A Rational Target for Dynamical Dark Energy: $w_0 = -27/28,\ w_a = -1/28$

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Abstract

This short note pre-registers a single falsifiable dark-energy target from the finite-QEC substrate programme before the next generation of dark-energy constraints is available. In the Chevallier–Polarski–Linder parameterisation,

$$w(a) = w_0 + w_a(1-a),$$

the framework predicts

$$w_0 = -\frac{27}{28} = -0.9642857, \qquad w_a = -\frac{1}{28} = -0.0357143.$$

Equivalently,

$$w(a) = -1 + \frac{a}{28} \quad \text{and} \quad w(z) = -1 + \frac{1}{28(1+z)}.$$

The point is not fitted to DESI, Euclid, Planck, or supernova data. It is a fixed rational target produced by the same 28-channel service clock that gives the scalar tilt target $n_s = 27/28$. Planck's Ω_Λ and n_s were known before this formulation and are therefore postdictions in this context. The live prediction is the slight, non-phantom departure from ΛCDM: $w_0 > -1$, $w_a < 0$, with $w_0 + w_a = -1$. The values are frozen here as a pre-registration claim: if later data prefer a different CPL point, the branch fails; if later data approach this point, the agreement is not to be reinterpreted as a fit. A future joint BAO+CMB+supernova/weak-lensing reconstruction that excludes this point in a flat CPL analysis would falsify this dark-energy branch. Conversely, a posterior concentrated near this point would not by itself prove the framework, because w_0–w_a constraints are model- and prior-dependent; it would turn this rational target into a serious object for follow-up.

Plain summary

Most of the universe's energy is a mysterious "dark energy" that is making the expansion of space speed up. The standard cosmological model treats it as a *cosmological constant*: an energy whose density never changes, summarised by one fixed number, $w = -1$, for all time.

This note places a sharp, dated bet against that simplest picture. The finite-QEC framework predicts that dark energy is *not* quite constant — it drifts by a small, fixed amount captured in the single line $w(a) = -1 + a/28$, where a is the size of the universe relative to today ($a = 1$ now).

Today's value is $w_0 = -27/28 \approx -0.964$, a touch above -1, returning to exactly -1 in the distant past.

What makes this a real test, not a vague claim, is that the number 27/28 is *not fitted* to any data. It is fixed in advance by the same "28-channel" counting the framework uses elsewhere, and it is written down here, dated, before the sharper measurements arrive. The drift is deliberately gentle — gentler than the early hints from current surveys — so the prediction is a single narrow target, not a vague "dark energy evolves."

Surveys now running — DESI, Euclid, Rubin, Roman — are measuring exactly this drift. If they settle on the constant $w = -1$, or on a drift much larger than 1/28, the prediction is wrong and this branch of the framework is dead. If they settle near 27/28, the framework has passed a test it could have failed. Either way the bet is honest: one rational number, recorded first, that the data can refute.

1 The Prediction

The prediction is deliberately one line:

$$\boxed{w(a) = -1 + \frac{a}{28}}. \tag{1}$$

In the CPL convention [1, 2] (the standard two-number summary in which w_0 is the dark-energy equation of state today and w_a measures its drift with cosmic scale),

$$w(a) = w_0 + w_a(1-a),$$

Eq. (1) is

$$\boxed{w_0 = -\frac{27}{28}}, \qquad \boxed{w_a = -\frac{1}{28}}. \tag{2}$$

The branch is non-phantom today ($w > -1$, the regime in which dark-energy density slowly falls rather than grows):

$$w_0 = -0.9642857 > -1,$$

but tends back to a cosmological-constant value in the early limit:

$$\lim_{a\to 0} w(a) = w_0 + w_a = -1.$$

Equivalently,

$$w(z) = -1 + \frac{1}{28(1+z)}.$$

This gives a small but definite time-dependence. The dark-energy density obeys

$$\frac{d\ln\rho_{\rm DE}}{d\ln a} = -3\big(1 + w(a)\big) = -\frac{3a}{28}, \tag{3}$$

$$\frac{\rho_{\rm DE}(a)}{\rho_{\rm DE,0}} = \exp\left[\frac{3}{28}(1-a)\right]. \tag{4}$$

Thus the high-redshift asymptote is only

$$\exp(3/28) = 1.11309$$

times today's density. The prediction is therefore not an early-dark-energy model with a large high-redshift component. It is a nearly-Λ branch with a fixed, rational, late-time thawing-like deviation (a dark energy that sat at $w = -1$ early on and only recently began to depart).

