Convergent Observational Pressure on ΛCDM: Eight Independent Results Consistent with Quantum-Geometry Dynamics

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Abstract

Standard cosmology based on ΛCDM faces a convergent crisis from multiple independent observational results published in 2024–2026. Eight distinct empirical findings — the JWST early galaxy excess, the extreme nitrogen enrichment and luminosity of MoM-z14, the rapid assembly of supermassive black holes via 'Little Red Dots', the Hubble tension confirmed at H_0 = 76.5 km/s/Mpc, the DESI DR2 evidence that dark energy is not a cosmological constant, the persistent S8 tension, the CMB large-scale anomalies with a joint probability of $\leq 3\times10^{-8}$ under ΛCDM, and the quantum redshift duality result — are each in tension with ΛCDM predictions. This paper demonstrates that each result is consistent with, and in several cases predicted by, the Quantum-Geometry Dynamics (QGD) framework and the Minimally Physically Derivable Theories (MPDT) metatheory. The key QGD predictions engaged are: (1) non-hierarchical simultaneous condensation of large-scale structures from the isotropic initial state, produced by distance-independent p-gravity; (2) expansion as material drift driven by n-gravity beyond the threshold d_Λ, not metric expansion; (3) dark matter as the free preonic background, producing different clustering from cold dark matter halos; (4) three-torus topology from the Conservation at the Boundary Theorem, producing specific large-scale CMB correlation patterns; and (5) redshift as intrinsic gravitational redshift at the source caused by n-gravity acting on the emitting electron at cosmological distances, combined with the Doppler effect, without metric expansion of space. None of these predictions was adjusted to fit the observations: all follow from the two QGD axioms and their derived consequences, not retrofitted to the observations but are necessary consequences of axioms that have been the foundation of the QGD programme for a decade or more. The paper is part of the Quantum-Geometry Dynamics (QGD) and Minimally Physically Derivable Theories (MPDT) programme (ORCID: 0000-0002-7966-4250).

Keywords: Quantum-Geometry Dynamics, QGD, MPDT, ΛCDM tensions, JWST, early galaxy formation, MoM-z14, Little Red Dots, Hubble tension, DESI, dark energy, S8 tension, CMB anomalies, three-torus topology, isotropic initial state, p-gravity, n-gravity, preons, dark matter, redshift, gravitational intrinsic redshift, photon propagation, large-scale structure

1 Introduction

The standard cosmological model — ΛCDM, incorporating cold dark matter, a cosmological constant Λ, and hierarchical bottom-up structure formation — has been the dominant framework in cosmology for three decades. It has made accurate predictions across many scales and is supported by the precision measurements of the cosmic microwave background by WMAP and Planck. Its success has been genuine and substantial.

Yet observations from 2024–2026, particularly from the James Webb Space Telescope and the Dark Energy Spectroscopic Instrument, have produced a convergent pattern of results that are in tension with ΛCDM predictions — not at the level of minor adjustments but at the level of foundational assumptions. Galaxies appear too early, too massive, and too chemically enriched. Supermassive black holes form too rapidly. The expansion rate is not uniform. Dark energy does not behave like a cosmological constant. Structure formation is weaker at low redshifts than CMB predictions imply. The CMB itself shows large-scale anomalies whose joint probability under ΛCDM is less than 3×10^{-8}. Cosmological redshift fits the QGD gravitational intrinsic redshift model — n-gravity acting on emitting electrons at cosmological distances — better than pure metric expansion.

Each of these tensions has been noted individually in the literature. What has not been noted is that they share a common structural source: each one is a consequence of ΛCDM's foundational assumptions — continuous spacetime, vacuum energy as a cosmological constant, hierarchical bottom-up structure formation, and metric expansion of space — applied to observations that do not fit those assumptions. Nor has it been noted that an axiomatic framework derived independently of these observations, predicts the conditions that generate them — not as a post-hoc exercise but because the predictions follow necessarily from two axioms that have been the foundation of the QGD programme for a decade or more.

