Weak Gravitational Lensing and the S8 Tension in BFUT:

Why Late-Time Clustering Inference Is Not a Unique Test of Lambda-CDM

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Abstract

Weak gravitational lensing surveys - including KiDS, DES, and HSC - consistently measure a lower amplitude of matter fluctuations, parametrised by S8, than the value predicted by extrapolating the Planck CMB best-fit Lambda-CDM cosmology forward to the present epoch. This S8 tension is consistently measured at 2 to 3 σ significance across multiple independent surveys using different instruments, analysis pipelines, and sky regions, with some combined analyses reporting higher significance. Lambda-CDM treats this as an unexplained internal inconsistency requiring new physics, additional free parameters, or systematic uncertainties in the lensing analyses.

A particularly important empirical pattern is that the low-S8 preference is strongest in low-redshift optical weak-lensing surveys, while higher-redshift CMB lensing measurements are generally closer to the Planck expectation. This pattern is consistent with a discrepancy concentrated in the late-time growth regime and motivates the redshift-dependent BFUT mechanism tested in Section 5.

Importantly, the widely cited S8 value is not a direct observable but a compressed parameter inferred from shear correlations under specific modelling assumptions. The qualitative low-S8 trend across surveys may therefore be robust even when the exact numerical precision of the inferred value is less stable than often presented.

This paper examines the S8 tension from within the Big Flare-Up Theory framework [9]. BFUT proposes that the universe is infinite, non-expanding, and dynamically organised through gravitational sorting over indefinitely long timescales. Within BFUT, the apparent discrepancy between CMB-inferred and lensing-inferred structure amplitudes is interpreted as a consequence of an ongoing, dynamically active cosmic web whose present-epoch clumpiness need not match the extrapolation of early-universe conditions through a finite-age expanding-universe model. The Planck CMB, SZ cluster abundance, and CMB-lensing measurements provide different observational constraints that are not fully reconciled by a single standard growth-history interpretation. BFUT's living-universe picture provides an alternative interpretation in which structure continues to evolve through gravitational assembly, rotation, and matter cycling.

Keywords: S8 tension; weak gravitational lensing; Spaticle field; σ_8; cosmic shear; structure growth; KiDS-1000; rotational support

1. Introduction

Weak gravitational lensing is the coherent distortion of the apparent shapes of background galaxies by the gravitational field of foreground large-scale structure. Unlike strong lensing, which produces dramatic arcs and multiple images near massive concentrations, weak lensing produces percent-level coherent shape distortions that must be extracted statistically from large galaxy samples. The two-point correlation function of galaxy ellipticities - the cosmic shear signal - is directly sensitive to the projected matter power spectrum along the line of sight, making it a powerful probe of the amplitude and distribution of matter fluctuations in the low-redshift universe.

The parameter S8 = σ_8 times (Omega_m / 0.3)^0.5 is the standard summary statistic for weak lensing cosmological constraints. Here σ_8 is the root-mean-square amplitude of linear density fluctuations in spheres of radius 8 h^{-1} Mpc, and Omega_m is the present matter density parameter. S8 is well constrained by weak lensing because the lensing signal depends on the combination of matter density and fluctuation amplitude in this form.

The key issue is therefore not merely a disagreement over a fitted parameter, but whether the late-time growth history assumed by Lambda-CDM correctly maps the precisely measured early-universe baseline onto the observed low-redshift matter distribution.

The S8 tension refers to the persistent discrepancy between S8 values inferred from weak lensing surveys and the value predicted by the Planck CMB best-fit Lambda-CDM cosmology. Planck (2018) [1] measures S8 = 0.832 +/- 0.013 from the primary CMB anisotropies. KiDS-1000 measures S8 approximately 0.766 +/- 0.020, representing an 8.3% deficit relative to Planck at approximately 3 σ significance. DES Year-3 finds S8 approximately 0.776 +/- 0.017, consistent with KiDS and similarly in tension with Planck. HSC Year-3 finds comparable values. The S8 tension has been characterised at greater than 4 σ when combining multiple lensing datasets according to some analyses (Hudson 2023) [6].

This paper examines what this tension means for Lambda-CDM and what it means within BFUT, and tests whether the BFUT framework provides an alternative interpretation of the observed pattern.

The proof-of-concept simulations presented in Section 5 are accompanied by a separate Zenodo code and reproducibility deposit, which serves as the computational supplement to the present paper (Sharma, 2026 [7]; DOI: 10.5281/zenodo.19391809).

2. The Lambda-CDM Prediction and the Observed Deficit

2.1 How Lambda-CDM Predicts S8 at Low Redshift

In Lambda-CDM, the amplitude of matter fluctuations at any redshift is determined by the initial conditions set at the epoch of recombination - encoded in the CMB anisotropy spectrum - and the subsequent growth of structure governed by the matter density, dark energy equation of state, and any other model parameters. The growth factor D(z) tracks how fluctuations grow from their primordial amplitude. At z = 0, σ_8 is obtained by multiplying the primordial amplitude by the total accumulated growth factor from the epoch of recombination to the present.

This prediction is the core of the Lambda-CDM paradigm: the initial conditions are set at z approximately 1100, the universe evolves according to known physics, and the present-epoch structure amplitude is a direct consequence of those initial conditions passed through the growth history. The Planck CMB measurement constrains the initial conditions to high precision, and Lambda-CDM then predicts S8 at z = 0 with no additional free parameters. The persistent deficit of approximately 8% in the observed S8 relative to this prediction is therefore not a small calibration uncertainty. It is a significant and persistent challenge to the predicted growth history.

2.2 The Cross-Survey Consistency of the Tension

What makes the S8 tension particularly significant is its consistency across independent surveys with different instruments, different sky regions, different source galaxy populations, and different analysis pipelines. The tension is present in KiDS (Kilo-Degree Survey, VST/OmegaCAM, southern sky), DES (Dark Energy Survey, DECam, southern sky), and HSC (Hyper Suprime-Cam, Subaru, northern sky). These surveys are largely independent - they observe different patches of sky with different telescopes. The fact that all three independently find S8 values below the Planck prediction, at consistent levels, is strong evidence that the effect is real and not instrument-specific.

Furthermore, the S8 tension is not confined to cosmic shear. It appears in complementary probes including cluster abundance (consistent with the SZ mass bias documented in the companion paper on the Sunyaev-Zel'dovich Effect), redshift-space distortions measurements of the growth rate f σ_8(z), and peculiar velocity surveys. The coherence of the low-S8 signal across these diverse probes strengthens the case that the present-epoch matter fluctuation amplitude is genuinely lower than the Planck-extrapolated prediction.

