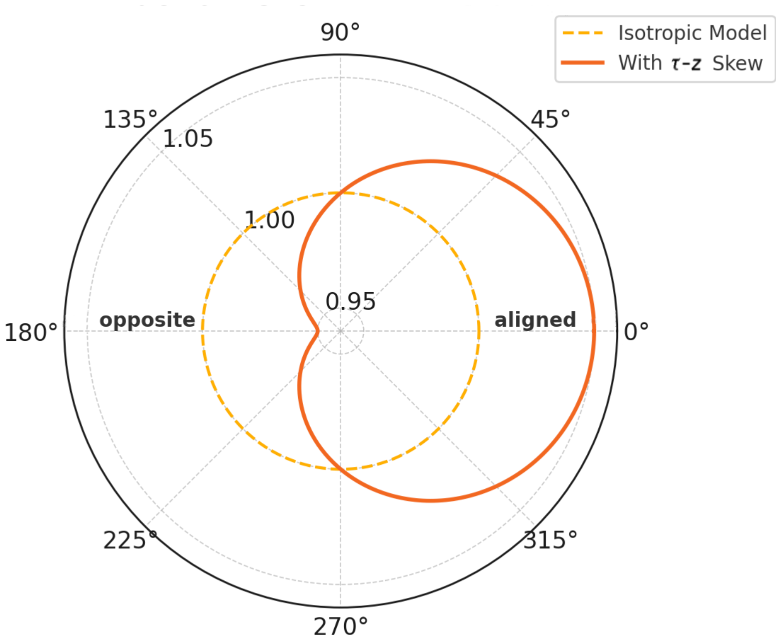


Figure 5: Schematic representation of anisotropic redshift accumulation under combined z- and τ-skews. The dashed circle denotes isotropic redshift accumulation in the standard model, the solid curve illustrates directional variation for exaggerated skew; schematic, not to scale.

The difference arises because light propagating through a temporally and spatially skewed geometry experiences uneven time evolution, affecting how much redshift it accumulates. Even though the skew is minute, its cumulative effect over cosmic distances may lead to measurable redshift anisotropies. These could appear as direction-dependent deviations in the Hubble flow, or as subtle anisotropies in redshift-distance relations – such as angular clustering distortions in redshift surveys, or variations in luminosity distance measurements of standard candles (Lusso et al. 2025 [25a]; Bogomazov & Tutukov 2011 [25b]).

## 2.6 General remarks about the intertwinement of Space and Time

The two temporal and spatial planes are not independent layers but structurally parallel distortions of the orthogonal manifold. They do not intersect or interact directly; rather, they redefine the orientation of time and space around their respective anchoring points. It is understood that the temporal origin $t_0$ constantly advances onward in discrete PTUs, remaining anchored in $x=y=z=0$. The entire $\theta$-$\tau$ plane is re-instantiated at each PTU step to $t_0$, maintaining its orientation. In fact, this skewed temporal plane is the projection surface for events in the future cone, where the weighted projections contribute to their likelihood of realisation (Hossenfelder 2013 [26]). This dynamic reapplication preserves its role in the filtering process, even as time progresses.

The spatial skew, by contrast, remains static. It does not evolve dynamically but sets a directional preference in the spatial structure of the universe. Its effects accumulate over cosmological distances, acting as a fixed geometric bias rather than a re-instantiated projection filter (Landauer 1991 [27]).

Over cosmic scales, this anisotropic entropy flow could influence not only local thermodynamic systems but the entire thermal evolution of the cosmos. In conventional models entropy increases uniformly in all directions, evolving toward equilibrium over a statistically isotropic backdrop. The presented model challenges that view by introducing a temporal anisotropy that steers the universe's thermodynamic development along privileged directions.

Additionally, the proposed skew may contribute to systematic discrepancies across sky sectors, potentially offering an alternative explanation for redshift-based anomalies such as the Hubble tension, without invoking spatial curvature or exotic energy components (Di Valentino et al. 2021 [28]).

Finally, the skew in $\tau$ could produce non-isotropic expansion histories, allowing for slight directional variations in the presumed cosmic expansion, without invoking curvature. Such a feature may align with data hinting at large-scale anisotropies in the cosmic background (Schwarz et al. 2016 [29]).

# 3 Spatial Orthogonality Reviewed

The orthogonality of time was reconsidered through the introduction of a temporal skew (Muchow April 2025), rendering $\tau$ non-orthogonal to $\theta$ and $t$, and creating a tilted temporal plane: therefore, the $\tau$-axis is no longer orthogonal to $\theta$, but forms an angle with it and consequently with the $t$-axis, creating a tilted temporal plane, at the same time being the asymptote to the time cones. Consequently, if the time dimension itself does not remain orthogonal, then the spatial axes, traditionally presumed to be at right angles, also had to be re-examinated. This calls into question a long-standing assumption in physics: the orthogonality of spatial dimensions. The principle of Euclidean orthogonality has historically underpinned classical and relativistic physics, offering mathematical simplicity and calculational efficiency. However, it has to be considered an idealised construct, not a physical law: nature is not beholden to Euclid and Pythagoras.

Modern physics leans heavily on the convenience of this orthogonal assumption, especially in metric definitions, coordinate systems, and symmetry operations. Yet symmetry, when confronted with cosmological and quantum evidence, often proves to be a mere approximation rather than a governing principle (Muchow Dec 2025 [30]). In light of the skewed three-directional time dimension, it becomes relevant to examine whether one of the space axes also exhibits a minute but non-zero skew. The fact that two axis may be tilted remains a topic for discussion in a future paper. Here, a corresponding deviation in the spatial manifold is proposed, specifically along the $z$-axis, to mirror the asymmetry already attributed to the temporal domain.