Quantum-Geometry Dynamics (QGD) is derived from two axioms: space is constituted by preons$^{(-)}$, discrete fundamental units of volume; and matter is constituted by preons$^{(+)}$, strictly kinetic particles propagating by directed leaps carrying intrinsic momentum $\tilde{c}$. Two opposing gravitational forces follow from these axioms: p-gravity, an attractive distance-independent force between preons$^{(+)}$, given by $g^{+}(a,b) = n(p^{+}{}_{a})\cdot n(p^{+}\_b)$; and n-gravity, a repulsive distance-dependent force whose magnitude increases with separation, given by $g^{-}(a,b) = n(p^{-}{}_{a})\cdot n(p^{-}\_b)\cdot d$, which dominates beyond the threshold distance d_{Λ}. The cosmological constant does not appear. Dark matter is not a separate substance but the free preonic background below the detection threshold. Expansion is material drift driven by n-gravity, not metric expansion. The initial state of the universe is a uniform cold isotropic distribution of free preons$^{(+)}$, derived from the axioms.

This paper documents eight independent observational results from 2024–2026 that are consistent with the QGD framework and its predictions, and shows how each engages a specific prediction derived from the QGD axioms. Section 2 provides a brief account of the relevant QGD predictions. Sections 3–10 address each observational result in turn. Section 11 discusses the cumulative pattern. An important chronological note: the predictions documented in this paper follow necessarily from two axioms that have been the foundation of the QGD programme for a decade or more. They are not retrofitted to the observations but are structural consequences of the axiomatic framework.

> **Chronological note:** The predictions are structural consequences of the axiomatic framework that any derivation from those axioms would have produced, independently of when the observations were made.

2 Relevant QGD Predictions

Five predictions from the QGD framework are engaged by the observations discussed below. Each follows from the axioms rather than being introduced to explain observations.

Prediction 1 — Non-hierarchical simultaneous condensation. Because p-gravity is distance-independent — $g^+(a,b) = n(p^+_a)\cdot n(p^+\_b)$, constant regardless of separation — large-scale mass concentrations form simultaneously from the isotropic initial state without waiting for the bottom-up merging of smaller structures that ΛCDM requires. The initial state — a cold uniform isotropic distribution of free preons$^{(+)}$ — is derived from the axioms as the unique state consistent with the absence of prior causal history [P24]. Structures of all scales condense simultaneously when the preonic density locally exceeds the threshold for p-gravity binding. This is Stage 2 condensation in QGD's causal lifecycle [P26].

Prediction 2 — Material expansion, not metric expansion. In QGD, space is constituted by preons(−) — a fixed finite structure. There is no expanding space. What appears as cosmological redshift and expansion is the material drift of matter through preonic space, driven by net n-gravity beyond d_Λ. The apparent Hubble parameter reflects the velocity of this material drift, which is scale-dependent because n-gravity's dominance threshold d_Λ produces different dynamics at different scales. There is no cosmological constant. No vacuum energy contributes to the expansion. The expansion is a material process with a natural scale dependence built into the force structure [P13].

Prediction 3 — Dark matter as free preonic background. In QGD, dark matter is not a separate exotic substance. It is the population of free preons$^{(+)}$ below the threshold density required for p-gravity binding into detectable composite structures. These free preons$^{(+)}$ are the remnant of the isotropic initial state that did not condense into luminous matter. They contribute gravitational effects through p-gravity but are undetectable by electromagnetic means because they have not formed bound structures that interact with the preonic field $\rho(p^-)$. The distribution of this free preonic background follows from the initial conditions and the condensation history, producing a different radial profile and clustering behaviour from cold dark matter halos [P13, P24].

Prediction 4 — Three-torus topology and CMB correlation patterns. The Conservation at the Boundary Theorem [P26] establishes that conservation of momentum at the boundary of finite preonic space requires space itself to have three-torus topology — derived, not assumed. Three-torus topology produces specific large-scale CMB correlation patterns that differ from an infinite flat universe: the temperature two-point correlation function is suppressed at angular scales above those corresponding to the size of the fundamental domain; the quadrupole and octopole have preferred orientations determined by the topology's principal axes; and the power spectrum shows a deficit at low multipoles. These are precisely the anomalies observed in the Planck and WMAP CMB data [P26].

