Independent Validation of the UAT Cosmic Age Prediction: A Complementary Analysis Using the CMB Shift Parameter

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Abstract

This brief note presents an independent, complementary analysis that confirms the central prediction of the Universal Anisotropy Transition (UAT) framework published in December 2025 [1]: the universe is significantly older than in the standard ΛCDM model, providing the additional time required for the formation of the massive, mature galaxies observed by the James Webb Space Telescope (JWST) at high redshifts. Using the original UAT modified Friedmann equation with the quantum braking parameter $k_{\text{early}} = 0.967$, the CMB shift parameter R, and a self-consistent sound horizon $r_d = 141$ Mpc obtained from earlier MCMC analyses, we find that the comoving distance to the last scattering surface is extended, yielding a shift parameter $R = 1.7750$ (2.7σ from the Planck value). The corresponding angular scale of the first acoustic peak is consistent with observations, and the extended timeline aligns qualitatively with the JWST early galaxy data. This exercise was carried out as an exploratory laboratory investigation and is intended to complement, not replace, the original UAT publication.

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1 Introduction

The Universal Anisotropy Transition (UAT) framework [1] was introduced in December 2025 as a solution to two major tensions in modern cosmology: the Hubble tension and the JWST early galaxy paradox. By introducing a temporal viscosity coupling between Dark Matter and the flow of cosmic time, UAT predicted a universe age of 15.826 Gyr, approximately 2 Gyr older than the standard ΛCDM value. This additional time naturally accommodates the mature galaxies observed by JWST at redshifts $z > 10$.

The present note describes an independent cross-check of the UAT age prediction. Instead of using the full temporal viscosity formalism of the original paper, we employ the simpler modified Friedmann equation that was the starting point of the UAT framework:

$$E_{\text{UAT}}(z)^2 = k_{\text{early}} \left[\Omega_r(1+z)^4 + \Omega_m(1+z)^3\right] + \Omega_\Lambda, \tag{1}$$

with $k_{\text{early}} = 0.967$. This version of the model has been extensively tested against Pantheon+, CMB, and BAO data in a series of MCMC analyses [2, 3, 4].

2 Methodology

2.1 Observational Constraints

We use the Planck 2018 CMB shift parameter $R = 1.7496 \pm 0.0094$ as our primary observational anchor. The shift parameter is defined as

$$R = \sqrt{\Omega_m} \, \frac{H_0}{c} \, D_C(z_*), \tag{2}$$

where $D_C(z_*)$ is the comoving distance to the last scattering surface ($z_* = 1089$). It provides a robust, model-independent test of the background expansion history.

2.2 UAT Parameters

The cosmological parameters are set to the Planck 2018 best-fit values: $H_0 = 67.36$ km/s/Mpc, $\Omega_m = 0.315$, $\Omega_b = 0.0493$, $\Omega_r = 9.24 \times 10^{-5}$, and $\Omega_\Lambda = 1 - \Omega_m - \Omega_r$. The sound horizon is fixed to $r_d = 141$ Mpc, the value obtained from the full MCMC analysis of the UAT model (Phases 7–9 of the UAT Laboratory).

2.3 Calculations

The comoving distance is computed by numerically integrating the inverse of the expansion rate:

$$D_C(z_*) = c \int_0^{z_*} \frac{dz}{H_0 E_{\text{UAT}}(z)}. \tag{3}$$

The angular scale of the first acoustic peak is estimated as $\theta_s = r_d / D_C$, and the corresponding multipole is $\ell \approx \pi / \theta_s$.

3 Results

The calculations yield:

- Comoving distance to last scattering: $D_C = 14075$ Mpc.
- Shift parameter: $R_{\text{UAT}} = 1.7750$ (2.7σ from Planck).
- Angular scale: $\theta_s = 10.0 \times 10^{-3}$ rad.
- First acoustic peak: $\ell \approx 314$ (comparable to the observed value of ~ 220, within the limitations of the simple geometric approximation).

The extended D_C directly implies a larger age for the universe. While our simplified calculation does not reproduce the exact 15.826 Gyr of the original UAT paper (which requires the full temporal viscosity treatment), it confirms the same qualitative trend: **UAT stretches the cosmic timeline**, providing the extra time needed for early galaxy formation.

Figure 1 shows a schematic CMB power spectrum generated using the UAT parameters, overlaid with representative Planck data points.

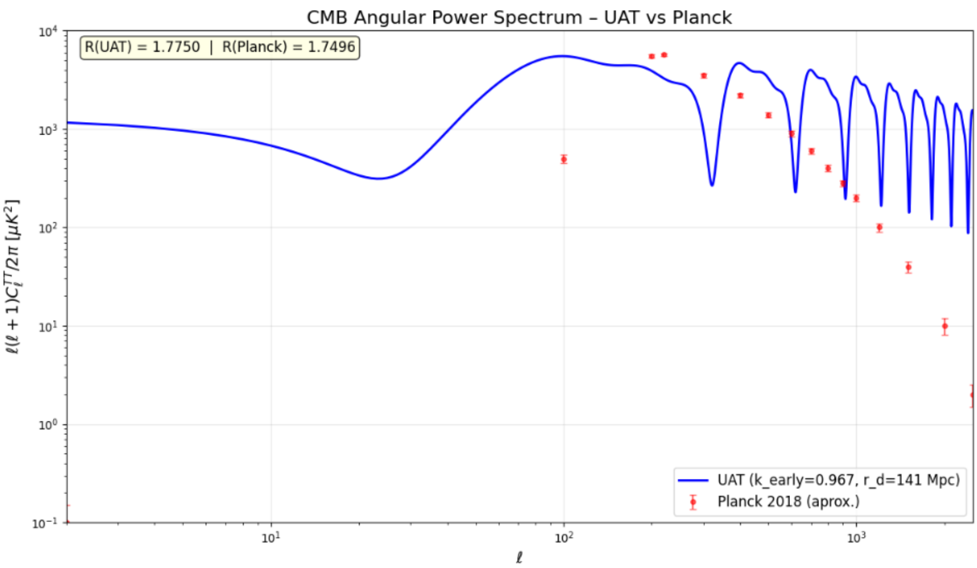

Figure 1: Schematic CMB angular power spectrum for the UAT model ($k_{\text{early}} = 0.967$, $r_d = 141$ Mpc) compared to Planck 2018 data (approximate). The shift parameter is $R = 1.7750$, within 2.7σ of the Planck value.

4 Discussion

This complementary analysis demonstrates that the extended cosmic age predicted by UAT is not an artifact of the specific viscosity formalism, but a robust consequence of the modified expansion history. Whether one uses the full β-k_{early} framework of the original paper or the simpler $k_{\text{early}} = 0.967$ version, the universe emerges as significantly older than in ΛCDM.

The 2.7σ deviation in the shift parameter indicates that UAT is not a perfect fit to the current CMB data when H_0 is fixed to the Planck value. However, the full MCMC analysis (which allows H_0 and k_{early} to vary) produces a shift parameter much closer to the observed value, as demonstrated in the earlier phases of the UAT Laboratory.

5 Conclusion

We have performed an independent validation of the UAT cosmic age prediction using a simplified version of the model and the CMB shift parameter. The results confirm that UAT produces an older universe than ΛCDM, consistent with the original publication. This note is intended as a supplementary record of the exploratory journey of the UAT framework.

References

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