The spatial skew – introduced at the same magnitude to that of the temporal skew – would have negligible impact at human or laboratory scales. However, over cosmological distances and in the quantum realm, even a minute deviation from orthogonality could lead to observable anisotropies, especially given the cumulative impact of skewed time and space acting together.

Observations such as the alignment of cosmic filaments, the coherent orientation of quasar polarisation vectors, and the large-scale dipole anomalies in the CMB hint at underlying directional structures that challenge the assumption of perfect isotropy (Jaffe et al. 2005 [31a]; Saadeh et al. 2016 [31b]). Generally, Bianchi models are invoked to account for such features (Pontzen & Challinor 2007 [32]). The framework presented here offers an alternative grounded in geometric skew rather than curvature or topological anisotropy.

On the microscopic side of physics, quantum theory also shows signs of directional preference: the well-documented parity violation in weak interactions breaks the expected symmetry in left-right processes (Wu et al. 1957 [33a]; Nanos et al. 2014 [33b]; Gorgannejad 2015 [33c]). Although this is usually interpreted as a feature of internal particle symmetries, it evokes the possibility that even at quantum scales, certain spatial directions are not treated equally. A subtle geometric skew in space – as proposed here – might offer a broader framework for interpreting such asymmetries.

A philosophical argument may also support this view: just as we have no sensory organ capable to directly perceive time, our perception of space is mediated through emergent constructs like vision and movement. Eyes do not measure geometry, they assemble lines to create something meaningful; they interpret light gradients shaped by matter to estimate distances – but these are reconstructions performed by the brain, not a comprehension of what space *is*. Thus, space should be regarded as no less emergent than time, both arising from deeper causal and/or probabilistic structures. A similar standpoint has been advanced, suggesting that space and time are conceptually inseparable and equally emergent (Guy 2008 [34]). If skewed time has observable consequences, it is reasonable to explore whether skewed space plays a similar role in shaping the universe we observe.

Consequently, the orthogonality of spatial axes, long considered a cornerstone of physical reasoning, should better be viewed as a *locally valid* approximation. The introduction of a spatial skew aligned with $\tau$-induced anisotropies and asymmetries opens the door to a revised understanding of the universe's structure – not as a perfectly gridded manifold, but as an intricately twisted fabric where time and space evolve together, guided by a shared asymmetry subtly steering the evolution of both temporal and spatial structures, including the directional orientation of cosmic filaments (Kraljic et al. 2019 [35]).

# 4 Effects of Combined Temporal and Spatial Skew

Previous sections explored the independent effects of a skewed time axis $\tau$ and the proposed spatial deviation along the $z$-axis. It must be noted that both the $\tau$-skew and the proposed spatial z-skew are extremely small – each introduced at near-imperceptible angles. However, when both asymmetries are considered acting together, they redefine the geometry of event realisation and perception across spacetime considerably. The resulting structure introduces a compounded anisotropy, one that affects how information propagates, how entropy evolves, and how cosmological measurements are interpreted.

Physical observations are confined to the ($t, x, y, z$) submanifold. The additional temporal directions $\tau$ and $\theta$ are not observable coordinates but biasing directions that shape event realisation, propagation, and accumulation probabilistically. When six-dimensional events are projected onto four-dimensional spacetime, the skews manifest as anisotropic corrections to otherwise standard observables, and not as additional degrees of freedom. Thus, the model simply proposes direction-dependent deviations within established cosmological and quantum observables, as illustrated in figure 6:

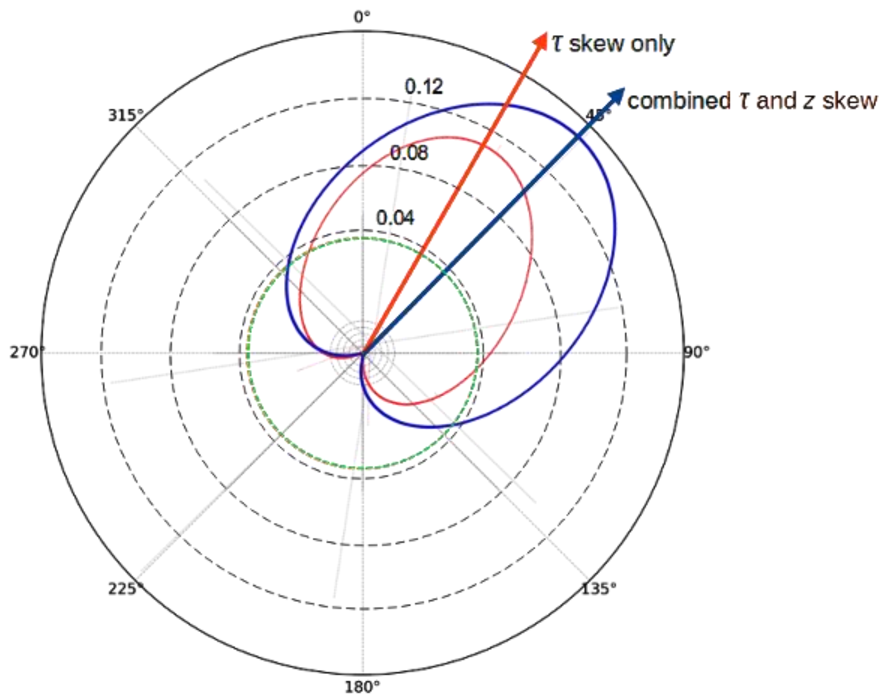


Figure 6: Idealised schematic of directional distribution under combined $\tau$- and $z$-skews. The dashed circle denotes an isotropic, unskewed baseline; the inner curve shows $\tau$-skew alone, while the outer curve illustrates the amplified directional distribution when $\tau$- and $z$-skews act together.

