Light in Light, Redshift and the CMB in the UQSH

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Abstract

This contribution develops a field-mechanical interpretation of redshift and the cosmic microwave background within the framework of the Universal Quantum Foam Hypothesis (UQSH). The work is deliberately structured in two stages: first, the underlying mechanics are presented in an accessible manner so that non-scientific readers can form an intuitive understanding of how light, frequency, spectrum, and temperature are interpreted within a continuous field medium. This is followed by a formalized description that expresses the same relationships in a more precise mathematical form.

Instead of interpreting redshift as a metric expansion of space, it is described here as a continuous reorganization of the internal rhythm of a spherically propagating boundary dynamics within a stationary field. The speed of light remains invariant as the maximal reorganization rate of the field; only the internal tension density of the ongoing field structure changes. Spectral lines are not interpreted as properties of transported particles, but as stable structural responses of material bonds to incoming field motion, whose relative ordering is preserved under scale transformation.

In this model, the cosmic microwave background appears as a stationary coupling band within a continuous reorganization process and not as a relic of a singular initial phase. Energy is not lost but changes its mode of organization within a cyclic tension flow across scales. Finally, the approach is placed in the context of the ΛCDM model and

discussed as an alternative ontological interpretation of the same observational data.

Light within Light, Redshift and the Cosmic Microwave Background

1. A Field-Mechanical Perspective within the Framework of UQSH

(Introductory section for non-scientific readers)

When we look at the sky today, we see light from very different distances. Some of these light sources are only a few light-years away, others billions. Almost everything we observe from large cosmological distances is redshifted. This means that the measured frequency is lower than the frequency at which the light was originally emitted. The farther away the source is, the stronger this shift toward lower frequencies tends to be.

In established cosmology, this phenomenon is usually explained by the expansion of space itself. While the light is traveling, the space between source and observer is said to increase, causing the wavelengths of light to stretch along with it. In that picture, redshift is a direct consequence of cosmic expansion.

The Universal Quantum Foam Hypothesis interprets the same observation differently. In this model, the universe is not an expanding container in which objects move apart, but a continuous, elastic field that is present everywhere. There is no “outside” and no empty nothingness between things. Everything that exists consists of organizational states of this field.

In this view, light is not a collection of individual particles flying through empty space. It is a spherically propagating boundary dynamics of the field. When a source radiates, it does not produce a single isolated light point, but a continuous sequence of tension fronts that spread out spherically in all directions. These fronts are densely arranged and are carried forward by the field itself.

What we measure as frequency is nothing other than the distance between these successive tension fronts. If they lie very close together, we speak of high frequency. If they are farther apart, we measure a lower frequency. Frequency is therefore not an independent object, but a measure of the internal rhythm of this continuous field motion.

One can imagine this rhythm like the regular pulsation of an invisible wave moving through the field. At every point in space, one tension front passes, then the next, then the next. If these fronts follow each other very quickly, the frequency is high. If more "time" lies between them, the frequency is lower. The decisive point is that the front itself always propagates at the same maximal field rate. It does not slow down simply because its internal sequence changes. Frequency therefore does not describe the speed of propagation, but how densely the individual tension impulses are organized. In this sense, frequency is a property of the internal structure of the motion, not of its external propagation. Redshift then means that this internal rhythm gradually changes along the path, while the spherical propagation itself remains intact.

2. What Happens When Light Is Emitted?

Continuing from here, the question arises what exactly happens at the moment of emission. When a star, a galaxy, or an active galactic nucleus emits radiation, it does not create a single, closed light sphere that moves in isolation from the rest of the universe. Instead, a continuous series of such tension fronts is triggered, directly following one another. The source sets the field into a rhythmic state, and this rhythm determines how tightly packed the fronts are at the beginning.

An energetic source generates a very dense internal rhythm, which we perceive as high frequency. A less energetic source produces a looser sequence. The decisive point, however, is that all these fronts, regardless of their initial frequency, propagate with the same maximal possible reorganization rate of the field. This rate corresponds to what we call the speed of light. There is therefore no difference in the speed of propagation, but only in the tension level and internal structure with which the motion begins.

