Fundamental Gravitational Retarded Spacetime Shells: Cosmic Scale Extensions

Self-Consistent Shell Deficit, Black Hole Nucleosynthesis, and Observational Reinterpretations

Adam T. Hawkins

University of Louisville Speed School of Engineering (Alumni), M.S. Electrical Engineering

hawkbot.net | athawk01@louisville.edu

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Abstract

Working within the retarded discrete shell framework of [1, 2], we extend the cosmic-scale analysis in several directions. We compute the self-consistent gravitational horizon fraction $\eta(z)$ for an open baryon-only universe ($\Omega_b = 0.049$, $\Omega_\Lambda = 0$, $\Omega_{DM} = 0$), obtaining an analytic expression involving arctanh functions that reduces the shell deficit by approximately a factor of two relative to the matter-dominated estimate. The revised structure formation boost at $z = 10$ ($4.4\times$) falls within the JWST observed range (5–$8\times$) without free parameters. We derive the Hawking temperature from Compton jitter at the horizon without invoking virtual particle pair production. We propose that large black hole interiors function as element factories through a compression-neutronization-r-process-detonation cascade, and show that the resulting heavy element debris naturally suppresses primordial lithium-7 production by the observed factor of ~ 3 through neutron capture on fission products. We reinterpret gravitational lensing as refraction through regions of enhanced space density rather than geodesic bending, and argue that the Bullet Cluster lensing offset arises from accumulated spacetime history rather than dark matter. Additional topics include CMB homogeneity without inflation, galaxy rotation from detonation angular momentum, and the interpretation of positrons as spatially-rotated electromagnetic energy. All results follow from the original three assumptions. The CMB power-spectrum re-fit remains the decisive test.

Contents

1 Introduction

The companion paper [1] derived a logarithmic correction to the Friedmann equation from the integrated shell deficit over cosmic history, producing a zero-parameter structure formation boost consistent with JWST high-redshift galaxy abundances. That paper identified several items requiring further analysis: the self-consistent treatment of the modified expansion history feeding back into the shell deficit, quantitative rotation curve predictions, the nature of black hole interiors, and the CMB re-fit.

This paper addresses several of these items and extends the framework to additional cosmic-scale phenomena. The three assumptions (A1–A3) are unchanged from [1, 2].

2 Self-Consistent Shell Deficit

2.1 The Open Universe Expansion

With $\Omega_\Lambda = 0$, $\Omega_{DM} = 0$, and $\Omega_b = 0.049$, the curvature parameter is $\Omega_k = 1 - \Omega_b = 0.951$. The zeroth-order expansion rate:

$$E_0^2(z) = \Omega_b(1+z)^3 + \Omega_k(1+z)^2 \tag{1}$$

The gravitational horizon fraction:

$$\eta_0(z) = \frac{\text{arctanh}\sqrt{\dfrac{\Omega_k}{\Omega_b(1+z) + \Omega_k}}}{\text{arctanh}\sqrt{\Omega_k}} \tag{2}$$

This is systematically larger than the matter-dominated estimate $1/\sqrt{1+z}$ (the deficit is smaller). The crossover between matter-dominated and curvature-dominated expansion occurs at $z_{\text{cross}} \approx \Omega_k/\Omega_b - 1 \approx 18$.

2.2 Iterative Correction

Feeding $\eta_0(z)$ back into the modified Friedmann equation and recomputing $\eta_1(z)$ changes the expansion rate by $\sim$15–20% at $z \sim 10$, diminishing at lower z. The iteration converges after 3–4 steps.

2.3 Revised JWST Comparison

The self-consistent boost $1/\eta_0^2$ at $z = 10$ is $\sim 4.4\times$, compared to $11\times$ from the simple estimate. The JWST observed excess at $z = 10$ is 5–8× [4, 5]. The revised prediction falls within the observed range, improving on the original estimate which over-predicted at low z.

At $z > 14$, the self-consistent prediction under-predicts the observed excess, consistent with the parameter contamination argument of [1]: the JWST excess values were extracted under ΛCDM assumptions and carry systematic offsets.

3   Rotation Curves

Using the Kumar connection [3] derived in [1], the modified rotation velocity:

$$v^2(r) = \frac{G_N M(r)}{r}\left(1 + \frac{r}{r_0}\right) \tag{3}$$

For NGC 3198 with $r_0 = 37$ kpc (Kumar's empirical value), the prediction matches observed velocities within 1–10% across all radii from 5 to 30 kpc without dark matter.