Prediction 5 — Intrinsic gravitational redshift. In QGD, cosmological redshift has two components. The first is the Doppler effect from the relative motion of source and observer, which QGD explains corpuscularly without requiring wave-like properties of light. The second — and at cosmological distances the dominant component — is intrinsic gravitational redshift at the source itself. N-gravity, $g^-(a,b) = n(p^-_a)\cdot n(p^-_b)\cdot d$, has a magnitude that increases with separation and beyond the threshold d_Λ becomes repulsive, vastly exceeding p-gravity. At cosmological distances the gravitational interaction acting on the emitting electron is therefore enormous. From the intrinsic redshift equation, an increase in gravity proportionally decreases the permitted momentum of photons the electron can emit, intrinsically redshifting them at the source. The photon does not lose momentum in transit — the redshift is established at the point of emission. There is no metric expansion of space. The cosmological redshift and the Hubble-like distance law emerge from the gravitational structure of QGD without invoking a cosmological Doppler effect [P13, Book Ch. 15].

3 The JWST Early Galaxy Excess

3.1 The observation

Since its first science observations in 2022, the James Webb Space Telescope has consistently found galaxies that are too numerous, too massive, and too bright at high redshifts to be consistent with ΛCDM's hierarchical structure formation model. The discrepancy is not limited to individual exceptional objects: McGaugh (2024) documents a pronounced and systematic excess of galaxies with stellar masses around 10^{10} solar masses across the redshift range $z = 6$ to $z = 10$, with JWST extending the excess to higher redshifts still. The number density of UV-bright galaxies at $z > 10$ is consistently more than an order of magnitude above pre-JWST ΛCDM predictions. Multiple spectroscopic confirmations have ruled out low-redshift contamination as an explanation for the bulk of the excess.

The severity of the challenge is well captured by the community's response. The ΛCDM community has proposed various modifications — enhanced star formation efficiency, primordial black hole seeds, exotic feedback mechanisms — but none of these is derived from the standard model's foundational assumptions. They are ad hoc adjustments to a framework that did not predict what was observed.

3.2 QGD consistency

The early galaxy excess is precisely what QGD predicts from the isotropic initial state and distance-independent p-gravity. In ΛCDM, large-scale structure forms through hierarchical merging: small dark matter halos form first and merge progressively into larger ones, with galaxies forming inside the halos. The timescale for this process scales with the merger history and sets a maximum galaxy mass at any given redshift. The observed excess violates this timescale.

In QGD, p-gravity acts between all pairs of preons$^{(+)}$ regardless of separation. From the isotropic initial state, local overdensities attract matter from all distances simultaneously rather than only from nearby regions. Large-scale mass concentrations can therefore form at the same time as small ones, without waiting for bottom-up merging. The number density of massive galaxies at high redshifts is not constrained by a hierarchical timescale because the hierarchy does not exist in QGD. The simultaneous condensation from an isotropic state naturally produces the broad distribution of galaxy masses and luminosities observed by JWST at $z > 6$.

> **QGD prediction:** Non-hierarchical simultaneous condensation from the isotropic initial state produces massive galaxies at high redshifts without hierarchical merging timescale constraints. The JWST excess across z = 6–14+ is a generic prediction of distance-independent p-gravity, not an anomaly.

4 MoM-z14: The Most Extreme Case

4.1 The observation

MoM-z14 is currently the most distant confirmed galaxy, at $z = 14.44$ — approximately 280 million years after the Big Bang. Published in The Open Journal of Astrophysics in January 2026 (Naidu et al. 2026), it has several properties that are essentially impossible within standard ΛCDM. Its UV luminosity (M_UV = −20.2) makes it more than 100 times brighter than pre-JWST consensus models predicted for this epoch. Its number density is 182^{+329}_{-105} times the pre-JWST model predictions. The source is extremely compact, with an effective radius of approximately 241 light years, yet shows rising star formation with a tenfold increase in the last 5 million years. Most strikingly, MoM-z14 shows extreme nitrogen enrichment with super-solar [N/C] > 1 — an abundance pattern similar to local globular clusters that requires multiple generations of massive stars. Standard stellar nucleosynthesis requires billions of years to produce such nitrogen enrichment, yet MoM-z14 exists 280 million years after the supposed Big Bang.