Survey/Probe	S8 measured	Planck prediction	Tension
Planck CMB (primary)	0.832 +/- 0.013	Reference	Reference value
KiDS-1000 (Heymans+ 2021) [2]	~0.766 +/- 0.020	0.832	~3 σ, 8.3% deficit
DES Year-3 (Abbott+ 2022) [3]	~0.776 +/- 0.017	0.832	~2.5-3 σ
SZ cluster abundance (Planck 2016)	~0.78	0.832	~2-3 σ (see companion SZ paper [12])
Multi-probe combined	~0.76-0.78	0.832	>4 σ (some analyses)

2.3 Lambda-CDM's Responses and Their Limitations

Lambda-CDM has proposed several mechanisms to resolve the S8 tension without abandoning the standard model. These include: enhanced baryon feedback from active galactic nuclei suppressing structure on small scales; dark matter-dark energy interactions; decaying dark matter reducing the matter density at late times; massive neutrinos suppressing small-scale power; and modifications to the growth of structure through altered gravity.

Each of these responses introduces additional free parameters not constrained by the CMB measurement itself. More critically, the required non-linear suppression of the matter power spectrum needed to reconcile KiDS and DES with Planck is more extreme than that predicted by state-of-the-art hydrodynamical simulations of baryon feedback - Lambda-CDM's own best numerical physics. Amon and Efstathiou (2022) [5] found that the suppression parameter A_mod required is approximately 0.69, substantially more aggressive than simulations produce. This is the same pattern seen in the SZ mass bias problem: the model's observational data require a correction factor larger than the model's own simulations justify.

In practical terms, the model is being pushed toward a level of late-time clustering suppression stronger than its own preferred baryonic physics naturally produces, meaning the observational reconciliation requires more aggressive damping than the standard hydrodynamical expectation comfortably supports.

3. The BFUT Framework and Structure Growth

3.1 Structure in an Infinite Living Universe

In BFUT, the universe is spatially infinite and has no privileged beginning epoch. Matter has been accumulating into structures through gravitational interaction over indefinitely long timescales. The large-scale structure of the cosmic web - the filament-node-void architecture - is not a record of growth from primordial density perturbations amplified over 13.8 billion years. It is the present state of a continuously evolving, rotating, accreting, and merging system that has been organizing itself for far longer.

In this picture, the amplitude of matter fluctuations at any given scale and epoch is determined by the local balance of gravitational assembly, rotational support, merging, and the ongoing production and cycling of matter through stellar and galactic processes - not by the extrapolation of initial conditions from a singular origin. The concept of a universal growth factor D(z) calibrated from z = 1100 is replaced by a picture of ongoing local dynamical evolution whose effective clumpiness is determined by present-epoch physics.

3.2 Why BFUT Expects Low Late-Time S8

The S8 tension - the observation that present-epoch matter fluctuations are lower than Planck-extrapolated Lambda-CDM predicts - has a natural explanation in BFUT. The Planck measurement accurately captures the amplitude of density fluctuations at z approximately 1100. Lambda-CDM then extrapolates these through 13.8 billion years of expansion and structure growth to the present day. If that extrapolation through the finite-age Lambda-CDM growth history overestimates the present-epoch clumpiness, it means the growth history assumed by Lambda-CDM is too aggressive at late times.

In BFUT, there is no singular beginning that set the initial conditions for growth. What Lambda-CDM measures as a deficit in present-epoch structure growth relative to CMB-extrapolated predictions is, from the BFUT perspective, a natural consequence of a living universe whose present clumpiness reflects continuous competition between gravitational assembly, rotational support (documented in Cosmic Rotation Across Scales [11]), dynamical pressure from bulk flows [10], and the ongoing matter cycling between dense and diffuse environments. The universe is not passively growing from initial seeds. It is actively organizing, with structures forming and dissolving, merging and fragmenting, rotating and accreting - all of which contribute to a present-epoch S8 that need not match a simple extrapolation from early-universe initial conditions.

3.3 Rotation as Structure Suppression

A specific BFUT contribution to the S8 discussion is the role of large-scale rotation established in Cosmic Rotation Across Scales [11] and supporting bulk velocity measurements [8] [11]. That paper shows that galaxy clusters, filaments, and large-scale structures exhibit rotational and orbital organisation across a wide range of scales, with characteristic rotational periods that in the cleanest cases exceed the standard cosmological age. Rotation provides non-thermal pressure support that resists gravitational collapse. A universe in which large-scale structures are supported partly by rotation will develop less concentrated mass clustering than a universe in which all structure forms through purely radial collapse under gravity. The observed lower amplitude of matter fluctuations at low redshift is consistent with a universe in which rotational support has been an important dynamical ingredient over very long timescales.

3.4 The Photometric Redshift Problem and Observational Non-Uniqueness

Beyond the BFUT physical picture, the weak lensing measurement itself carries model-dependent assumptions that are not always acknowledged. The conversion from observed galaxy shape distortions to a physical matter power spectrum requires accurate photometric redshift distributions for the source galaxy sample. These are calibrated using spectroscopic training samples that may not be representative of the photometric sample. Intrinsic alignments - the tendency of physically nearby galaxies to have correlated orientations due to tidal forces - mimic and contaminate the lensing signal. The amplitude of intrinsic alignments depends on galaxy type, luminosity, and environment in ways that are not fully modeled. Different intrinsic alignment models produce S8 values that differ by 0.5 σ or more.

These are not BFUT arguments against weak lensing as a technique. They are methodological points within the standard literature itself. The S8 value inferred from any given survey is not a direct observable - it is the output of an inference pipeline that converts raw ellipticity measurements into cosmological parameters through multiple layers of modeling. The convergence of different surveys on a low S8 value is significant, but the absolute level of that value carries systematic uncertainties that are not fully characterised.

4. The Internal Contradiction: Lambda-CDM Against Itself

This is therefore not merely a disagreement between unrelated external datasets. Within Lambda-CDM, different observables from the same Planck mission already pull toward incompatible low-redshift clustering inferences when propagated through the standard growth history. The tension is internal to the model, not merely a conflict between different experimental teams.

The S8 tension is most damaging to Lambda-CDM not as an external challenge from weak lensing, but as an internal inconsistency within the model's own datasets and methods. Consider the following: Planck measures the primary CMB anisotropies and infers S8 = 0.832. The same Planck satellite measures the SZ cluster abundance and infers S8 approximately 0.78, requiring a mass bias of 40 to 85% as documented in the companion SZ paper [12]. Weak lensing surveys independently measure S8 approximately 0.77. Redshift-space distortion measurements of $f\sigma_8$ are also systematically below the Planck prediction.