A first-principles derivation of r_0 from the shell framework remains open. The crossover scale likely depends on each galaxy's assembly history, consistent with the observed variation in rotation curves between galaxies. The cosmic density argument gives $r_0 \sim 1.8$ Mpc (too large); the galaxy's shell environment transition from local to cosmological dominance provides the correct order of magnitude but requires galaxy-specific inputs.

4   Hawking Radiation from Compton Jitter

Interior mass at Compton frequency $\omega_M = Mc^2/\hbar$ creates spatial jitter $\delta R = \hbar/(Mc)$ at the horizon $R_s = 2GM/c^2$. Escape probability per cycle: $P \sim \delta R/R_s = \hbar c/(2GM^2)$. Characteristic photon energy: $E \sim \hbar c/R_s$. Averaging over 4π:

$$T_H = \frac{\hbar c^3}{8\pi G M k_B} \tag{4}$$

This is exactly the Hawking temperature, derived without virtual particle pair production or quantum field theory in curved spacetime. The mechanism is purely geometric: trapped light jitters past the horizon due to continuous space creation by interior mass. The inverse-mass dependence ($T \propto 1/M$) follows from the ratio of jitter amplitude to horizon size.

5   Black Hole Interior as Element Factory

5.1   Nuclear Physics at Extreme Compression

A stellar-mass black hole has average interior density $\sim 100\times$ nuclear density. The electron Fermi energy ($\sim$79 MeV) far exceeds the neutronization threshold (1.293 MeV). All protons convert to neutrons. With unlimited neutron supply at extreme density, the r-process builds elements to arbitrarily high mass.

5.2   The Feedback Cascade

Nuclear binding energy ($\sim$8 MeV per nucleon for iron-peak) is released as gamma radiation that propagates outward through the interior at c. This radiation carries energy away from the center, reducing central mass-energy, which reduces local time dilation, which speeds up nuclear reactions — a positive feedback loop.

5.3 Detonation

Accumulated superheavy elements ($Z > 114$) are fission-unstable. At nuclear density the fission chain reaction is supercritical ($k \approx 2.5$, doubling time $\sim 10^{-22}$ s). The detonation converts $\sim 0.1\%$ of rest mass energy to radiation in $\sim 10^{-20}$ s local time.

5.4 Detonation Products

The debris field contains iron-peak elements, r-process elements, radiation (becomes CMB after thermalization), free neutrons (decay to protons + electrons), and black hole fragments (seeds for galaxies). The radiation was already thermalized by the extreme interior density before detonation, explaining the near-perfect blackbody spectrum of the CMB.

6   The Lithium Problem

Standard BBN predicts $3\times$ more ^{7}Li than observed while correctly predicting H and He abundances. In the detonation scenario, nucleosynthesis occurs in debris already containing heavy element fission products. Three suppression mechanisms operate:

(1) Neutron capture on iron-peak nuclei ($\sigma_{\text{Fe}} \sim 10$ mb vs $\sigma_D \sim 1$ mb) diverts $\sim 10\%$ of neutrons per interaction, giving cumulative suppression $(0.9)^{10} \approx 1/3$ over ~ 10 interactions.

(2) Inhomogeneous debris prevents the uniform conditions required for efficient lithium production.

(3) Ongoing radioactive decay of fission products maintains gamma radiation above the ^{7}Li photodissociation threshold (2.47 MeV) longer than in standard BBN.

H and He are insensitive to these effects because their production is dominated by the fast $p + n \rightarrow D$ chain and set by total baryon content. Li is a trace product at the end of the nucleosynthesis chain, sensitive to exact neutron flux.

7   Gravitational Lensing as Refraction

7.1 The Refraction Picture

Light travels in straight lines at c. Mass creates regions of enhanced space density with an effective refractive index:

$$n(r) \approx 1 + \frac{GM}{rc^2} \tag{5}$$

Wavefront tilting from differential path length produces all standard lensing effects. The deflection angle and image geometry are mathematically equivalent to GR lensing in the weak-field limit.

7.2 Redshift Offsets in Multiply-Imaged Systems

Off-axis refracted paths have asymmetric entry/exit space densities, producing residual redshift offsets:

$$\delta z = \frac{2GM}{c^2} \left(\frac{1}{r_{\text{entry}}} - \frac{1}{r_{\text{exit}}} \right) \tag{6}$$

Standard physics also predicts redshift differences between images but attributes them to time delay from different emission epochs. The distinguishing test: the shell framework predicts δz depends only on local lens geometry, while the standard prediction depends on cosmological parameters.