4.2 QGD consistency

The combination of MoM-z14's properties is naturally explained by QGD's Isotropic Initial State. In QGD the universe does not begin with a Hot Big Bang singularity. It condenses from a preexisting cold isotropic distribution of free preons(+). This initial state has no singularity, no inflation, no hot plasma epoch in the standard sense. The earliest structures form by condensation under p-gravity directly from the cold isotropic background.

In this picture, '280 million years after the Big Bang' is not the correct interpretation of the observation. The light from MoM-z14 has been redshifted by a factor of 15.44, consistent in QGD with the intrinsic gravitational redshift mechanism: at the cosmological distance of MoM-z14, n-gravity acting on the emitting electrons is enormous, dramatically reducing the permitted photon momentum at emission. The galaxy itself may be arbitrarily old — its formation is not bounded by a Big Bang timescale. What QGD predicts is that structures of any mass can form simultaneously from the isotropic preonic background, with chemical evolution proceeding on stellar timescales that are not constrained by cosmological age. The nitrogen enrichment, which requires multiple stellar generations, is consistent with a galaxy that formed long before the light we observe was emitted.

The extreme brightness is also natural in QGD: distance-independent p-gravity produces compact high-density condensation centres that form efficiently and sustain high star formation rates. The compactness of MoM-z14 — 241 light years effective radius — is consistent with an early-stage preonic condensation in which p-gravity has concentrated a large preonic mass into a small volume.

> **QGD prediction:** The Isotropic Initial State [P24] and distance-independent p-gravity predict simultaneous condensation of structures of all masses and high chemical enrichment rates at any epoch. MoM-z14's luminosity, number density, chemical enrichment, and compactness are generic consequences of this initial condition.

5 Little Red Dots and Rapid SMBH Formation

5.1 The observation

A population of compact, high-redshift objects discovered by JWST and known as 'Little Red Dots' (LRDs) has been characterised in detail in 2025–2026. A Nature paper (January 2026) established that in most objects studied with the highest-quality JWST spectra, the broad lines are produced by electron scattering in extremely compact, highly ionised cocoons, consistent with supermassive black holes of 10^{5-7} solar masses. Chandra X-ray observations (April 2026) provided the first direct X-ray detection coinciding with an LRD, giving the strongest evidence to date that LRDs are growing supermassive black holes hidden within massive gas clouds. The critical problem is timing: LRDs appear fully assembled at epochs when ΛCDM's bottom-up merging scenario predicts only stellar-mass black holes should exist. The standard model requires stellar black holes to grow through accretion and merging over billions of years. LRDs require an alternative: direct collapse of massive primordial gas clouds into heavy black hole seeds — a top-down formation process.

5.2 QGD consistency

LRDs are the direct observational counterpart of QGD's Stage 2 condensation process for compact high-density systems. In QGD, p-gravity is distance-independent, meaning that all preons$^{(+)}$ within a condensation volume contribute their full attractive force regardless of their distance from the condensation centre. This produces a naturally top-down formation mechanism: large preonic masses condense simultaneously rather than through progressive merging of smaller units.

A primordial gas cloud of millions of solar masses collapsing directly into a supermassive black hole seed is exactly what QGD predicts for regions of the isotropic initial state where the preonic density was locally elevated. The entire mass participates in the condensation simultaneously under p-gravity, without requiring the sequential build-up that ΛCDM's gravity model demands. LRDs may therefore be the observational signature of the earliest preonic condensation centres — Stage 2 objects in QGD's causal lifecycle caught in the act of initial collapse.

> **QGD prediction:** Distance-independent p-gravity predicts top-down simultaneous mass condensation without bottom-up merging. LRDs are consistent with early-stage preonic condensation centres forming supermassive objects directly from the isotropic preonic background.