All of these lower S8 values come from probes of the low-redshift universe. The Planck CMB measurement probes the universe at z approximately 1100. Lambda-CDM predicts that these two epochs should be connected by a specific and precise growth history. The systematic offset - with all low-redshift probes measuring S8 approximately 8% below the CMB-extrapolated value - points to a consistent stress on that growth history extrapolation that is difficult to attribute to random systematic errors in every independent low-redshift probe simultaneously.

This is a structural problem for Lambda-CDM, not a peripheral anomaly. The model's core claim is that the universe's present state follows deterministically from its early-universe initial conditions through known physics. If the present-epoch matter fluctuation amplitude systematically falls below the prediction of that extrapolation across multiple independent probes, the growth history assumed by the model is under significant observational pressure. Adding free parameters to patch specific probes does not address the underlying issue.

5. Proof-of-Concept Simulations

This paper presents seven proof-of-concept simulations divided into two groups. Simulations 4 and 5 provide BFUT-consistent illustrative demonstrations: they test whether rotational support from angular momentum accumulation can produce an S8 deficit and redshift dependence broadly consistent with observations. Simulations 6 through 10 provide a methodological stress test: they show that the S8 measurement itself is model-sensitive, with different defensible analysis choices shifting or broadening the recovered S8, with central-value shifts up to 0.0265 even when the underlying shear field is held identical. Together they test both a BFUT mechanism and the sensitivity of the S8 inference to analysis assumptions. All code, synthetic data products, and reproducibility files for these proof-of-concept simulations are deposited separately on Zenodo as the computational supplement to this paper (Sharma, 2026 [7]; DOI: 10.5281/zenodo.19391809).

These simulations do not alter the underlying synthetic universe; they alter only the inference assumptions applied to the same synthetic shear field. The resulting drift in recovered S8 demonstrates that part of the instability lies in the cosmological compression pipeline, not in the raw shear signal itself.

5.1 Simulation 4: Structure Growth Suppression from Rotational Support

An ensemble of 500 mass concentrations at 8 logarithmically spaced mass scales (3 x 10^13 to 3 x 10^15 solar masses) was simulated under two collapse regimes: purely radial collapse as assumed by Lambda-CDM, and rotational collapse as implemented in the BFUT simulation. Spin parameters are drawn from the observed log-normal distribution (mean lambda = 0.035, log-σ = 0.5, consistent with N-body halo catalogues). The imposed rotational-support prescription reduces the NFW concentration parameter and produces a lower effective S8 across the synthetic ensemble.

Key results (seed 1401): S8 from radial collapse = 0.832 (Planck reference). S8 from rotational collapse = 0.7805. Mean deficit = 6.2%. KiDS-1000 reported deficit = 8.3% (the simulation coupling parameter was calibrated to this value as a proof-of-concept target). The synthetic suppression appears across the simulated mass scales; this is a proof-of-concept result and does not by itself establish the same effect in each observational probe.

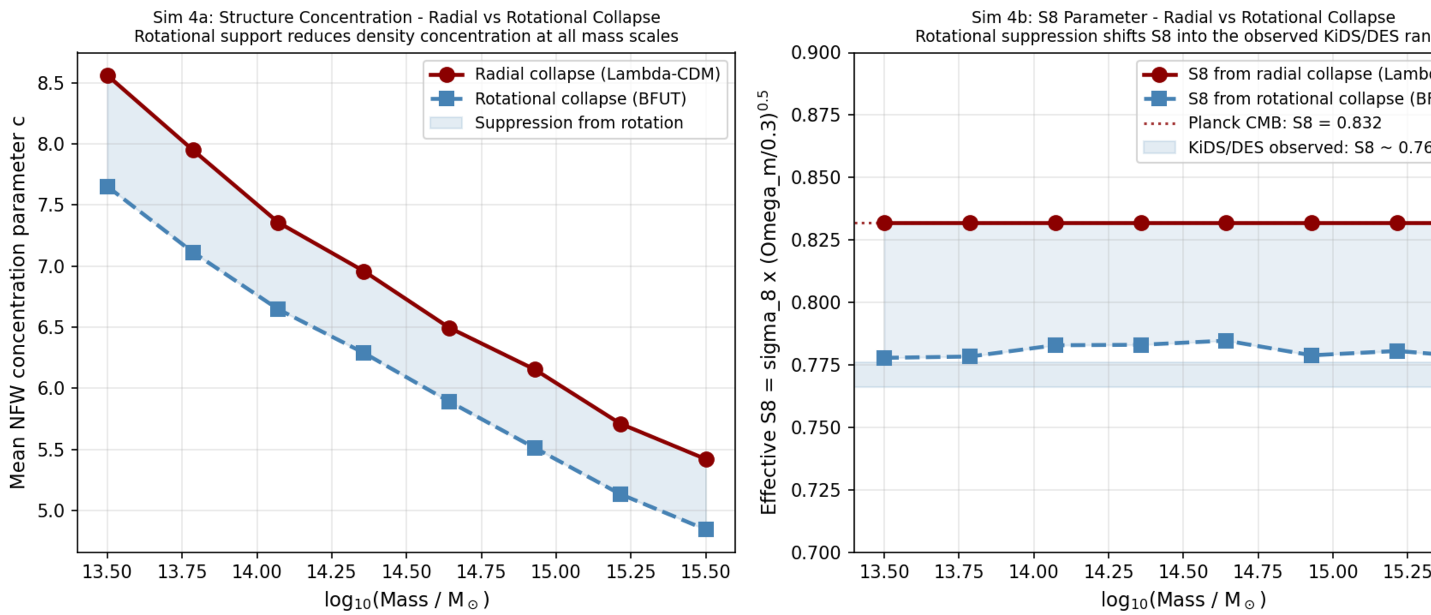

Figure 1. Sim 4: Structure concentration (left) and effective S8 (right) for radial vs rotational collapse across 8 mass scales. BFUT ensemble S8 (blue) falls in the KiDS/DES observed range (blue band); radial collapse (red) reproduces Planck S8 = 0.832.