One can imagine that different sources "knock" on the field with varying strength. Some strike very rapidly and densely, others more slowly. But once the impulse is triggered, it is carried forward by the field itself. The difference between gamma radiation, visible light, or radio waves therefore does not lie in one traveling faster or slower than another, but in how densely the tension fronts were originally organized. The speed of light remains a property of the field, while frequency is a property of the internal structure of the emitted pattern.

It is important not to imagine this spherical propagation as a single, gigantic light bubble detaching from the Sun and expanding outward as one solid object. The actual process begins at an extremely small scale, in the quantum domain. If one were to compare the size of the Sun to a few millimeters, the region in which a single tension front is triggered would be incomparably smaller, far beyond direct sensory intuition.

From every minute region of the emitting surface, countless such microscopic field excitations are initiated continuously. Not one, but an immense number of these micro-initiations occur at every instant. The large spherical wave we perceive is therefore not a transported object, but the collective result of innumerable local reorganizations of the field.

What appears as a coherent expanding light sphere is, in fact, a continuously renewed boundary process. The field does not carry a substance outward; it reorganizes itself locally from point to point, maintaining continuity through its own internal dynamics.

3. What Happens on the Way Through the Universe?

On their journey through the universe, these tension fronts do not move through a completely empty or neutral environment. Again and again, they encounter matter, atoms, molecules, or more complex structures. At the moment when such a front meets an atomic or molecular bond, something decisive happens: the incoming field motion sets this structure into oscillation. But it does not oscillate arbitrarily. Every stable bond possesses only very specific allowed oscillation patterns. Exactly these discrete patterns are excited.

One can imagine this process as "light within light." A larger, overarching tension front encounters a finer internal structure. The coarse motion carries within it a multitude of possible internal gradations. When it meets a molecule, a finer substructure is filtered out of this broader dynamics. The molecule acts like a resonator that absorbs, enhances, or weakens specific components of the incoming field motion. The resulting spectrum is therefore not a property of an isolated photon, but the fine internal structuring of a tension front that has been shaped by matter.

This shaped structure then continues onward. If it encounters no further strong coupling on its way, its internal arrangement remains intact. The relative distances between the individual spectral lines remain stable because they are determined by the intrinsic properties of matter. What changes during cosmological propagation is not this internal proportion, but the overall scale of the rhythm.

The tension front gradually reorganizes toward larger distances between its impulses. The frequency decreases, but the fine internal structuring remains preserved. That is why we can still recognize characteristic spectral lines even from billions of light-years away. They are shifted overall toward the red, but their structure remains the same. Redshift changes the scale of the motion, not the embedded pattern within that motion.

4. Why Do Spectra Remain Preserved?

Why does this structure remain preserved over immense distances, even though the overall frequency changes? The decisive point lies in the fact that the spectrum represents an internal order shaped by stable material structures. Once a tension front has been modulated by atoms or molecules, it carries this fine structuring forward as part of its own internal dynamics.

One may imagine this in the following way: the large, spherical field motion forms a kind of fundamental wave. Within this fundamental wave, finer sub-waves exist that arise through interaction with matter. These sub-waves are not externally attached; they are part of the same boundary dynamics. They are light within light, a finer structure embedded within a larger motion.

As long as the propagating front does not encounter dense or strongly coupling matter again, this internal structuring is not destroyed. The field carries it onward because there is no preferred direction or selective dissolution within that structure. What changes over the course of propagation is the spacing of the overall sequence of impulses. The tension front gradually reorganizes toward larger separations between its impulses, yet the ratio of the fine spectral lines to one another remains constant.

This is why we observe the same characteristic spectral patterns in very distant galaxies as we do in laboratory measurements. Hydrogen exhibits the same lines, only at longer wavelengths. This does not mean that the light has remained unchanged. It means that its internal structure has been preserved as a relative order while the overall scale of its rhythmic structure has shifted. Redshift changes the frequency, but not the identity of the pattern carried by that frequency.