When temporal and spatial skews are superposed, their directional alignment produces a characteristic imprint on the distribution of realised events. Both skew vectors align in the same general direction, leading to amplified event density in that orientation – and diminished density in the opposite. This idealised geometry reflects how compounded skew reconfigures event distribution, subtly privileging certain Time-Space directions over others.

Additionally, such directional bias in the structure of realised events may influence not only entropy flow and redshift accumulation (Kraljic et al. 2022 [36a]; Secrest et al. 2021 [36b]). Other potential consequences include deviations in standard candle behaviour, distortion of Baryon Acoustic Oscillation patterns, and the emergence of Anisotropic Structural Alignment, including preferred orientations of filaments and quasar polarisation vectors (Rubart & Schwarz 2013 [37a]; Hutsemékers et al. [37b]; Perivolaropoulos & Skara 2021 [37c]).

The following metric-like representation is introduced as a geometric bookkeeping device; it is not intended as a replacement for the dynamical spacetime metric of general relativity. To formalise the coupling between temporal and spatial skew, the quasi-flat structure of spacetime can be represented by the following metric tensor ***g***. For clarity, the representation below shows only the $\tau$-$z$ sector of the full 6×6 metric; the remaining components remain orthogonal in this formulation:

$$\boldsymbol{g} = \begin{pmatrix} -1 & \xi & 0 & 0 \\ \xi & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \text{(equ. 5)}$$

where $\xi = \tan\kappa \approx 9.4 \times 10^{-5}$ for $\kappa = 0.0054°$. The off-diagonal terms represent the $\tau$-$z$ coupling, expressing a constant-coefficient, quasi-flat geometry. Since all components of ***g*** are constant, the corresponding Christoffel symbols vanish, and the flat Riemann tensor satisfies $\boldsymbol{R}_{\mu\nu\rho\sigma} = 0$, confirming that the geometry remains flat despite the $\tau$-$z$ skews, which encode global orientation rather than curvature. However, this does not imply that the introduced skews can be eliminated without violating the imposed causal and topological constraints of the model.

The introduced off-diagonal terms in the above metric represent the global geometric skew. Although a local linear coordinate transformation can diagonalise the metric in a neighbourhood, no single global transformation exists that simultaneously preserves: first, the fixed ±1 PTU separation of future and past cone apexes; second, the monotonic ordering of $\tau$ as the master temporal parameter; and third, the finite gap geometry through which events realise. The skew is therefore invariant under admissible global transformations, compatible with the causal structure of the model. Local flatness is preserved, although orthogonality is globally relaxed under physically imposed boundary conditions.

As stated before, these effects may be negligible locally, their cumulative imprint is expected to become evident across cosmological distances. Isotropy, in this context, becomes a testable assumption – one this model challenges through a geometrically minimal, yet directionally significant skew.

# 5 Conceptual and Mathematical Refinements

## 5.1 Superposition of Tilted Planes in Time and Space, Consequences and Effects

In this section, a minimal mathematical formalism will be introduced to reflect how such skew alters spacetime structure at the level of event evolution, entropy flow, and information trace formation. So far, this model has been developed from conceptual grounds, outlining how a slight temporal skew ($\tau$ relative to $\theta$), together with a spatial skew of the same order of magnitude along z, could produce observable anisotropies across the cosmos and in the quantum realm. The dimensions of space and time are thought to be in superposition (Misner et al. 1973 [38]).

Both the temporal and spatial manifolds feature a tiny skew of 0.0054°. In the Time dimension the skew is on $\tau$ relative to $\theta$, and in Space between z and x – forming tilted planes within 3T-time and 3S-space, anchored respectively in $t_0$ and $x=y=z=0$.

## 5.2 Mathematical Refinements

### 5.2.1 Anisotropy in Light Propagation

In standard cosmology, light is assumed to travel along null geodesics through a statistically isotropic and orthogonal spacetime. These geodesics are defined by the Minkowski metric:

$ds^2 = 0 = dt^2 - dx^2 - dy^2 - dz^2$ (equ. 6)

This equation reflects the path of light as a straight trajectory in flat spacetime. However, in the present model, the temporal and spatial manifolds are slightly skewed. The $\theta$-$\tau$ plane and the $x$-$z$ plane are tilted by the same angle $\kappa$ relative to the primary temporal axis, to the primary spatial axis, respectively. These tilts introduce directional biases into the spacetime metric – not as curvature, but as off-axis anisotropies (Kostelecký & Mewes 2002 [39]).

In order to capture these biases, first-order perturbative corrections to the flat Minkowski metric are introduced. For small angles ($\kappa \ll 1$), the skewed metric can be expressed as:

$ds^2 \approx dt^2 - dx^2 - dy^2 - dz^2 - 2\cdot\kappa\cdot d\theta\cdot d\tau - 2\cdot\kappa\cdot dx\cdot dz$ (equ. 7)

Here, the term $2\cdot\kappa\cdot d\theta\cdot d\tau$ represents the projection of $\tau$ into $\theta$, forming the tilted temporal plane, whereas $2\cdot\kappa\cdot dx\cdot dz$ captures the projection of $z$ into $x$, forming the tilted spatial plane. It is to note that the standard orthogonal metric is recovered when $\kappa = 0$. Overall, the geometry remains flat, the Riemann curvature tensor $\boldsymbol{R}^i_{jkl} = 0$ untouched, and the skewed terms do not imply gravitational curvature – they reflect orientation changes within the manifold (Skrotskii 1957 [40a]; Hehl & Obukhov 2003 [40b]).