2 Why This Is a Useful Flag

Two nearby rational numbers are already part of the same cosmology cluster:

$$n_s = \frac{27}{28} = 0.9642857, \qquad \Omega_\Lambda = \frac{12\pi}{55} = 0.685438.$$

Both are close to Planck-era values [3]. They are not being advertised here as forward predictions, because the relevant Planck constraints were already known before the current canon reached its present form. They are useful as internal coherence checks, but they are not the flag.

The live flag is Eq. (2). The reason is timing. DESI has already reported BAO (baryon-acoustic-oscillation) constraints that, in combination with CMB and supernova data, make evolving dark energy an active empirical question rather than a purely speculative one [4, 5]. Euclid and related surveys are designed to sharpen the same late-time expansion and growth constraints [6, 7]. The framework's target sits in the quadrant that current evolving-dark-energy discussions make interesting:

$$w_0 > -1, \qquad w_a < 0.$$

It is not merely "some $w \neq -1$", and it has no fitted continuous parameter. It is also a *mild* departure — gentler than the central values of current DESI–supernova combinations — so the rational point sits squeezed between ΛCDM on one side and the stronger evolving-dark-energy fits on the other, and can be excluded from either direction.

3 Framework Origin, Stated Minimally

The finite-QEC substrate programme contains a 28-channel service instrument. In the current canon the finite serial-clock part is reduced to a one-jump, uniform channel service law. The late dark-energy branch further identifies the active R4 support as a one-dimensional comoving service ledger. A one-dimensional comoving support has physical measure proportional to a. Writing the positive Landauer/QEC activation fraction as

$$f(a) = a$$

and the per-channel gap as

$$\Delta_1 = \frac{1}{28},$$

gives

$$1 + w(a) = \Delta_1 a,$$

which is Eq. (1).

This paragraph is intentionally shorter than the derivation in the companion cosmology paper. The purpose here is to freeze the empirical target, not to reproduce the whole finite-code argument. The claim should be read with the following tier label:

Piece	Status in this prediction note
28-channel service clock	Canon-derived finite-instrument result.
One-dimensional R4 late support	Canon-derived inside the current register/instrument; outside-sector completeness remains a caveat.
FRW lift $f(a) = a$	Homogeneous coarse-grain of the one-dimensional support.
CPL target	Fixed prediction of this branch, Eq. (2).

The tier matters. The prediction is sharp enough to be useful, but not so unconditional that an observational failure would automatically invalidate the whole finite-QEC substrate programme. It would invalidate this late dark-energy branch.

4 Rigidity Audit

The main risk in a rational prediction is hidden freedom. A number such as $-27/28$ is scientifically interesting only if the denominator is forced by the framework's finite record machinery rather than chosen because it lands near current data. For that reason this note is accompanied by the executable audit

`python_code/dark_energy_prediction_rigidity_audit.py`.

The audit separates three nearby-looking numbers that have different epistemic status.

Number	Audit verdict	Meaning for this prediction
28	Prediction-grade conditional theorem	The $8 \to 112 \to 28$ service instrument is fixed by 14 affine hyperplanes and two transverse modes. With one-jump service and one-dimensional R4 support, $w_0 = -27/28,\ w_a = -1/28$ follow with no continuous parameter.
55	Rigid supporting ledger	The Bekenstein severing ledger has 56 directed records, with one global-complement blind slot, leaving 55 readable channels and $\Omega_\Lambda = 12\pi/55$. This supports the same finite-count cluster but is not the DESI/Euclid prediction being frozen here.
17.7 keV	Sharp but more conditional	The line position $E_\gamma \simeq 8.84\,\mathrm{keV}$ is sharp if $m_{\nu_R} = \alpha^2\Lambda_{\mathrm{QCD}}$ is accepted. The line flux and absolute abundance still depend on the sterile mixing/source map, so this is not as rigid as the w_0, w_a target.

The audit result is the reason Eq. (2) is worth putting on record. The hidden freedom is no longer an arbitrary denominator in $w(a)$. It is a named physical fork: change the service scheduler, change the support dimension, or add an outside dark-energy channel, and the prediction changes. Within the current finite instrument those alternatives are not available silently.

5 Pre-registration Record

This section is the explicit pre-registration. It is included so that the claim cannot be moved after DESI, Euclid, Rubin, Roman, or future supernova analyses sharpen the reconstruction.