5. Why Do We Observe Gamma-Ray Bursts from Extremely Large Distances?

Against this background, it also becomes understandable why we can observe Gamma-Ray Bursts even from extremely large distances. Such events begin with an extraordinarily high tension density. Their tension fronts are initially packed extremely close together; their internal rhythm is maximally compressed. If one imagines that all frequency ranges start simultaneously from a common starting line, then the high-frequency excitations begin, so to speak, with a very large "reserve of tension."

They too are subject, over their long journey through the field, to the same continuous reorganization as any other radiation. Their internal rhythm gradually changes, the distances between the tension fronts increase, and the frequency decreases. Yet because they begin in a very high frequency range, they remain above our detection threshold even after billions of light-years. What we register is therefore not the original gamma radiation in exactly the same form, but a strongly reorganized yet still sufficiently high-frequency boundary dynamics that can reach our regime.

Weaker initial frequencies, by contrast, begin closer to our coupling threshold. They reorganize in the same way, but they fall below the range to which our detectors can respond much earlier. They pass into deeper scales without us being able to perceive them directly as light. In this sense, our observation depends not only on distance, but also on the initial tension level of the source.

6. The Cosmic Microwave Background as a Scale-Relative Transit Band

Within the UQSH, the cosmic microwave background is neither a relic of a singular initial phase nor a stationary final state of the field. Rather, it represents the frequency range in which strongly rarefied boundary dynamics still couple to our material observational regime. Spherically propagating Light Bubbles continuously reorganize along their path toward larger geometric pattern widths. Their internal rhythm is gradually stretched without violating the maximal reorganization rate of the field. The observed frequency therefore decreases not due to a global expansion, but due to ongoing field-mechanical rarefaction along cross-scale tension gradients. The value measured today, approximately 2.725 Kelvin, does not mark a universal thermodynamic ground state within this framework, but rather the lower coupling threshold of our current scale domain. It corresponds to the frequency band in which strongly rarefied, long-lived boundary dynamics from highly diverse sources and distances remain measurable. Below this range, reorganization continues. The dynamics do not disappear but transition into deeper scale regimes that are no longer directly accessible to our material system. The apparent isotropy of the background radiation is therefore not a sign of perfect uniformity, but the expression of a large-scale averaged transit dynamics of many paths through differently tensioned field regions. An absolute zero point in the sense of complete dynamical absence is structurally excluded within the UQSH framework. Every scale carries its own reorganization dynamics and thus a scale-relative temperature expression. The zero point would imply the complete cessation of field reorganization and would correspond to a singularity, which is not realizable within a continuously dynamic field medium. The cosmic microwave background is therefore not a final state, but an observable transition range within an ongoing, scale-dependent field organization.

7. Energy Loss or Reorganization?

A central question is: Is energy lost over cosmological distances? Within the framework of the UQSH, the answer is: no. What changes is not the existence of the dynamics, but its mode of organization. A boundary dynamic whose frequency decreases during propagation does not lose substance. It reorganizes its internal structure into larger geometric pattern widths. The observed decrease in energy is a change in coupling to our regime, not a destruction of field activity. Decondensed patterns continue their reorganization even below our measurable band. The dynamics does not disappear; it transitions into deeper scale domains. There it remains part of the field process, even if it is no longer directly accessible to our bound structures. A complete loss of energy would mean that field reorganization ceases. That would be equivalent to reaching a state free of dynamics. Such a state would correspond to a singularity and is structurally excluded within a continuously reorganizing field medium. The UQSH therefore does not describe a thermal standstill and no cosmic decay. It describes an ongoing, scale-dependent reorganization in which dynamics never vanishes, but merely changes its geometric manifestation.

8. The Central Idea

In the end, the core idea can be summarized in a few fundamental statements. In this picture, frequency is not a property of a particle, but a coupling quantity. It describes how densely the tension fronts of a field process are organized one after another and how closely they remain coupled to our observational regime. A spectrum is not the trace of a transported object, but the structured response of stable material patterns to an incoming field motion. It is, so to speak, light shaped by light, a fine internal drawing within a larger boundary dynamic.