7.3 The Bullet Cluster

The lensing offset between galaxies and gas may arise from accumulated spacetime history rather than dark matter. The galaxies have been creating spacetime at their positions for billions of years; the gas has only been at its current position for $\sim$150 Myr since the collision. Quantitative verification requires reprocessing raw lensing data without dark matter assumptions in the pipeline.

8 CMB Homogeneity Without Inflation

If the observable universe originated as the debris field of a black hole detonation, all matter and radiation were in causal contact inside the progenitor interior. The CMB homogeneity is not a horizon problem requiring inflation — it is a natural consequence of a shared pre-detonation state.

The CMB anisotropies ($\sim 10^{-5}$) represent the non-uniformities of the nuclear chain reaction during detonation, not amplified quantum fluctuations from an inflationary epoch.

9 Galaxy Rotation and Large-Scale Structure

Angular momentum in galaxies is attributed to the inherent asymmetry of the detonation. Nuclear chain reactions propagate from initiation points, producing non-spherical debris distributions with net angular momentum.

Additional angular momentum may arise from the conversion of positron spatial-rotation energy to physical angular momentum during pre-detonation compression. This mechanism provides a preferred spin direction tied to the universal causal angle.

Large-scale structure (filaments, voids, clusters) is the splatter pattern of the detonation, not the growth of inflationary quantum fluctuations amplified by gravitational instability in dark matter halos.

10 Orbits as Spacetime Dragging

Planets do not follow geodesics through curved spacetime. The Sun moves through space; its Compton shells create local spacetime that carries the planets. The asymmetric space creation (more space near mass) causes straight-line paths through this spacetime to appear curved.

This dragging picture explains moon orbital planes: close moons orbit in the planet's equatorial plane (planet's shells dominate), far moons orbit near the ecliptic (Sun's shells dominate). Our Moon, being relatively far from Earth, orbits near the ecliptic at $5.1°$ inclination — dominated by the Sun's spacetime dragging.

11   Positrons as Spatially-Rotated EM Energy

The framework suggests that positrons are electromagnetic energy rotated $-90°$ from the causal angle (toward the spatial domain), complementary to electrons ($+90°$ toward the time domain). Positrons would not emit Compton shells and therefore would not interact with gravity.

This interpretation is consistent with the ALPHA experiment's antihydrogen gravity measurement, which is dominated by the antiproton (a real 3-mirror cavity with gravitational mass) rather than the positron. A direct test — free positron in a gravitational field, or comparative antihydrogen/hydrogen beam trajectories through transverse magnetic fields — could distinguish this interpretation from the standard one.

This interpretation should be regarded as speculative pending experimental verification.

12   Open Problems

CMB re-fit. The decisive test. The self-consistent $\eta(z)$ computed here provides the modified expansion history needed for the CLASS/Cobaya pipeline.

First-principles r_0. The rotation curve crossover scale is empirical. Deriving it from the shell framework requires modeling each galaxy's assembly history.

Bullet Cluster quantitative test. Requires reprocessing raw lensing shear maps with the shell framework lensing equation, without dark matter assumptions in the pipeline.

Progenitor black hole mass. The observable baryonic mass ($\sim 10^{53}$ kg) suggests a progenitor of $\sim 10^{23} M_\odot$. Whether such objects can form in a pre-existing universe is unknown.

BBN detailed calculation. The lithium suppression argument is qualitative. A full nucleosynthesis network computation with heavy element debris as initial conditions would provide quantitative predictions for all light element abundances.

Positron gravity. The prediction that positrons do not respond to gravity is experimentally testable but has not been directly measured.

13   Conclusion

The self-consistent shell deficit calculation improves the JWST structure formation prediction at $z \sim 10$, placing it within the observed range. Hawking radiation emerges from Compton jitter without virtual particles. The black hole element factory provides a natural mechanism for heavy element production and lithium suppression. Gravitational lensing reinterpreted as refraction produces testable predictions for redshift offsets in multiply-imaged systems.

The framework continues to produce results consistent with observations from a simpler starting point than the standard model, without dark matter, dark energy, or inflation. Whether this consistency reflects physical reality or coincidence remains to be determined by the CMB re-fit and the other tests described above.

Acknowledgments

References

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