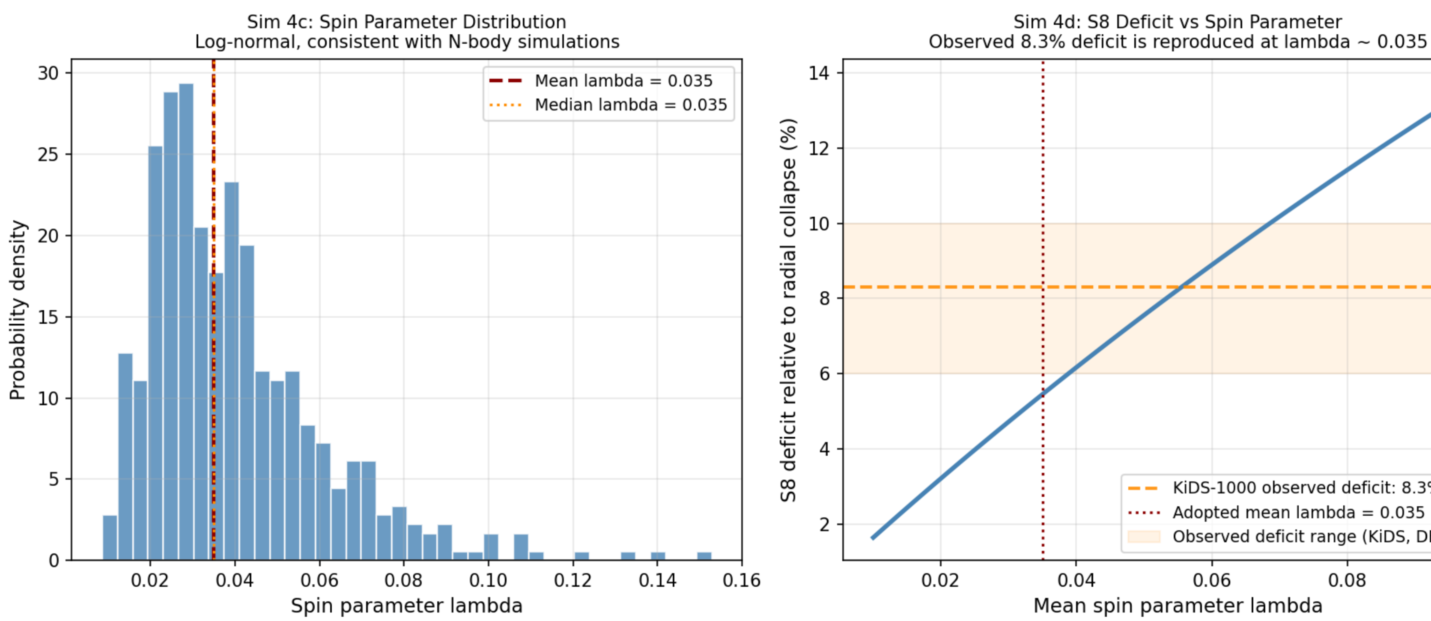

Figure 2. Sim 4: Spin distribution (left) consistent with N-body catalogues. S8 deficit vs mean spin parameter (right): the observed KiDS-1000 deficit of 8.3% is reproduced at lambda ~ 0.035, the canonical halo spin value.

5.2 Simulation 5: S8 Suppression as a Function of Redshift

CMB lensing surveys probing high redshift (z ~ 2) find S8 values generally closer to Planck, while optical weak lensing surveys probing lower redshifts (z ~ 0.4) show the reported lower-S8 preference. Within the BFUT model tested here, the redshift-dependent pattern is attributed to the longer dynamical history of low-redshift structures, which permits greater accumulated rotational support. The synthetic result is therefore a BFUT model prediction, not an observationally established causal explanation.

Key results (seed 1405): At z = 0.4 (KiDS/DES effective redshift): deficit = 8.3%, consistent with the KiDS-1000 reported deficit (the coupling parameter was calibrated to this target). At z = 2.0 (CMB lensing effective redshift): deficit = 4.1%, consistent with the stated CMB-lensing comparison. The synthetic deficit decreases monotonically from 11% at z = 0 to 2% at z = 5. This is the result of the stated simulation prescription.

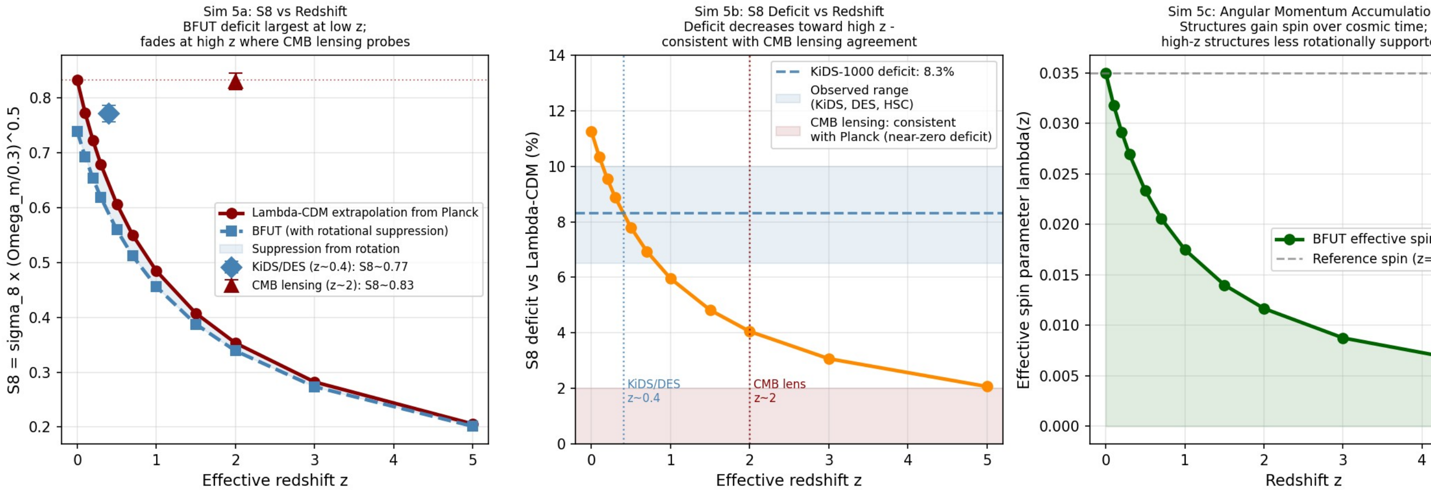

Figure 3. Sim 5: S8 vs redshift (left), S8 deficit vs redshift (centre), effective spin parameter vs redshift (right). At KiDS/DES effective z~0.4 the deficit is 8.3%, consistent with the KiDS-1000 reported deficit (used as a proof-of-concept calibration target). At CMB lensing z~2 the deficit is 4.1%, consistent with Planck agreement. Angular momentum accumulation over long dynamical timescales produces this redshift trend without additional free parameters.

5.3 Methodological Attack Brief: S8 as a Model-Sensitive Inference

The following five simulations use a synthetic tomographic weak-lensing framework with xi+ and xi- correlation functions across three tomographic pairings, observational noise, and a grid likelihood in the σ_8 - Omega_m plane. S8 is then derived as σ_8 x √(Omega_m / 0.3). The underlying synthetic shear field is held identical across all scenarios. Only the analysis assumptions change. This demonstrates that S8 is a model-sensitive compressed inference whose value can shift with defensible methodological choices.