Temperature, finally, is not an absolute material property, but a measure of the average tension level of a region of the field. It describes how strongly or how weakly the local organization is structured on average. In this context, the cosmic background radiation does not appear as the final state of a past explosion, but as a stable transitional band within an ongoing field organization. It marks the band in which radiation can still couple efficiently to our material regime, while below it further dynamics continue to exist that we can no longer distinguish.

And the speed of light, in this view, is not the velocity of an object moving through space. It is the maximum reorganization rate of the field itself. Everything that propagates as light follows this rate. What changes is not the speed of propagation, but the internal tension state and thus the coupling to our observable band.

9. A Field-Mechanical Description within the Framework of the UQSH

9.1 Field-Mechanical Formulation of Redshift

Within the Universal Quantum Foam Hypothesis, redshift is not interpreted as a metric stretching of space, but as a continuous reorganization of the internal rhythm of a spherically propagating boundary dynamic in a stationary field medium. The spherical symmetry does not represent a transported shell of substance, but the geometric locus of constant phase in a continuously reorganizing field.

The speed of light remains invariant and is understood as the maximum reorganization rate of the field:

$$c = \text{constant}$$

The observed frequency continues to be given by

$$f = \frac{c}{\lambda}$$

An increase in wavelength therefore does not correspond to a change in propagation speed, but to a reduction of the internal reorganization density of the tension front.

The observed redshift remains formally defined as

$$z = \frac{\lambda_{\text{obs}} - \lambda_{\text{emit}}}{\lambda_{\text{emit}}}$$

The interpretation changes, however:

$$\lambda$$

does not describe a stretched spatial quantity, but the distance between successive tension fronts within a stationary field.

9.2 Field Gradients and Continuous Reorganization

Let $S(x)$ be a dimensionless local saturation parameter of the field. It is assumed that the frequency evolves along a propagation path according to

$$\frac{df}{dr} = -\kappa \, f \, \nabla S(x)$$

where κ is an effective coupling coefficient.

This relation describes:

- Stronger dilution occurring in low-tension regions.
- Greater stability of the internal rhythm in highly saturated regions.
- Integration of this effect over large distances into a systematic decrease of frequency.

In this way, an effective redshift arises without assuming a globally expanding spacetime.

9.3 Preservation of Relative Spectral Structures

If a boundary dynamic has been modulated by matter, it carries an internal structure Φ_{rel}, determined by discrete eigenmodes of stable bonds.

The observed spectral distribution results from a scale transformation:

$$\Phi_{\text{obs}}(\lambda) = \Phi_{\text{rel}}\left(\frac{\lambda}{1+z}\right)$$

Thus:

- Relative line separations remain invariant.
- Intensity ratios remain normalized and stable.

Redshift changes the global scale of the rhythm, not the imprinted internal structure. This is consistent with extragalactic spectral measurements.

9.4 High-Frequency Sources and Long-Distance Visibility

For high-frequency sources with initial frequency f_0, the effective reorganization along a distance r can be idealized as

$$f(r) = f_0 \, e^{-\kappa r}$$

As long as

$$f(r) > f_{\text{threshold}}$$

the boundary dynamic remains within the observable regime.

Gamma-ray bursts begin with extremely high initial rhythm density. Even after significant reorganization, they remain above the detection threshold, whereas weaker sources fall below this limit earlier.

9.5 The Cosmic Background Radiation as a Coupling Band

The measured temperature of the cosmic background radiation is

$$T \approx 2.725\,\mathrm{K}$$

with corresponding energy density

$$u = aT^4$$

The UQSH interprets this state not as the relic of an explosion and not as a stationary attractor, but as the presently measurable transit range of widely reorganized field excitations. Radiation patterns that reduce their geometric density over large distances eventually reach a frequency band in which they can still efficiently couple to our material observational regime. This range fulfills three structural conditions:

1. Above it, source-imprinted spectral structures dominate.
2. Below it, the coupling capacity of our bound material structures decreases.

3. Within this band, a statistically averaged temperature value appears, arising from the superposition of highly diverse sources and paths.

The CMB is therefore not an energetic final state, but an observation-dependent transit band within an ongoing cross-scale field reorganization.

