

# Comparing Cosmological Frameworks Against Direct Observational Data: A JWST Case Study

Miguel Ángel Percudani

Independent Researcher, Puan, Buenos Aires, Argentina

miguel\_percudani@yahoo.com.ar

ORCID: 0009-0007-1748-3212

August 21, 2026

## Abstract

This note proposes a comparison between the UAT/UCP framework [1, 2] and  $\Lambda$ CDM using only direct observational data from the James Webb Space Telescope (JWST), without importing the adjusted internal parameters of either model into the evaluation. The aim is to define a fair observational baseline: both frameworks must account for the same measured redshifts, stellar masses, angular sizes, and abundance patterns of high-redshift galaxies. We argue that many recent JWST anomalies are naturally accommodated by the causal redshift correction of UAT/UCP, while  $\Lambda$ CDM requires additional adjustable astrophysical mechanisms for each anomaly. This note does not claim validation of UAT/UCP; it documents a comparison strategy based on direct observables and minimal theoretical assumptions.

## 1 Introduction

Recent observations from JWST have placed significant pressure on the standard  $\Lambda$ CDM model [9]. Several classes of high-redshift objects appear too massive, too compact, or too evolved for the age assigned to them under the standard expansion history.

The standard response has been to introduce additional astrophysical mechanisms: direct-collapse black holes, super-Eddington accretion, bursty star formation, and new compact object classes. Each mechanism is plausible individually, but their combined introduction weakens the predictive power of the model.

This note proposes an alternative approach to comparison. Instead of comparing best-fit parameters, we compare how well each framework accounts for direct observables under minimal assumptions.

## 2 Direct Observables from JWST

The following quantities are measured more or less directly from JWST data:

- spectroscopic and photometric redshift  $z_{\text{obs}}$ ;
- stellar mass  $M_*$ ;
- angular size;
- spectral energy distribution;
- number density of galaxies as a function of redshift and mass;
- black hole mass estimates from broad-line regions.

These observables do not require us to assume  $\Lambda$ CDM or UAT/UCP in advance. They form a common baseline.

### 3 The $\Lambda$ CDM Interpretation

Under the standard model, the cosmic age at a given redshift is fixed by the Friedmann equation with the Planck-adjusted parameters [9]. For a galaxy at  $z = 12$ , the standard age is approximately 0.34 Gyr. This produces tensions:

- $10^{10} M_{\odot}$  galaxies at  $z > 10$  require extremely efficient star formation [18];
- supermassive black holes at  $z > 7$  require exotic seeds or super-Eddington growth [19];
- Little Red Dots require a new compact object class [20];
- quiescent galaxies at  $z > 4$  require premature quenching mechanisms [21].

Each of these requires an additional mechanism, often with one or more free parameters.

### 4 The UAT/UCP Interpretation

The UAT/UCP framework [1, 2, 3] introduces a causal redshift correction:

$$(1 + z_{\text{obs}}) = (1 + z_{\Lambda\text{CDM}})(1 + z_{\text{causal}}),$$

with

$$z_{\text{causal}} = \left( \frac{\kappa}{k_{\text{early}}} \right) R_{\text{geom}} \approx 1.48,$$

where  $\kappa/k_{\text{early}} = 5.315$  is the thermodynamic overdrive ratio and  $R_{\text{geom}} = 0.279182$  is the 8-phase geometric residue [4].

Under this correction, a galaxy observed at  $z_{\text{obs}} = 12$  is actually at  $z_{\Lambda\text{CDM}} \approx 4.23$ , corresponding to a cosmic age of about 1.3 Gyr instead of 0.34 Gyr.

This single correction, with no additional astrophysical tuning, simultaneously addresses:

- the apparent overmassive galaxies at high redshift;

- the rapid growth of early supermassive black holes;
- the redness and compactness of Little Red Dots;
- the presence of quiescent galaxies at high redshift.

## 5 Comparison Criteria

To keep the comparison fair, both frameworks should be evaluated against the same observables using the following rules:

1. **No adjusted parameter import.** Do not use Planck best-fit values to assess UAT/UCP, and do not use UAT/UCP constants to assess  $\Lambda$ CDM.
2. **Same data.** Both frameworks must account for the same JWST catalogue.
3. **Penalise additional mechanisms.** Each extra astrophysical assumption should be counted as a cost in model complexity.
4. **Report failures openly.** If a framework requires an extra parameter to explain an observation, that must be documented.

## 6 Qualitative Outcome

Under these criteria, the JWST anomalies show a notable asymmetry.

$\Lambda$ CDM requires at least four independent auxiliary mechanisms to address the anomalies:

- efficient early star formation;
- direct-collapse or super-Eddington black hole growth;
- a new class of Little Red Dots;
- early quenching.

UAT/UCP, by contrast, applies one causal redshift correction derived from already calibrated constants [5]. The same correction has implications for the Hubble tension [10] and for the effective matter density [6].

This does not prove that UAT/UCP is correct. It shows that, under minimal assumptions, UAT/UCP provides a more parsimonious description of the JWST anomalies.

## 7 Limitations

This note is not a statistical validation. The comparison is qualitative and based on published interpretations of JWST data.

The following limitations must be recorded:

- The causal redshift correction has not been derived from a complete UAT/UCP action [7].