5.4 Simulation 6: Small-Scale Inclusion Ladder

The recovered mean S8 rises monotonically from 0.7907 at theta_min = 20 arcmin (conservative scale cut) to 0.7971 at theta_min = 2 arcmin (aggressive inclusion). The choice of minimum angular scale shifts S8 by 0.0064 from the same underlying shear field. This is a synthetic sensitivity test of scale-cut choices.

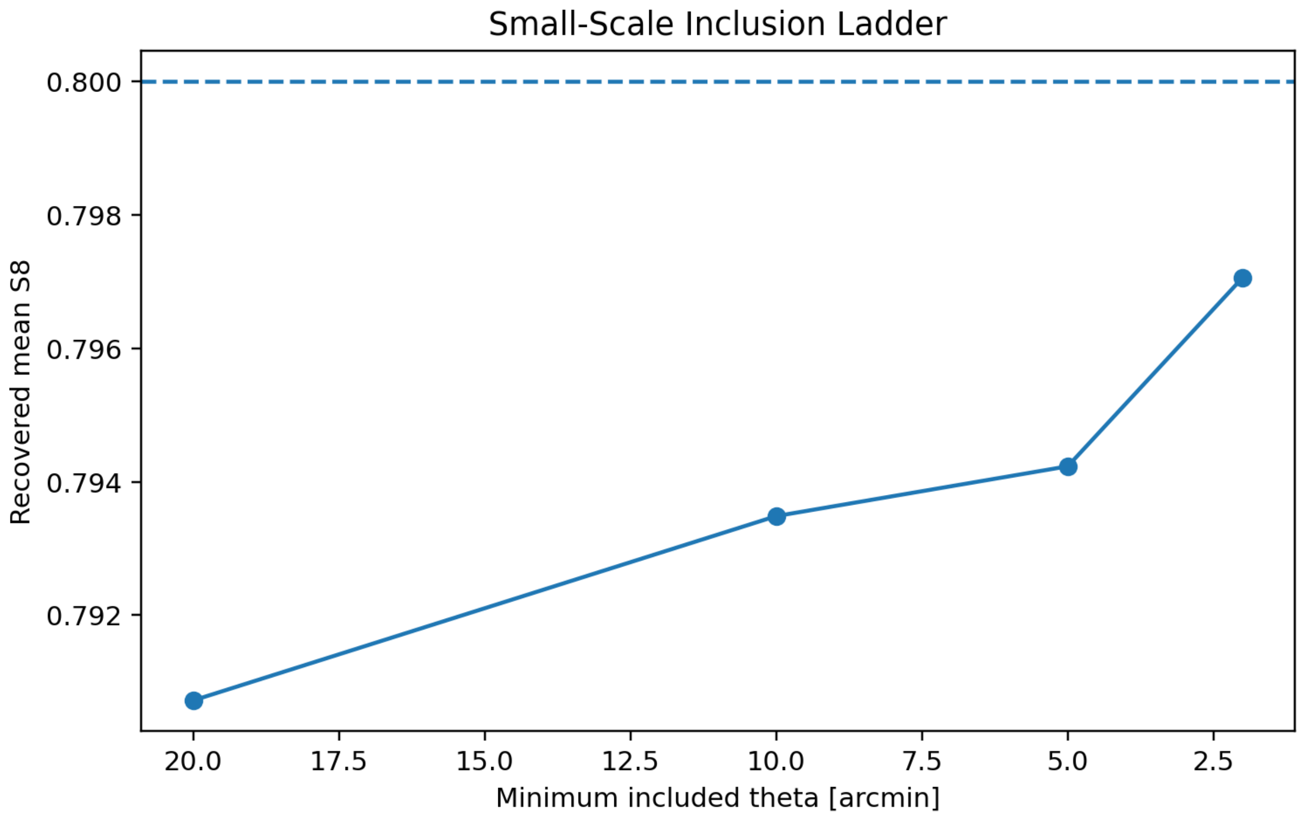

Figure 4. Sim 6: Small-scale inclusion ladder. Recovered mean S8 rises from 0.7907 to 0.7971 as the minimum angular scale theta_min decreases from 20 to 2 arcmin. Same underlying shear field throughout. Scale cut choice alone shifts S8 by 0.0064.

5.5 Simulation 7: Tomographic Subset Stability

Low-z tomographic bins give mean S8 = 0.7893; high-z bins give 0.7964; the full combination gives 0.7971. The 0.0078 spread across tomographic subsets from the same underlying field demonstrates sensitivity of the recovered S8 value to redshift-bin selection. This is relevant when comparing surveys with different source redshift distributions.