6 The Hubble Tension

6.1 The observation

The Hubble tension — the discrepancy between measurements of the Hubble constant from the early universe (CMB, giving $H_0 \approx 67.4$ km/s/Mpc) and the local universe (distance ladder, giving $H_0 \approx 73$–76 km/s/Mpc) — has intensified into a recognised cosmological crisis. Scolnic et al. (2025), using DESI data and the Coma Cluster as a distance anchor, measured $H_0 = 76.5 \pm 2.2$ km/s/Mpc — a 4.6σ discrepancy from the Planck value when the DESI fundamental plane relation is inverted. This measurement is independent of the Cepheid distance ladder and anchors the tension from 'our own backyard' in a way that minimises the systematic uncertainties that ΛCDM defenders have invoked to resist earlier results.

6.2 QGD consistency

In QGD, what appears as cosmological expansion is not the stretching of space but the material drift of matter through preonic space, driven by net n-gravity beyond d_Λ. The combined gravitational interaction is $g(a,b) = k\cdot g^+(a,b) - g^-(a,b)$, where $g^+(a,b) = n(p^+{}_a)\cdot n(p^+\_b)$ and $g^-(a,b) = n(p^-{}_a)\cdot n(p^-\_b)\cdot d$. The interaction is attractive when $k\cdot g^+ > g^-$ and repulsive when $k\cdot g^+ < g^-$. N-gravity dominates beyond the threshold d_Λ where it exceeds p-gravity. The net force at different scales depends on the distribution of matter relative to d_Λ.

This produces a natural scale-dependence of the apparent expansion rate. At scales well above d_Λ, n-gravity has been dominant for a long time and the material drift velocity is relatively well-established. At scales approaching d_Λ from above, the transition from p-gravity to n-gravity dominance is more recent and the drift velocity is different. The Hubble 'constant' measured at different scales samples different stages of this transition and gives different values — not because of measurement error but because the apparent expansion rate genuinely varies with scale in QGD. The tension is therefore not a sign of systematic error or unknown physics to be added to ΛCDM. It is the expected signature of a scale-dependent material drift process misinterpreted as metric expansion with a universal constant.

> **QGD prediction:** Expansion as material drift driven by n-gravity produces a scale-dependent apparent H_0. The Hubble tension is a structural consequence of the QGD force equation, not a measurement anomaly.

7 DESI DR2: Dark Energy Is Not a Constant

7.1 The observation

The Dark Energy Spectroscopic Instrument's second data release (March 2025), based on over 47 million galaxies and quasars in the largest 3D map of the universe ever constructed, provides the best measurements of the baryon acoustic oscillation scale to date. The DESI DR2 results show that the evidence for a time-evolving dark energy equation of state has increased since the Year 1 results. When combined with CMB, supernova, and weak lensing data, DESI DR2 favours an equation-of-state parameter that deviates from $w = -1$ (the cosmological constant) at statistically significant levels, with the equation of state appearing to evolve with redshift. This is a direct challenge to the ΛCDM framework, in which Λ is by definition a constant.

7.2 QGD consistency

In QGD there is no cosmological constant and no vacuum energy. The accelerated expansion is driven by net n-gravity beyond d_Λ, which is a force between material preons(+) rather than a property of empty space. The rate of this material drift depends on the distribution of matter relative to d_Λ, the local preonic density, and the dynamical history of the region being observed. It is therefore not a constant: it varies with the matter distribution, the expansion history, and the scale at which it is measured.

The QGD prediction is that the apparent dark energy equation of state should vary with redshift because the underlying physical process — net n-gravity driving material drift — has a different effective strength at different epochs and scales. The DESI DR2 finding of a time-evolving dark energy equation of state is precisely what QGD predicts, not as a model extension but as a direct consequence of the force equation. No additional parameter or modification is required: the evolution follows from the axioms.

QGD prediction: No cosmological constant exists in QGD. The apparent accelerated expansion is material drift driven by n-gravity beyond d_Λ, which is inherently scale- and time-dependent. DESI DR2's evidence for a time-evolving dark energy equation of state is consistent with this prediction.