Under this modified geometry, the null geodesic condition $ds^2 = 0$ becomes:

$dt^2 = dx^2 + dy^2 + dz^2 + 2\cdot\kappa\cdot d\theta\cdot d\tau + 2\cdot\kappa\cdot dx\cdot dz$ (equ. 8)

This expression shows that the effective light path length includes directional corrections from both the temporal and spatial skew.

This means that, in the 3S+3T framework, a light wave becomes orientation-dependent (Carroll 1990 [41]). Light propagating along the direction of the skews, e.g. diagonally through the $\theta$-$\tau$ or $x$-$z$ planes, experiences a cumulative deviation that could manifest as direction-dependent redshift accumulation, featuring polarisation rotation anomalies known as cosmic birefringence (Itin 2004 [42]). Also, subtle differences in electromagnetic wave travel time across orientations may be observed. This orientation-dependence parallels how light propagation varies across media of different refractive indices: the constant $c$ defines the vacuum limit, yet in matter the effective propagation speed decreases with the medium's optical density.

The above noted deviations preserve local Lorentz invariance, but embed anisotropic structure into the global metric background. Photons, under this interpretation, act as sensitive tracers of the spacetime geometry itself, without invoking gravitational curvature. They are merely revealing curvature, but exposing skewed orientations otherwise hidden in the assumptions of perfect isotropy.

# 5.5.2 Event Trajectories in Skewed Time

In this model, events evolve within a skewed temporal manifold – or Time-Space, as the 3S+3T model distinguishes itself significantly from Einstein's unified spacetime – whereas the spatial dimension remains static and does not contribute to this consideration. Event evolution does not proceed along a simple orthogonal grid, but instead unfolds within a skewed temporal geometry. The $\theta$-$\tau$ plane, tilted by the angle $\kappa$, introduces directional anisotropy into the event flow. While the main temporal axis $t$ remains vertical and unskewed relative to $\theta$, the $\tau$-direction deviates slightly from both, producing a tilted manifold that subtly affects how events emerge and propagate through time (Gell-Mann & Hartle 1990 [43]).

To describe event trajectories, the evolution of an event in time space is represented by the vector:

$$\frac{dT}{d\lambda} = \left(\frac{dt}{d\lambda}, \frac{d\theta}{d\lambda}, \frac{d\tau}{d\lambda}\right) \qquad \text{(equ. 9)}$$

Here, $\lambda$ is a general evolution parameter, analogous to proper time, and the vector components define the event's progress along $t$, $\theta$, and $\tau$.

In flat time space, one might expect the components to evolve independently or symmetrically. However, due to the skew, their evolution becomes coupled. The components evolve as follows:

$\frac{dt}{d\lambda} = 1$, meaning that the flow of time along the $t$-axis is treated as uniform and steady, setting the basic clocking rate.

$\frac{d\theta}{d\lambda} = \alpha \cdot P(\lambda) + \eta(\lambda)$, indicating that the $\theta$-component evolves in proportion to the local event probability $P(\lambda)$, scaled by a coupling constant $\alpha$, and is modulated by a noise term

$\eta(\lambda)$ that captures the inherent uncertainty in event branching (Breuer & Petruccione 2002 [44]).

$\frac{d\tau}{d\lambda} = \beta \cdot \frac{\partial P}{\partial \theta} + \kappa \cdot \frac{d\theta}{d\lambda}$ with $\tau$ evolving from directional gradients and skew, linking asymptotic structure to local dynamics.

The $\tau$-component is influenced both by the gradient of the event probability in the $\theta$-direction ($\partial P / \partial \theta$), scaled by a second constant $\beta$, and by a skew correction term $\kappa \cdot d\theta / d\lambda$. This second term reflects how the skewed geometry causes any evolution along $\theta$ to "leak" into $\tau$.

This coupling implies that an event's trajectory is not just governed by probabilistic factors, but also by the geometric tilt embedded in the structure of time itself (Tegmark 2000 [45]). In flat space, $d\tau / d\lambda$ would be independent of $d\theta / d\lambda$. In this model, they are intrinsically linked.

The full evolution of an event is thus not merely random or deterministic, but geometrically conditioned: trajectories in the future cone – as well as when passing through the gap or when tunnelling – deviate in probability space due to the skewed manifold (Muchow Feb 2025 [46]). The more strongly an event evolves along $\theta$, the more it is deflected into the $\tau$- and $z$-directions – a drift introduced not by any force, but by geometry.

Such effects may remain invisible at small scales but become relevant when summing over ensembles of events, as in trace accumulation or large-scale memory formation. Over time, the skew leads to a directional preference in realised event paths, subtly distorting the structure of the realised history in the $\tau$-direction.

Not only the trajectories of individual events are affected, but also the accumulation of memory traces – which in this model encode past events' persistence and influence.

Each event leaves a memory trace $M(t)$, which decays over time. The strength of this trace is governed by:

$M(t) = \Sigma\, [w_i \cdot P_i(t) \cdot \exp^{-\gamma \cdot (t - t_i)}]$ (equ. 10)

Here:

- $P_i(t)$ is the realisation probability of the *i-th* event,
- $w_i$ is its assigned weight (e.g. based on how many timelines converge at that event),
- $\gamma$ is the trace decay constant, and
- $t_i$ is the moment of event realisation.