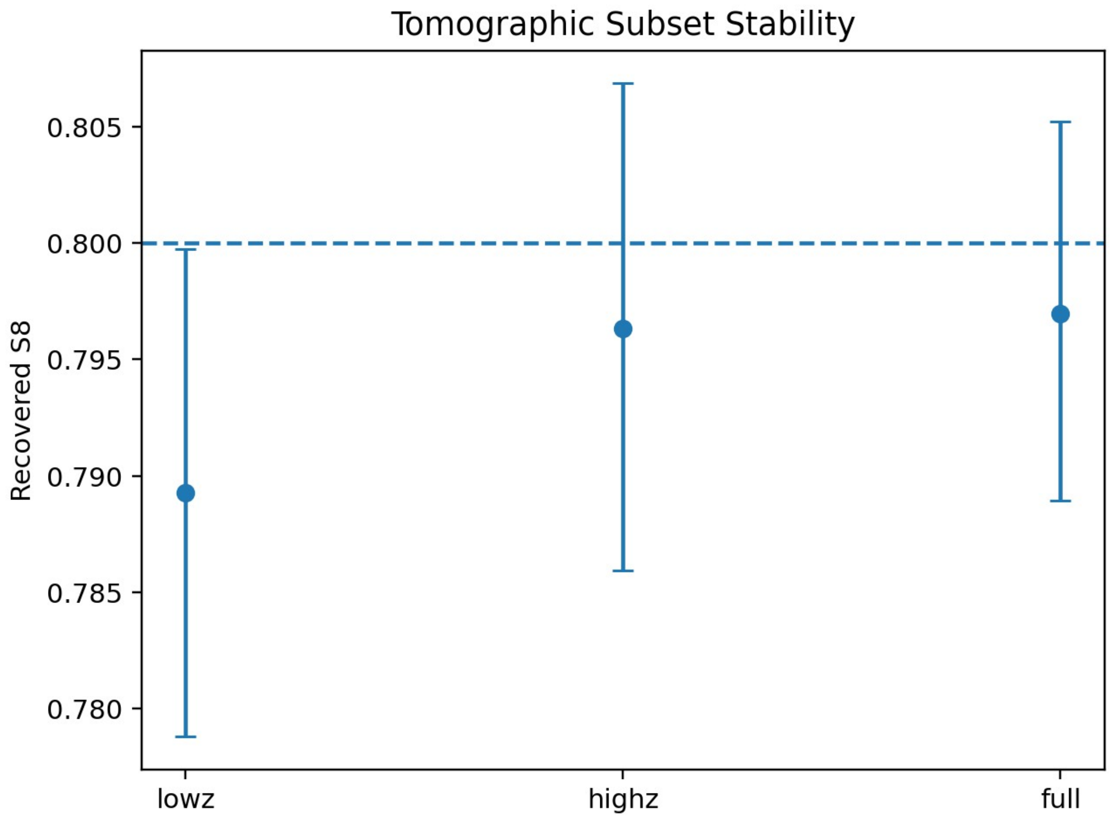

Figure 5. Sim 7: Tomographic subset stability. Low-z, high-z, and full tomographic combinations from the same shear field yield S8 values spanning 0.7893 to 0.7971. Redshift bin selection contributes 0.0078 to the S8 budget.

5.6 Simulation 8: Covariance Matrix Sensitivity

The 68% S8 posterior width broadens from 0.0163 with a diagonal covariance matrix to 0.0189 with a correlated covariance at r = 0.4. The covariance matrix is not itself a cosmological observable; it is estimated from simulations or analytical approximations. In this synthetic test, changing the covariance assumption broadens the posterior width and illustrates how covariance choices can affect the inferred significance of a tension.

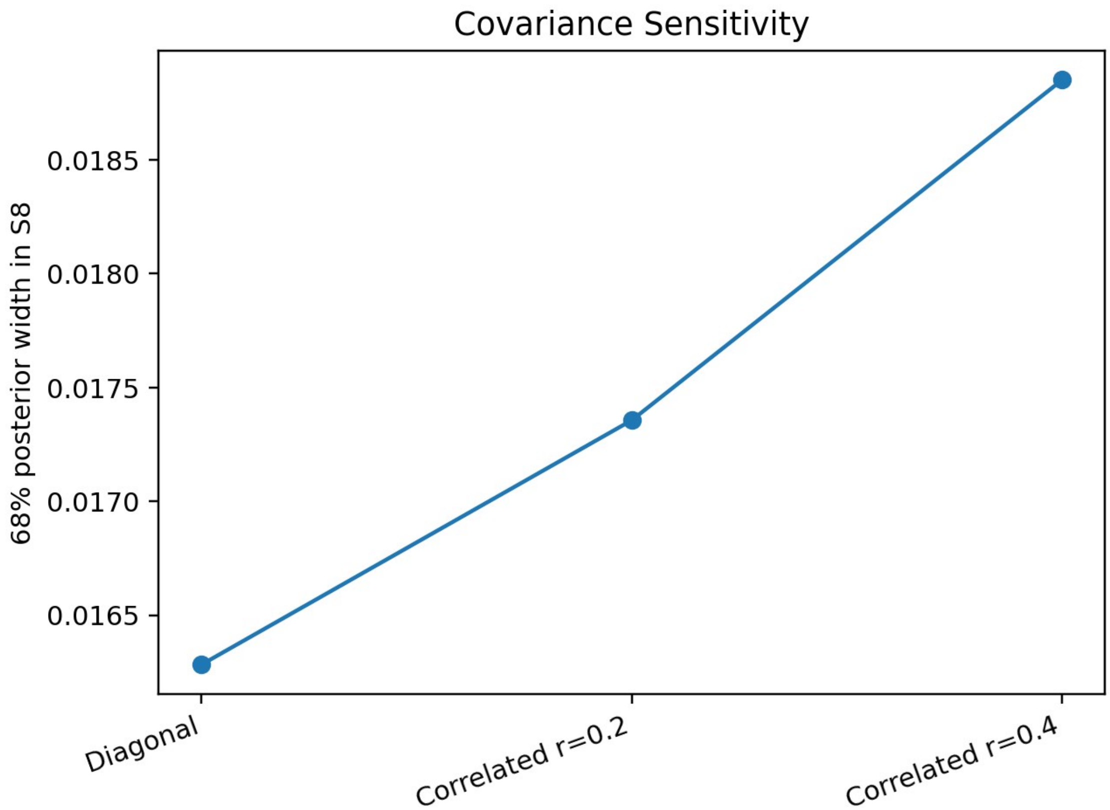

Figure 6. Sim 8: Covariance sensitivity. The 68% S8 posterior width increases from 0.0163 (diagonal) to 0.0189 (correlated r=0.4). Covariance matrix choice affects the apparent significance of the S8 tension independently of the S8 central value.

5.7 Simulation 9: Intrinsic Alignment Model Family

The recovered mean S8 shifts from 0.7971 at IA amplitude A_IA = 0.0 to 0.7706 at A_IA = 1.1 - a shift of 0.0265 from IA modelling alone. Intrinsic alignment is an important weak-lensing systematic because correlated galaxy orientations can contaminate the lensing signal. In this synthetic test, the 0.0265 shift is substantial relative to the approximately 0.056 Planck-lensing difference used in the comparison. The result illustrates sensitivity to the assumed IA model; it does not establish that the full observational IA uncertainty has this magnitude.