8 The S8 Tension

8.1 The observation

The S8 tension refers to the persistent discrepancy between the amplitude of matter clustering at low redshifts as measured by weak gravitational lensing surveys (DES, KiDS, HSC) and the amplitude predicted from CMB measurements under ΛCDM. Weak lensing consistently finds $S8 = \sigma8\sqrt{(\Omega m/0.3)} \approx 0.75–0.78$, while ΛCDM predicts $S8 \approx 0.83$ from the Planck CMB parameters. A 2026 review confirms the tension remains unresolved, with S8 appearing to increase with effective redshift across different probes, potentially indicating scale-dependent or time-dependent modifications to structure formation. The discrepancy implies that the universe has less large-scale structure at low redshifts than ΛCDM predicts from the early universe.

8.2 QGD consistency

In QGD, dark matter is not cold dark matter in extended halos surrounding galaxies. It is the free preonic background: a diffuse distribution of unbound preons$^{(+)}$ that have not condensed into detectable composite structures. This distribution is not concentrated in dark matter halos. It does not produce the specific clustering behaviour that cold dark matter halos generate in ΛCDM: the cuspy NFW profile, the extended halo mass function, the correlation between halo mass and galaxy properties. The QGD free preonic background produces a shallower mass distribution and different clustering statistics.

The S8 tension — less clustering than predicted — is consistent with replacing concentrated cold dark matter halos with a diffuse free preonic background. The free preonic background contributes to the total mass density Ωm but does not produce the concentrated halo structure that amplifies clustering in ΛCDM simulations. The weak lensing measurement, which is sensitive to the projected mass distribution rather than just the baryonic component, would find a lower clustering amplitude than ΛCDM predicts if the dark matter component is more smoothly distributed than cold dark matter halos. This is what QGD's free preonic background implies.

QGD prediction: Free preonic background dark matter is more smoothly distributed than cold dark matter halos, producing lower clustering amplitude at low redshifts. The S8 tension is consistent with this difference in dark matter distribution.

9 CMB Large-Scale Anomalies and Three-Torus Topology

9.1 The observation

The Planck and WMAP measurements of the cosmic microwave background have revealed persistent large-scale anomalies that are difficult to explain within ΛCDM. Four specific anomalies have been identified and their joint probability assessed: the low large-angle temperature correlation $S_{1/2}$; the excess power in odd versus even low-ℓ multipoles; the variance asymmetry in the northern versus southern ecliptic hemispheres; and the alignment and planarity of the quadrupole and octopole. A careful analysis finds the joint probability of all four anomalies occurring by chance in ΛCDM to be $\leq 3\times10^{-8}$ — a statistically decisive result. Additionally, the CMB power spectrum shows a deficit of power at low multipoles (large angular scales) that is not explained by ΛCDM.

9.2 QGD consistency

The Conservation at the Boundary Theorem [P26] derives the topology of finite preonic space from conservation of momentum at the boundary. The result is three-torus topology: preonic space wraps around so that any preon$^{(+)}$ reaching the boundary continues from the opposite face, conserving its momentum vector. This topology is derived from the axioms rather than assumed as a prior.

Three-torus topology has specific and well-known consequences for the CMB power spectrum and correlation functions. In a three-torus universe with finite fundamental domain, wavelengths larger than the fundamental domain cannot exist: the temperature two-point correlation function is suppressed at angular scales above those corresponding to the domain size. The quadrupole and octopole are the multipoles most sensitive to this suppression and most strongly affected by the preferred orientations of the topology's principal axes. The power asymmetry between hemispheres and the deficit at low multipoles are also natural consequences of a finite three-torus geometry.

All four of the observed anomalies are consistent with three-torus topology. The low large-angle correlations, the quadrupole-octopole alignment and planarity, the power asymmetry, and the low-multipole power deficit are precisely the signatures that three-torus topology predicts. They are anomalies only within the assumption of an infinite or unbounded flat universe. Within QGD's derived three-torus topology, they are expected features.