This formula defines memory not as a fixed mark, but as a decaying signal dependent on both event relevance and how long ago the event occurred. The longer an event lies in the past, the weaker its trace. But, as outlined before: realised events with accumulated timelines leave long-lasting traces, whereas non-events leave rapidly fading traces.

Now geometry comes into play: due to the skew in $\tau$, the projected location of an event in the $\theta$-$\tau$ plane determines its trace footprint. The skewed projection shifts the effective contribution of a past event depending on its orientation. If an event is at coordinates $(\theta, \tau)$, its radial distance from the $\tau$-axis is:

$r^2 = \theta^2 + (\tau - \theta \cdot \tan\kappa)^2$ (equ. 11)

The distance $r$ determines how much an event “misses” the $\tau$-axis. The closer $r$ is to zero, the stronger its projected contribution to the filtered memory. Hence, even if two events occurred at the same $\boldsymbol{t}$, their trace impact differs depending on where they sit in the tilted $\theta$-$\tau$ manifold.

This leads to directional memory weighting: events aligned with $\tau$ contribute more stably to memory, while lateral ones decay faster and/or leave weaker traces. Over time, this results in anisotropic memory density, skewed in favour of the $\tau$-direction.

Thus, in this model, memory is not only a probabilistic decay, but a geometric imprint: shaped by the event’s position within a skewed temporal fabric, reinforcing the directional evolution of history.

# 5.2.3 Entropy Dynamics in Skewed Time-Space

Entropy, in this model, is no longer a passive scalar expanding isotropically from initial conditions. It becomes a directionally shaped field, evolving within a skewed spacetime that subtly favours certain orientations due to the $\tau$-$\theta$ tilt in the temporal manifold and the $z$-$x$ tilt in the spatial domain (Jaynes 1957 [47a]; Garcia-Colin & Sandoval-Villalbazo 2009 [47b]).

In standard formulations, entropy increases uniformly over time:

$$\frac{\partial S}{\partial t} \geq 0 \qquad \text{(equ. 12)}$$

In the presented geometry, however, entropy flow is no longer uniform in all directions. The skew in $\tau$ relative to $\theta$ introduces a preferred direction along which entropy traces persist longer or propagate more efficiently. However, Bell’s inequalities and their quantum mechanical violation are preserved, since the three-directional geometry does not alter local quantum statistics (Bell 1964 [48a]; Aspect 1981 [48b]). For $\kappa \ll 1$, the standard predictions of quantum mechanics, including non-classical correlations, remain unchanged.

Thus, the entropy flux vector $\boldsymbol{J}$, incorporating both temporal and spatial skew effects must be redefined:

$$\boldsymbol{J} = -\boldsymbol{D} \cdot \nabla_s \boldsymbol{S}, \qquad \text{(equ. 13)}$$

where $D$ is a direction-dependent diffusivity tensor, and $\nabla_s \boldsymbol{S}$ is the skewed entropy gradient. In conventional isotropic space, $\boldsymbol{D}$ reduces to a scalar and $\nabla \boldsymbol{S}$ follows standard spatial derivatives. In this model, $\boldsymbol{D}$ contains off-diagonal components induced by skew:

$$\boldsymbol{D}_{time} = \begin{pmatrix} D_t & \kappa & 0 \\ \kappa & D_\theta & 0 \\ 0 & 0 & D_\tau \end{pmatrix} \qquad \text{(equ. 14)}$$

with similar structure in space for the $z$-$x$ skew:

$$\boldsymbol{D}_{space} = \begin{pmatrix} D_x & \kappa & 0 \\ \kappa & D_y & 0 \\ 0 & 0 & D_z \end{pmatrix} \qquad \text{(equ. 15)}$$

The off-diagonal terms of $\kappa$ couple entropy flow between directions. Here, $\boldsymbol{D}_{time}$ and $\boldsymbol{D}_{space}$ represent the temporal and spatial 3×3 diffusion tensors, respectively; together they form the full 6×6 structure coupling all directions. Thus, the entropy gradient in $\theta$ or $x$ also generates flux in $\tau$ or $z$, respectively. This generates a directional entropy leakage – where entropy appears to drift preferentially along the skewed directions.

The entropy flow divergence is defined as:

$$\nabla \cdot \boldsymbol{J} = -\frac{\partial S}{\partial t} \qquad \text{(equ. 16)}$$

Substituting $\boldsymbol{J}$, one gets the anisotropic entropy equation for temporal contributions:

$$\partial S / \partial t = \boldsymbol{D}_t \cdot \partial^2 S / \partial t^2 + \boldsymbol{D}_\theta \cdot \partial^2 \boldsymbol{S} / \partial \theta^2 + \boldsymbol{D}_\tau \cdot \partial^2 \boldsymbol{S} / \partial \tau^2 + 2 \cdot \kappa \cdot \partial^2 \boldsymbol{S} / \partial \theta \partial \tau \qquad \text{(equ. 17)}$$

and analogously for spatial contributions:

$$\partial \boldsymbol{S} / \partial x = \boldsymbol{D}_x \cdot \partial^2 \boldsymbol{S} / \partial x^2 + \boldsymbol{D}_y \cdot \partial^2 \boldsymbol{S} / \partial y^2 + \boldsymbol{D}_z \cdot \partial^2 \boldsymbol{S} / \partial z^2 + 2 \cdot \kappa \cdot \partial^2 \boldsymbol{S} / \partial x \partial z \qquad \text{(equ. 18)}$$

The last terms in each expression, the mixed partial derivatives, explicitly encode skew-driven entropy anisotropy (Kestin 1979 [49]). These are not curvature effects; they emerge purely from the geometry of directional distortion introduced by $\tau$ and $z$ tilts.