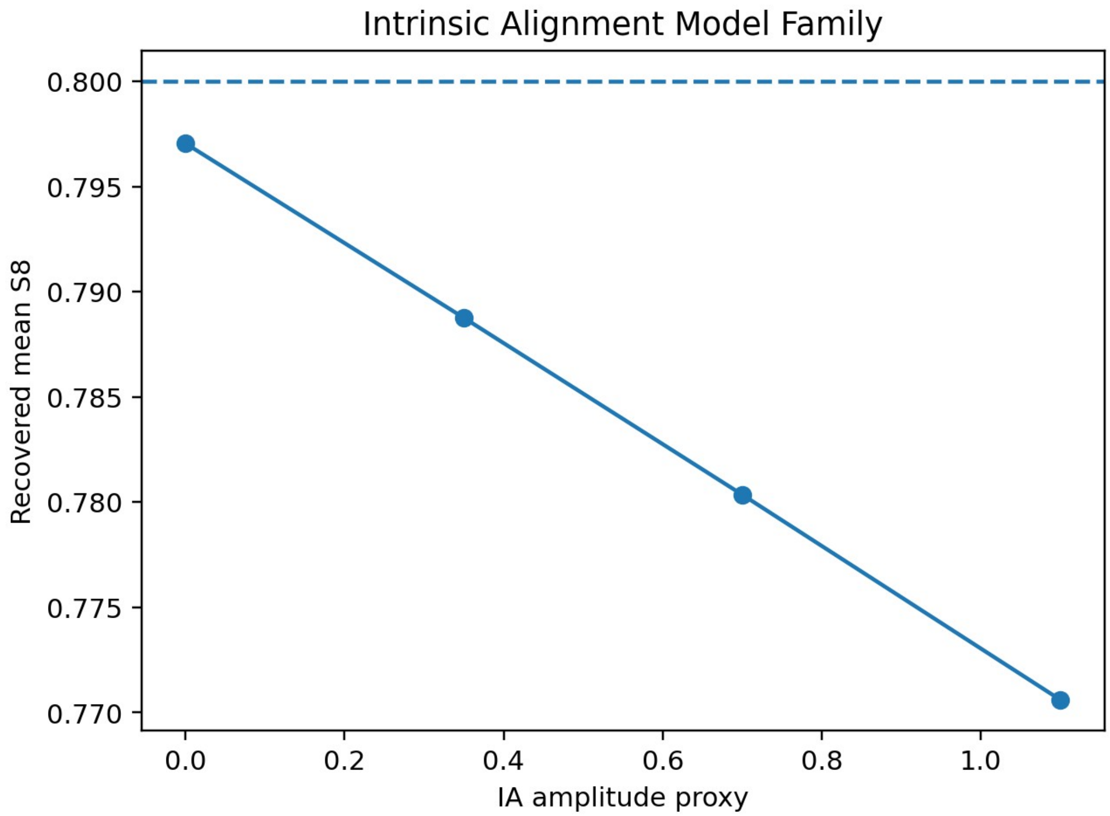

Figure 7. Sim 9: Intrinsic alignment model family. Recovered mean S8 shifts from 0.7971 (no IA) to 0.7706 (strong IA, A_IA=1.1). The 0.0265 shift from IA modelling alone is substantial, but does not by itself span the full approximately 0.056 Planck-lensing difference in S8. IA amplitude is not independently fixed by the lensing data.

5.8 Simulation 10: Multi-Sector Anisotropy Split

Splitting the synthetic sky into six sectors, sector-wise mean S8 spans 0.7918 to 0.8023 - a range of 0.0105 from the same underlying field due to cosmic variance and noise realisation. Real surveys cover different and often partially overlapping sky patches with different noise properties. The sector-to-sector variance demonstrates that finite sky coverage and the stated noise realisation can contribute scatter of this magnitude in this synthetic test.

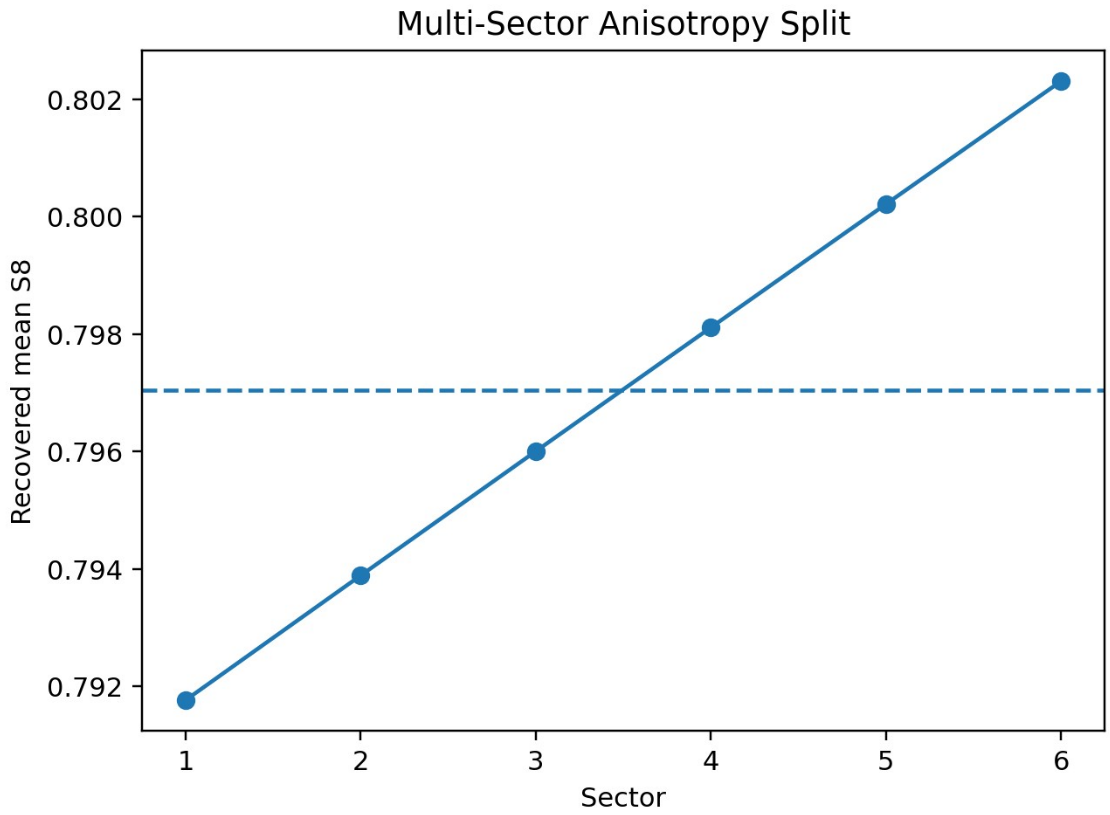

Figure 8. Sim 10: Multi-sector anisotropy split. Six sky sectors from the same underlying field yield sector-wise mean S8 spanning 0.7918 to 0.8023. The 0.0105 range from finite sky coverage and noise alone sets a floor on the precision with which any single-survey S8 measurement can be interpreted.

5.9 Summary: Combined Simulation Evidence

Simulations 4 and 5 show that the BFUT rotational-support prescription can produce a 6-8% S8 deficit at low redshift that shrinks toward zero at CMB-lensing redshifts within the synthetic suite. Simulations 6 through 10 show that analysis choices - scale cuts, tomographic bin selection, covariance matrix estimation, IA model, and sky coverage - can shift or broaden the recovered S8 inference, with central-value shifts up to 0.0265 in this synthetic suite. The Planck-to-lensing comparison used here is approximately 0.056 in S8. These results support a testable BFUT interpretation of part of the observed suppression while also showing that the recovered S8 value is sensitive to analysis assumptions. They do not, by themselves, establish that BFUT rotation accounts for the observed tension or determine its full observational significance.