> **QGD prediction:** Three-torus topology derived from the Conservation at the Boundary Theorem [P26] predicts suppressed large-angle CMB correlations, preferred quadrupole-octopole orientations, and a low-multipole power deficit. All four observed CMB anomalies are consistent with this prediction. Their joint probability under ΛCDM is $\leq 3\times10^{-8}$; under QGD three-torus topology they are expected features.

10 Quantum Redshift Duality

10.1 The observation

Lee (2026), published in Monthly Notices of the Royal Astronomical Society (DOI: 10.1093/mnras/stag726), presents a hybrid model in which the observed redshift comprises a standard metric-expansion component together with an additional line-of-sight contribution arising from the cumulative conversion of photon energy into effective mass as a function of path length and frequency. Fitting this model to the Pantheon+SH0ES compilation, the metric-expansion Hubble constant is recovered to a value consistent with the Planck baseline within 0.33σ, while the redshift-binned analyses show that the hybrid model restores the constancy of the Hubble parameter across all redshift bins. The paper demonstrates that an additional photon energy-loss mechanism proportional to path length resolves the apparent redshift-binned variation of H_0 that appears when pure metric expansion is assumed.

10.2 QGD consistency and distinction

The Lee hybrid model is a phenomenological proposal whose physical mechanism — conversion of photon energy into 'effective mass' — is unspecified. What makes it relevant here is its functional form: a path-length-proportional photon energy loss in addition to or instead of pure metric expansion. The functional form is phenomenologically similar to what QGD predicts, though the physical mechanism differs, as discussed below.

In QGD, cosmological redshift arises from two mechanisms. The first is the Doppler effect from the relative motion of source and observer, explained corpuscularly without wave-like properties. The second — dominant at cosmological distances — is intrinsic gravitational redshift at the source. N-gravity increases in magnitude with separation and beyond d_Λ becomes repulsive, vastly exceeding p-gravity. At cosmological distances the gravitational interaction on the emitting electron is enormous, proportionally decreasing the permitted photon momentum the electron can emit — intrinsically redshifting at the source. The photon does not lose momentum in transit. Space itself is fixed and not expanding.$^{(-)}$ — a momentum exchange at the scale of a single preonic volume. The cumulative effect of these discrete interactions at cosmological distances the n-gravity acting on the emitting electron is enormous, intrinsically redshifting the emitted photons at the source. This gives a distance-dependent redshift consistent with the Hubble law at small redshifts. Space itself is fixed and not expanding. The photon does not lose momentum in transit — the redshift is established at the point of emission through the gravitational effect on the emitting electron.

The distinction from Lee's proposal is important. Lee's hybrid model adds a path-length-proportional energy loss term to standard metric expansion. QGD replaces metric expansion entirely: redshift arises from the Doppler effect and intrinsic gravitational redshift at the source from n-gravity acting on the emitting electron. The photon does not lose momentum in transit and there is no metric expansion. The functional convergence — both producing a distance-proportional redshift without a cosmological constant — is notable, but the physical mechanisms are fundamentally different. QGD's mechanism is derived from the axioms; Lee's is a phenomenological addition to the standard model.

QGD prediction: Cosmological redshift arises from the Doppler effect and intrinsic gravitational redshift at the source caused by n-gravity acting on the emitting electron. The photon does not lose momentum in transit. There is no metric expansion of space. The Lee hybrid model's distance-proportional redshift is phenomenologically similar in observational form, but physically distinct — QGD's mechanism is gravitational redshift at the source derived from the axioms, not transit energy loss.

11 Discussion

11.1 The pattern of convergent pressure

The eight observational results discussed in this paper are independent of each other. They come from different instruments, different teams, different methodologies, and different aspects of the observable universe: galaxy formation, black hole seeding, cosmological expansion, structure growth, CMB topology, and photon propagation. No single systematic error or unknown bias could affect all of them simultaneously. Their convergence on a common set of difficulties for ΛCDM is therefore significant beyond what any individual result would imply.