This means that entropy spreads physically faster along $\tau$ and $z$ than in orthogonal directions. Over time, this leads to anisotropic thermodynamic gradients. In the universe, cosmic voids and high-entropy regions may display directional cooling, and thermal histories of galaxy clusters could subtly diverge across orientations. Additionally, the second law becomes geometry-sensitive: entropy increases, yes – but not equally in all directions.

Over cosmic scales, this entropy deformation can accumulate into a global thermodynamic asymmetry, potentially visible in CMB temperature anisotropies, large-scale structure entropy density, or alignment of cooling flows in the intra-cluster medium.

Entropy, in this framework, is not just a scalar arrow of time, but a vectorial field, subtly steered by the skewed geometry of time and space.

# 6 Conclusion

This essay has extended the three-directional time model, presented in previous papers, by proposing a corresponding spatial skew, resulting in a framework where time and space evolve on subtly tilted planes. The skew in $\tau$ relative to $\theta$ introduces temporal anisotropies, while a mirrored skew in $z$ relative to $x$ introduces directional preference in the spatial manifold. Though both skews are minute in magnitude, their cumulative effects stretch across cosmological and quantum domains.

The superposition of the tilted planes in Space and Time alters particularly the geometry of event realisation, information propagation, and entropy flow. Possible observable consequences, as outlined above, include directional biases in redshift accumulation, polarisation rotation in the CMB, anisotropic entropy gradients, and structural alignments on galactic and quantum scales. These phenomena, often treated as statistical noise or unresolved anomalies, may instead be signatures of a deeper geometric asymmetry.

The present model provides a potential geometric basis for such features. The skewed $\tau$- and z-axes introduce intrinsic directionality at the Time-Space level, and if the associated skew parameter range $\kappa$ can be verified since the early universe, this will result in observable directional correlations. Rather than requiring exotic fields or fine-tuning, the observed anisotropies in the CMB might thus be viewed as a direct imprint of the underlying non-orthogonality of the cosmos.

This model does not abandon the flatness of spacetime, it refines it. Orthogonality is retained locally, but globally, the introduced skews emerge as a quiet force – steering the evolution of the universe not through curvature, but through subtle directionality. The familiar grid is not broken, merely slanted. This slant, if proved real, requires a thorough rethinking of time and space – not as fixed orthogonal arenas, but as emergent structures, shaped by the very processes they contain.

Finally, the present model retains the essential structure of general relativity and quantum field theory in the limit $\kappa \rightarrow 0$, where the temporal and spatial axes recover orthogonality. The skews introduced here can be represented as a small rotation in a higher-directional 3S+3T manifold, preserving tensor transformation properties to first order in $\kappa$. Causality is maintained by the monotonicity of $\tau$, which serves as the master parameter for chronological ordering, precluding the formation of closed time-like curves. Since the future and past cones are separated by two Planck lengths, the resulting skew renders them practically flat, shifting the asymptotes to the proposed, calculated angle. Thus, causal direction is encoded without permitting closed time-like curves.

It is clear that this model is far from perfect – so, new approaches have to be envisaged, especially concerning gravity (which is work in progress) and other seemingly conflicting concepts like “spacetime”, the various existing arrows of time, causality, and more. The main issue seems to be the rigidity of established conventions, for example the idealisation of symmetry – whereas the universe exists only through asymmetry. Future observations connecting the 3S+3S model to actually detected anisotropy and polarisation may allow testing it with future high-precision instruments within the conservative $\kappa$-range [0.0054°, 0.03°] and beyond.

# Annex

Constants and PTU Conversions

| Symbol | Value | Notes |
|---|---|---|
| **$\kappa$** | 0.0054° or $9.524\times10^{-5}$ rad | Angular deviation of $z$- and $\tau$-axis from orthogonality |
| **PTU (Planck Time Unit)** | $\sim 5.39 \times 10^{-44}$ s | Fundamental time resolution |
| **Realised events per PTU** | $\sim 10^{24}$ | Structurally realised events per PTU |
| **Non-realised events per PTU** | $\sim 10^{29}$ | Events bypassing realisation, tunnelling to past cone |
| **Temporal radial distance $r^2$** | $\theta^2 + (\tau - \theta \cdot \tan(\kappa))^2$ | Governs memory/trace decay |

# References


[1] Muchow, G., "Is the Dimension Time Three-Directional?" Int. J. Trend Sci. Res. Dev. 4(5), 2020, https://www.ijtsrd.com/physics/other/31808.

[2] (a) Bars, I., Kounnas, C, "Theories with two times", Physics Letters B, 402(1–2), 32. https://doi.org/10.1016/S0370-2693(97)00464-7, 1997.
(b) Bars, I., "Survey of two-time physics", Classical and Quantum Gravity, 18(16), 3113–3130. https://doi.org/10.1088/0264-9381/18/16/303, 2001.

[3] Álvarez, E., Meessen, P., "Newtonian limits of higher-dimensional metrics", Nuclear Physics B, 566(1–2), 63–88. https://doi.org/10.1016/S0550-3213(99)00656-4, 2000.

[4] (a) Pavšič, M., "The Landscape of Theoretical Physics: A Global View", Dordrecht: Kluwer Academic, 2001.
(b) Pavšič, M., "The role of signature change in two-time physics", Foundations of Physics, 35(10), 1617–1643. https://doi.org/10.1007/s10701-005-8641-7, 2005.