Field	Frozen entry
Date of this record	30 June 2026.
Parameterisation	Flat CPL dark energy, $w(a) = w_0 + w_a(1 - a)$.
Frozen values	$w_0 = -27/28$, $w_a = -1/28$.
Equivalent law	$w(a) = -1 + a/28$.
Immediate corollary	$w_0 + w_a = -1$, so the early limit is -1 and the present value is slightly non-phantom.
No-fit rule	The denominator 28 is not to be changed, rescaled, or replaced by a neighbouring rational to match a future posterior.
Allowed branch failure	A new scheduler, support dimension, hidden positive ledger, or negative-rate channel may define a new branch, but it does not save this pre-registered branch.
Primary empirical target	Published flat-CPL posteriors after this date from joint BAO, CMB, supernova, weak-lensing, or growth analyses, especially DESI full-survey and Euclid-era results.
Failure condition	Exclusion of $(w_0, w_a) = (-27/28, -1/28)$ under the same assumptions used for the quoted flat-CPL likelihood.
Positive condition	A posterior preference for $w_0 > -1,\ w_a < 0$ with the fixed rational point inside the preferred region, without adding curvature, phantom crossing, or early-dark-energy freedom.

A companion file,

`dark_energy_prediction_preregistration.json`,

records the same values in machine-readable form. The point of the file is not technical sophistication; it is timestamp discipline. A rational target announced after the posterior settles is not a prediction.

6 How the Prediction Fails

The clean falsification test is a flat CPL reconstruction using a transparent combination of BAO, CMB, supernova, weak-lensing, and growth data. The branch fails if the posterior excludes

$$(w_0, w_a) = \left(-\frac{27}{28}, -\frac{1}{28}\right)$$

at high significance under the same assumptions used to quote the ΛCDM comparison. In practical terms:

- a result consistent with ΛCDM but excluding the rational point would falsify the branch;
- a robust phantom preference, $w_0 < -1$, would falsify the positive R4 activation reading unless a new negative-rate channel were added;
- a robust non-phantom deviation markedly stronger than the rational point — for example a posterior centred well below $w_0 = -27/28$ along the $w_0 + w_a \simeq -1$ direction — would also exclude it: the target is a narrow point, not the whole $w_0 > -1$ quadrant;

- a robust positive w_a in the CPL convention would contradict the one-dimensional support law;
- strong evidence for a large early-dark-energy fraction would not be explained by this branch, because Eq. (4) changes the early density by only 11.3% relative to today.

There is also a softer failure mode. If future posteriors remain broad and prior-driven, this prediction is not confirmed or refuted. It remains a well-posed target waiting for sharper data. Cosmological parameters are inferred objects, not laboratory readings.

7 What Would Count as a Positive Result

A positive result would require more than a best-fit point lying nearby. The minimum useful checklist is:

1. the analysis states the CPL convention explicitly;
2. the data combination is published with enough covariance information to evaluate the fixed point in Eq. (2);
3. ΛCDM is disfavoured relative to a dynamical branch;
4. the fixed rational point lies inside the preferred region without being tuned by extra framework parameters; and
5. the same analysis does not require curvature, a large early-dark-energy component, or a phantom crossing that the branch does not contain.

Even then, the correct conclusion would be modest: the rational target survived a live empirical test. It would not prove the finite-QEC substrate programme. It would, however, make the 28-channel service-clock reading much harder to dismiss as numerology.

8 Pre-registered Numerical Target

For convenience, the numerical target is:

Quantity	Exact value	Decimal value
w_0	$-27/28$	-0.9642857143
w_a	$-1/28$	-0.0357142857
$w_0 + w_a$	-1	-1.0000000000
$w(z = 1)$	$-55/56$	-0.9821428571
$\rho_{\mathrm{DE}}(a \to 0)/\rho_{\mathrm{DE},0}$	$e^{3/28}$	1.11309

9 Conclusion

The framework's late dark-energy branch predicts a fixed rational CPL point:

$$(w_0, w_a) = \left(-\frac{27}{28}, -\frac{1}{28}\right).$$

This is close enough to ΛCDM to be observationally difficult, but far enough away to be scientifically risky as DESI, Euclid, Rubin, Roman, and supernova data improve. The point is not a fitted number. It is a sharp target from the 28-channel service clock and the one-dimensional R4 support law. The branch should be judged exactly that way: not as a broad claim that dark energy evolves, but as a specific rational prediction that future cosmological reconstructions can exclude.

References

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