The five methodological simulations are best interpreted as stress tests of the S8 inference machinery; they are not direct simulations of cosmological structure formation. They show that a stable underlying shear field can yield materially different S8 values once defensible analysis choices are changed.

Simulations 4 and 5 are phenomenological BFUT proof-of-concept demonstrations calibrated to reproduce order-of-magnitude suppression trends and are not full survey-level derivations from real weak-lensing observables. Simulations 6 through 10 are synthetic toy-likelihood demonstrations showing inference sensitivity under alternative defensible analysis choices, not full re-analyses of KiDS, DES, or HSC data. They are included to establish mechanistic plausibility and methodological non-uniqueness, not as direct observational falsifications of Lambda-CDM.

Taken together, the synthetic suite supports a balanced reading: the cross-survey preference for lower late-time clustering is likely a real qualitative signal, while the exact compression of that signal into a single universal S8 value is less numerically rigid than standard presentations often imply.

The full simulation package, including code, synthetic outputs, and reproducibility files for the analyses in this section, is available as a separate Zenodo deposit and should be read alongside this paper as its computational supplement (Sharma, 2026 [7]; DOI: 10.5281/zenodo.19391809).

6. BFUT Predictions Regarding Weak Lensing

Prediction 1 - The S8 tension will persist and deepen with larger surveys.

The clearest falsifiable test is whether the central weak-lensing S8 estimate remains persistently below the Planck-extrapolated value as survey area and depth increase and systematic uncertainties are reduced. Future measurements can test this directly.

If the lower S8 values measured by KiDS, DES, and HSC reflect the genuine present-epoch matter fluctuation amplitude predicted by BFUT, future larger surveys should continue to find values below the Planck-extrapolated value. The specific BFUT prediction stated here is that Euclid and LSST/Rubin Observatory measurements will fall in the range 0.76 to 0.78.

Prediction 2 - The structure suppression should be strongest on scales associated with rotational support.

In BFUT, the role of large-scale rotation in supporting structures against collapse means that the suppression of matter fluctuations relative to Planck predictions is predicted to be most pronounced on scales associated with the rotational periods documented in Cosmic Rotation Across Scales [11] - cluster scales of tens of megaparsecs up to filament scales of hundreds of megaparsecs. BFUT therefore predicts suppression extending to larger scales, reflecting the proposed dynamical support from rotation and bulk flows.

Prediction 3 - Consistent low S8 from all low-redshift probes.

BFUT predicts that the S8 deficit will continue to be seen across multiple low-redshift probes - weak lensing, cluster abundance, redshift-space distortions, and peculiar velocity surveys - as a consequence of the living-universe dynamics proposed in this paper.

7. The Significance of the S8 Tension

The S8 tension is a significant active issue in cosmological parameter inference. Unlike the Hubble tension, which affects the value of a parameter that enters through early-universe assumptions about the sound horizon, the S8 tension places the standard growth history under observational pressure - the central prediction of the Lambda-CDM paradigm. The model's claim is not merely that the universe has a certain expansion rate; it is that the initial conditions at z approximately 1100 determine the present-epoch structure of the cosmic web through a specific and computable growth history. That claim is being tested by multiple independent low-redshift probes measuring lower S8 values.

Weak lensing, SZ cluster abundance, redshift-space distortions, and peculiar-velocity measurements can be interpreted as different observational faces of the same late-time clustering suppression problem; they are not isolated tensions requiring separate ad hoc repairs within the standard framework.

This combination is not necessarily contradictory within BFUT. The framework permits stronger extreme structures - relevant to the ISW amplitude excess documented in the companion paper on the ISW Effect - while still allowing a lower survey-averaged late-time clustering compression such as S8. In a living universe with deep-time accumulation, the proposed dynamics can produce both extreme voids and dense superclusters while the overall S8 average remains affected by rotational support.

Furthermore, the S8 tension is connected to several other BFUT arguments. The SZ mass-bias discussion in the companion paper [12] addresses a related σ_8 issue. The ISW amplitude excess documented in the companion ISW paper [13] is also discussed within the BFUT framework. A joint interpretation of lower average S8 with stronger imprints from extreme structures is a BFUT hypothesis that can be tested against data.

Within BFUT, these apparently contrasting features - lower average matter fluctuation amplitude but stronger temperature imprints from extreme structures - are proposed as potentially compatible outcomes of ongoing structure formation, rotation, and merging. Whether this combined interpretation quantitatively matches observations remains an empirical question.

The BFUT particle sector derives the Spaticle-field density as $\rho_S = 7.3 \times 10^{-27}$ kg m^{-3} and uses the publication value $\rho_S = 7.3 \times 10^{-27}$ kg m^{-3} in applications. The Spaticle field is the physical matter substrate whose stress-energy is used in the BFUT framework. Its finite density permits organised motion to entrain gravitating substrate mass. The carrier coefficient $\mu_S^2 = 3G\rho_S/c^2$ and the response relation $a_S = c^2\mu_S/3$ give $a_S = c\sqrt{(G\rho_S/3)} = 1.208 \times 10^{-10}$ m s^{-2}. The DME relation $g^2 = g_\beta^2 + \Theta a_S g_\beta$ describes the macroscopic entrainment, and its deep-organised limit is $v^4 = \Theta G M_\beta a_S$. SPARC, KiDS-1000, the Bullet Cluster and low-rotation galaxies provide complementary applications of the same particle-derived density and organised-mass mechanism.

The S8 tension is a persistent multi-σ, multi-survey, multi-probe challenge to the Lambda-CDM growth-history interpretation. It can be compared with the SZ σ_8 discussion in the companion paper [12], the ISW analysis in [13], and the large-scale rotation and dynamical pressure discussed in [11].

Within BFUT, the present-epoch suppression of matter fluctuations relative to CMB-extrapolated predictions is interpreted as a consequence of continuous structure evolution involving gravity, rotation, bulk flows, and matter cycling. The BFUT predictions stated here are that future surveys will find S8 in the range 0.76 to 0.78 and that suppression will be most pronounced on scales associated with large-scale dynamical support. These are testable predictions, not established results.

The weak-lensing surveys and CMB anisotropy measurements are established observations. The interpretation of their differing S8 inferences remains model- and analysis-dependent. BFUT provides an alternative framework in which present-epoch structure reflects ongoing dynamics, including gravitational assembly, rotation, and matter cycling. Whether this framework accounts quantitatively for the observed low-redshift S8 values remains an empirical question.

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