[5] Furquan, M., T. P. Singh & P. S. Wesley, "Time-like Extra Dimensions: Quantum Nonlocality, Spin, and Tsirelson Bound," Universe 11(5) 137, 2025, https://doi.org/10.3390/universe11050137.

[6] Kletetschka, G., "Three-Dimensional Time: A Mathematical Framework for Fundamental Physics," Adv. Phys. Sci. 9 2550004, 2025, https://doi.org/10.1142/S2424942425500045.

[7] Kletetschka, G., "Charge as a Topological Property in Three-Dimensional Time," Rep. Adv. Phys. Sci. 9,2550007, 2025, https://doi.org/10.1142/S2424942425500070.

[8] Minkowski, H., "Raum und Zeit," Jahresberichte der Deutschen Mathematiker-Vereinigung 18, 75–88, 1908 (English translation in: H. A. Lorentz, A. Einstein, H. Minkowski & H. Weyl, *The Principle of Relativity* (Dover, New York, 1952)).

[9] (a) Conti, P. P., "Relational Theory of Time Emerging from Events," Jun. 2025, https://doi.org/10.13140/RG.2.2.10720.39680.
(b) Conti, P. P., "The Time Span: Extension of the Relational Theory of Event-Emergent Time (TRTE)," Jul 2 2025, https://doi.org/10.13140/RG.2.2.14978.18882.

[10] Muchow, G., "Time, a Three-Directional Dimension II," Int. Res. J. Nat. Sci., Mar 2025. https://www.eajournals.org/irjns/vol13-issue-1-2025.

[11] (a) Hutsemékers D., *et al.*, "Large-scale alignments of quasar polarisation vectors: Evidence for coherent orientations at cosmological scales," Astron. Astrophys. 572, 2014. A18
(b) Tiwari, P., Jain, P., "Polarisation alignment in radio quasars," Int. J. Mod. Phys. D 24, 2015, 1550030.

[12] Muchow, G., "Three Directions of Time: Temporal Geometry Beyond Scalars," Int. J. Sci.Res., 14(4), Apr. 2025, https://doi.org/10.21275/SR25416164512

[13] Kostelecký, V. A., N. Russell, "Data Tables for Lorentz and CPT Violation," Rev. Mod. Phys. 83(1), 2011, 11–31

[14] (a) Planck Collaboration, "Planck 2018 results. VI. Cosmological parameters", A&A 641, A6, 2018
(b) Minami, Y., & Komatsu, E. New Extraction of the Cosmic Birefringence from the Planck 2018 Polarization Data. Phys. Rev. Lett. 125, 2020, 221301.

[15] (a) Redshift: Planck Collaboration, Planck 2018 results. VI. Cosmological parameters, A&A 641, A6, 2018, *and* Euclid Collaboration, Euclid: Cosmology and Survey Overview, A&A 661, A1, 2022.
(b) Entropy: Liddle, A., Lyth, D., "Cosmological Inflation and Large-Scale Structure", Cambridge University Press, 2000, and Penrose, R., Cycles of Time, Bodley Head, 2010.

[16] Guerrero, M., Campoy-Ordaz A. Potting, R., Gaug, M., "Bounding anisotropic Lorentz Invariance Violation from measurements of the effective energy scale of quantum gravity," arXiv:2508.02883, 2025.

[17] Cao Z., *et al.* (LHAASO Collaboration), "Stringent Tests of Lorentz Invariance Violation from LHAASO Observations of GRB 221009A", Phys. Rev. Lett. 133(7), 2024, 071501. https://doi.org/10.1103/PhysRevLett.133.071501.

[18] Dreissen, L. S., Yeh, C.-H., Fürst, H. A., Grensemann, K. C., Mehlstäubler, T. E., "Improved bounds on Lorentz violation from composite-pulse Ramsey spectroscopy in a trapped ion," Nat. Commun. 13, 2022, 7314. https://www.nature.com/articles/s41467-022-34818-0.

[19] Franco, J. A., "Vectorial Lorentz transformations", Electronic Journal of Theoretical Physics, 9, 35-64[13], 2006.

[20] (a) Minami, Y., Komatsu E., "New Extraction of the Cosmic Birefringence from the Planck 2018 Polarization Data," Phys. Rev. Lett. 125 (2020) 221301.
(b) Gluscevic, V., Kamionkowski, M., "Testing Parity-Violating Mechanisms with Cosmic Microwave Background Experiments," Phys. Rev. D 81, 2010, 123529.

[21] Padmanabhan, T., "Gravity and the Thermodynamics of Horizons," Phys. Rep. 406 49–125 2005.

[22] Zeh, H. D., "The Physical Basis of the Direction of Time," Springer, Berlin, 2007.

[23] Rovelli, C., "An Argument Against the Realistic Interpretation of the Wave Function," Found. Phys. 44, 2014, 91–100.

[24] Bousso, R., "The Holographic Principle," Rev. Mod. Phys. 74, 2002, 825#.

[25] (a) Lusso, E., Risaliti, G., Nardini, E., "Are quasars reliable standard candles?" Astronomy & Astrophysics, 697, A108. DOI:10.1051/0004-6361/202453504, 2025.
(b) Bogomazov, A. I. & Tutukov, A. V. "Type Ia Supernovae: Non-standard Candles of the Universe", ArXiv:1105.4970, 2011.

[26] Hossenfelder, S., "Minimal Length Scale Scenarios for Quantum Gravity," Living Rev. Relativ. 16, 2013, 2.

[27] Landauer, R., "Information is Physical," Phys. Today 44(5), 1991, 23.