9.6 Energy Conservation in the Field-Mechanical Framework

Since the field is stationary, local energy conservation holds:

$$\nabla_\mu T^{\mu\nu} = 0$$

The decrease of the observed frequency does not imply destruction of energy, but a change of organizational mode.

Diluted boundary dynamics can reorganize into high-frequency radiation again in highly saturated regions. This leads to a cyclic flow of energy across scales, not a thermal end state.

9.7 Physical Consequences

The field-mechanical interpretation implies:

- Redshift is path-dependent.
- Inhomogeneous tension distributions influence frequency drift.
- Gravitation continues to appear as field geometry.
- The speed of light remains universally invariant.

The UQSH therefore does not replace the observed equations, but their ontological interpretation.

10. Outlook and Contextualization within the Framework of the ΛCDM Model

The ΛCDM model (Lambda Cold Dark Matter) currently represents the established standard model of cosmology. It describes the large-scale structure of the universe with remarkable precision. In particular, it explains:

- the statistical distribution of galaxies,
- the shape of the CMB power spectra,
- baryonic acoustic oscillations,
- and the accelerated expansion through a cosmological constant Λ.

At the same time, ΛCDM is based on several ontological assumptions whose physical nature remains unresolved. Approximately 95% of the cosmic energy content is modeled in the form of dark matter and dark energy—components that explain gravitational effects but have not been directly identified.

11. Open Tensions within the ΛCDM Framework

Despite its successes, several persistent discrepancies exist:

Hubble Tension: Different measurement methods systematically yield different values for the expansion rate H_0.

σ_8 **Tension:** The observed density fluctuation amplitude on intermediate scales deviates from model predictions.

CMB Anomalies: Large-scale asymmetries, dipole modulations, and statistical peculiarities remain not fully understood.

Nature of Dark Energy: Λ is introduced as a constant without a microphysical explanation.

Cosmological Initial Conditions: The model assumes a highly specific initial state whose fine-tuning is not derived from an underlying mechanical principle.

These points do not imply that ΛCDM has been refuted. They indicate, however, that its ontological foundation remains incomplete.

12. UQSH in Comparison

The UQSH follows a fundamentally different approach. It replaces:

- expansion with continuous field reorganization,
- dark energy with stationary tension relaxation,
- dark matter with gravitational contributions of non-persistently bound dynamics,
- spacetime curvature with field geometry of bound organization.

At the same time, it remains compatible with:

- local invariance of the speed of light,
- relativistic time dilation,
- preservation of relative spectral structures,
- the observed CMB temperature.

The decisive difference lies not in the measurable quantities, but in the interpretation of the underlying mechanism.

13. Potential Advantages of a Field-Mechanical Approach

A stationary field model could possess the following structural advantages:

- No global initial singularity required.
- No ontologically independent dark energy.
- Cyclical energy redistribution instead of a thermal end state.
- Redshift as a local integral effect rather than a global metric change.
- Gravitation as a continuous field geometry across all scales.

In this picture, the universe would not appear as an expanding container, but as a stationary medium with dynamic self-organization.

14. Central Tests

Any serious alternative approach must be tested against the same observations as ΛCDM. For the UQSH, this leads to concrete tasks:

- Reproduction of the CMB power spectrum.
- Quantitative description of the Hubble relation.
- Explanation of large-scale structure formation.
- Precise modeling of galaxy rotation curves without additional matter components.
- Consistency with gravitational wave measurements.

Only such a quantitative elaboration can determine the viability of the model.

15. Concluding Remarks

The ΛCDM model is currently the most successful cosmological framework. Nevertheless, fundamental ontological questions remain open. The UQSH does not offer a purely parametric alternative, but a structurally different description of the underlying reality: a stationary field whose dynamics generate all observable phenomena.

Whether this perspective can resolve existing tensions more consistently is not a philosophical question, but one that must be decided mathematically.

The approach developed here is therefore not intended as a refutation of the standard model, but as an invitation to interpret the same observational data differently—with the aim of reducing the number of fundamental assumptions and making the mechanism behind the parameters explicit.

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