The common thread is not that ΛCDM makes wrong predictions in detail. It is that ΛCDM's foundational assumptions — hierarchical bottom-up structure formation, a cosmological constant, cold dark matter halos, metric expansion, infinite flat topology, and continuous spacetime — each generate predictions that the observations challenge. The modifications proposed within ΛCDM to address individual tensions (early dark energy, warm dark matter, modified gravity, enhanced star formation efficiency) are not derived from the standard model's axioms. They are ad hoc additions that address symptoms without identifying the cause.

11.2 QGD's explanatory position

QGD derives from two axioms without importing the assumptions that generate ΛCDM's tensions. The distance-independent p-gravity naturally produces non-hierarchical structure formation. The absence of a cosmological constant and the replacement of metric expansion with n-gravity material drift naturally produce scale-dependent apparent expansion rates. The free preonic background naturally produces different clustering from cold dark matter halos. The three-torus topology naturally produces the observed CMB anomalies. The intrinsic gravitational redshift mechanism naturally produces the distance-proportional redshift that the Lee model captures phenomenologically.

None of these is a post-hoc adjustment. Each follows from the two axioms. The QGD Cosmology paper [P13] derives the dark matter account and the expansion mechanism from the axioms. The Isotropic Initial State paper [P24] derives the initial conditions from the axioms. The Conservation at the Boundary Theorem [P26] derives the three-torus topology from the axioms. The Bell

Correlations paper [P23] derives the quantum correlation function from the axioms. The Physical Irreversibility paper [P7] derives the arrow of time from the axioms. The programme is axiomatically closed: no prediction is introduced to fit a specific observation.

11.3 What remains to be done

The most important remaining task is quantitative. The QGD constants — x (preonic volume), $\tilde{m}$ (preonic mass unit), $\tilde{c}$ (fundamental preonic momentum), and k (gravitational coupling) — have not yet been constrained numerically in SI units. The Addendum F of the QGD book identifies four measurement pathways for this programme. Without numerical values for these constants, QGD's predictions can be compared qualitatively but not quantitatively with observations. A quantitative prediction of a_0 from k and $\tilde{c}$ would provide the most direct test: if the value of a_0 predicted by QGD matches McGaugh's measured value of approximately 1.2×10^{-10} m/s², this would be a decisive empirical confirmation. Similarly, a prediction of d_Λ in physical units from the constants would allow comparison with the DESI-measured scale of dark energy transition.

The mirror galaxy prediction from the Boundary Theorem also awaits a targeted search. The AI-assisted discovery of approximately 1,400 anomalous objects in the Hubble Legacy Archive provides the right dataset. A systematic search for antipodal reversed-chirality galaxy pairs in this dataset would constitute a direct test of the three-torus topology prediction.

12 Conclusion

Eight independent observational results from 2024–2026 are in tension with ΛCDM's foundational assumptions and consistent with the predictions of the Quantum-Geometry Dynamics framework derived from two axioms. The JWST early galaxy excess and MoM-z14 challenge hierarchical structure formation and are consistent with simultaneous condensation from the isotropic initial state. The Little Red Dots challenge bottom-up SMBH formation and are consistent with distance-independent p-gravity producing top-down collapse. The Hubble tension and DESI DR2 dark energy evolution challenge metric expansion with a cosmological constant and are consistent with scale-dependent material drift driven by n-gravity without vacuum energy. The S8 tension challenges the clustering behaviour of cold dark matter halos and is consistent with a more smoothly distributed free preonic background. The CMB large-scale anomalies challenge an infinite flat universe and are consistent with derived three-torus topology. The quantum redshift duality result challenges pure metric expansion and is consistent with QGD's intrinsic gravitational redshift mechanism.

The convergence is not coincidental. The tensions share a common source: ΛCDM's foundational assumptions about the nature of space, matter, gravity, and expansion. QGD replaces those assumptions with two axioms from which the relevant predictions follow without adjustment. The framework was not developed to explain the observations: the predictions follow necessarily from axioms that have been the foundation of the QGD programme for a decade or more. The convergence between the axiomatic programme and the observational record is the strongest available evidence that the programme is on the right track.

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