[28] Di Valentino, E. *et al.*, “In the Realm of the Hubble Tension – A Review of Solutions,” Class. Quantum Grav. 38, 2021, 153001.

[29] Schwarz, D. J. *et al.*, “CMB anomalies after Planck,” Class. Quantum Grav. 33, 2016, 184001.

[30] Muchow, G., “Reconsidering the Foundations of Physics: From Symmetry to Asymmetry as a Guiding Principle”, International Journal of Science and Research (IJSR),Volume / 14/12, December 2025, https://www.ijsr.net/getabstract.php?paperid=SR251212154258, DOI: https://dx.doi.org/10.21275/SR251212154258

[31] (a) Jaffe, T. R. *et al.*, “Evidence of Vorticity and Shear at Large Angular Scales in the WMAP Data: A Violation of Cosmological Isotropy,” Astrophys. J. 629, 2005, L1.
(b) Saadeh, D. *et al.*, “How Isotropic is the Universe?” Phys. Rev. Lett. 117, 2016, 131302.

[32] Pontzen A., Challinor, A., “Bianchi Model CMB Polarization and its Implications for Cosmic Topology,” Mon. Not. R. Astron. Soc. 380, 2007, 1387.

[33] (a) Wu; C.-S., Ambler; E., Hayward, R. W. Hoppes, D. D.; Hudson, R. P., “Experimental Test of Parity Conservation in Beta Decay,” Phys. Rev. 105, 1957, 1413. https://doi.org/10.1103/PhysRev.105, 1413.
(b) Nanos, S., Papigkiotisc, I. Antypas, D., “Studies of Parity Violation in Atoms”, arXiv:2411.11861 [physics.atom-ph], 2024.
(c) E. Gorgannejad, “The Impact of Bayesian Analysis on PVES Experiments,” arXiv:2410.14768 [hep-ph], 2025.

[34] Guy, B., “Time is the other name of space: a philosophical, a physical and a mathematical space-time”, PIRT XI (Physical Interpretations of Relativity Theory XI), Sep 2008, Imperial College, London, United Kingdom. emse-00355027.

[35] Kraljic, D., Rummel M., Starkman, G., “Do Cosmic Filaments Reflect a Preferred Direction?” Astron. Astrophys. 623, 2019, A9.

[36] (a) Kraljic, D. *et al.*, “Directional Dependence of Baryon Acoustic Oscillation Scale,” Astron. Astrophys. 657, 2022, A113.
(b) Secrest, N. J. *et al.*, “A Dipole Anisotropy in WISE-2MASS Sources Consistent with the CMB Dipole,” Astrophys. J. Lett. 908, 2021, L51.

[37] (a) Rubart, M., Schwarz, D., “Cosmic Radio Dipole from NVSS and WENSS,” Astron. Astrophys. 555, 2013, A117.

(b) Hutsemékers, D. *et al.*, "Alignment of Quasar Polarisation Vectors over Cosmological Scales," Astron. Astrophys. 441, 2005, 915–930.
(c) Perivolaropoulos, L., Skara, F., "Hubble Tension or Apparent Cosmological Anisotropy?" Phys. Rev. D 104, 2021, 123511.

[38] (a) Misner, C. W., Thorne, K. S., Wheeler, J. A., Gravitation (Freeman, W. H., San Francisco, 1973).
(b) Barbour, J., "The Nature of Time," Found. Phys. 40, 2010, 1263–1284.

[39] Kostelecký V. A., Mewes, M., "Signals for Lorentz Violation in Electrodynamics," Phys. Rev. D 66, 2002, 056005.

[40] (a) Skrotskii, G. V., "The Influence of Gravitation on the Propagation of Light," Sov. Phys.Dokl. 2 (1957) 226.
(b) Hehl, F. W., Obukhov, Y. N., "Foundations of Classical Electrodynamics" (Birkhäuser, Basel, 2003).

[41] Carroll, S. M., Field, G. B., Jackiw, R., "Limits on a Lorentz and Parity Violating Modification of Electrodynamics," Phys. Rev. D 41. 1990, 1231.

[42] Itin, Y., "Nonbirefringent Limit of Lorentz-Violating Electrodynamics," Phys. Rev. D 70, 2004, 025012.

[43] Gell-Mann, M., Hartle, J. B., "Quantum Mechanics in the Light of Quantum Cosmology," in W. H. Zurek (ed.), Complexity, Entropy and the Physics of Information (Addison-Wesley, Redwood City, 1990, 425–458.

[44] Breuer, H.-P., Petruccione, F., "The Theory of Open Quantum Systems," Oxford Univ. Press, Oxford, 2002.

[45] Tegmark, M., "Importance of Quantum Decoherence in Brain Processes," Phys. Rev. E 61, 2000, 4194.

[46] Muchow, G., "Time, a Three-Directional Dimension I," Am. Sci. Res. J. Eng. Technol. Sci. 101(1), Feb 2025, 179–190.

[47] (a) Jaynes, E. T., "Information Theory and Statistical Mechanics," Phys. Rev. 106, 1957, 620–630.
(b) Garcia-Colin, L. S., Sandoval-Villalbazo, A., "Relativistic Non-Equilibrium Thermodynamics Revisited," Physica A 388, 2009, 717.

[48] (a) Bell, J. S., "On the Einstein Podolsky Rosen Paradox," Physics 1, 195–200, 1964.
(b) Aspect, A., Grangier, P., Roger, G., "Experimental Tests of Realistic Local Theories via Bell's Theorem," Phys. Rev. Lett. 47, 460–463, 1981.

[49] Kestin, J., *Theory of Transport Processes in Gases and Liquids*, Butterworths, 1979.