- The JWST catalogue is still incomplete and subject to systematic uncertainties.
- Both frameworks may change as new data arrive.
- No UAT/UCP Boltzmann solver exists to produce first-principles CMB spectra [8, 13, 14].

Therefore, the result of this note is a methodological proposal, not a definitive judgment.

## 8 Conclusion

A fair comparison between UAT/UCP and  $\Lambda$ CDM should be based on direct observables and minimal assumptions. Under those conditions, the JWST anomalies currently favour the parsimony of UAT/UCP, because a single causal redshift correction naturally accommodates several phenomena that  $\Lambda$ CDM treats with separate adjustable mechanisms.

The correct conclusion is not that UAT/UCP is validated, but that it deserves to be tested with the same rigour as  $\Lambda$ CDM, using neutral numerical tools and direct data [15, 16, 17].

**Acknowledgments:** The author thanks the JWST community for making high-redshift observations publicly available.

## References

- [1] M. A. Percudani, *Universal Applied Time (UAT/UCP): A Fundamental Theory of Cosmology from First Principles*, Zenodo, 2024. DOI: 10.5281/zenodo.17729221.
- [2] M. A. Percudani, *The Causal Coherence Constant  $\kappa_{crit}$ : A Fundamental Limit on Retrocausal Influence*, Zenodo, 2024. DOI: 10.5281/zenodo.18210808.
- [3] M. A. Percudani, *Before the Metrics: The Observer's Dilemma and the Conceptual Origin of the UAT/UCP Framework*, Zenodo, 2026. DOI: 10.5281/zenodo.21778464.
- [4] M. A. Percudani, *Experimental Verification of the Geometric Invariant  $R_{geom}$* , Zenodo, 2026.
- [5] M. A. Percudani, *Resolving JWST High-Redshift Anomalies with the UAT/UCP Framework: Causal Redshift Correction and the Restoration of Cosmic Chronology*, Zenodo, 2026.
- [6] M. A. Percudani, *A Phenomenological Relation for the Effective Matter Density within the UAT/UCP Framework*, Zenodo, 2025. DOI: 10.5281/zenodo.21328187.
- [7] M. A. Percudani, *Unified Action for the UAT/UCP Framework:  $S_{total} = S_{bulk} + S_{boundary} + S_{coherence}$* , Zenodo, 2026. DOI: 10.5281/zenodo.21433360.
- [8] M. A. Percudani, *Structural Incompatibility Between the UAT/UCP Framework and Standard Cosmological Boltzmann Solvers*, Zenodo, 2026.

- [9] Planck Collaboration, *Planck 2018 results. VI. Cosmological parameters*, Astron. Astrophys. **641**, A6 (2020). DOI: 10.1051/0004-6361/201833910.
- [10] A. G. Riess et al., *A Comprehensive Measurement of the Local Value of the Hubble Constant with 1 km/s/Mpc Uncertainty from the Hubble Space Telescope and the SH0ES Team*, Astrophys. J. Lett. **934**, L7 (2022). DOI: 10.3847/2041-8213/ac5c5b.
- [11] D. J. Fixsen, *The Temperature of the Cosmic Microwave Background*, Astrophys. J. **707**, 916 (2009). DOI: 10.1088/0004-637X/707/2/916.
- [12] B. D. Fields et al., *Big-Bang Nucleosynthesis after Planck*, JCAP **2020**, 010 (2020). DOI: 10.1088/1475-7516/2020/03/010.
- [13] D. Blas, J. Lesgourgues, T. Tram, *The Cosmic Linear Anisotropy Solving System (CLASS). Part II: Approximation schemes*, JCAP **2011**, 034 (2011). DOI: 10.1088/1475-7516/2011/07/034.
- [14] A. Lewis, A. Challinor, A. Lasenby, *Efficient Computation of Cosmic Microwave Background Anisotropies in Closed Friedmann-Robertson-Walker Models*, Astrophys. J. **538**, 473 (2000). DOI: 10.1086/309179.
- [15] C. R. Harris et al., *NumPy: Array processing for numbers, strings, records, and objects*, Nature **585**, 357 (2020). DOI: 10.1038/s41586-020-2649-2.
- [16] P. Virtanen et al., *SciPy 1.0: Fundamental Algorithms for Scientific Computing in Python*, Nature Methods **17**, 261 (2020). DOI: 10.1038/s41592-019-0686-2.
- [17] J. D. Hunter, *Matplotlib: A 2D Graphics Environment*, Comput. Sci. Eng. **9**, 90 (2007). DOI: 10.1109/MCSE.2007.55.
- [18] I. Labbé et al., *A population of red candidate massive galaxies 600 Myr after the Big Bang*, Nature **616**, 266 (2023). DOI: 10.1038/s41586-023-05786-2.
- [19] R. Maiolino et al., *A small and vigorous black hole in the early Universe*, Astron. Astrophys. **682**, L12 (2024). DOI: 10.1051/0004-6361/202347140.
- [20] J. Matthee et al., *Little Red Dots: An Abundant Population of Faint Active Galactic Nuclei at  $z \sim 5$  Unveiled by the EIGER and FRESCO JWST Surveys*, Astrophys. J. **963**, 129 (2024). DOI: 10.3847/1538-4357/ad2345.
- [21] K. Glazebrook et al., *A massive galaxy that formed its stars at  $z \sim 11$* , Nature **628**, 537 (2024). DOI: 10.1038/s41586-024-07191-9.