☑ **Fact-Checked Science**

PAPER CHECK · COSMOLOGY

With other data, the largest supernova set hints dark energy is changing, at about 3σ

A team led from the University of Queensland combined the Pantheon+ and Dark Energy Survey samples into “Unite”, a Hubble diagram of 2,884 likely type Ia supernovae [1 Abstract]. Together with baryon acoustic oscillations (BAO) and the cosmic microwave background (CMB), it prefers dark energy that changes over time at 3.3σ, but its Bayesian evidence shows “only weak preference”, and the supernovae alone show no change [1 Abstract][1 §10.1]. The paper is a preprint, submitted to PASA and not yet peer reviewed, whose data will be public only on acceptance; its first version’s 2.5σ was corrected to 3.3σ in the second [1 Ack.][1 p. 22]. S0 News said “it’s looking like dark energy is changing over time” and blamed a wrong “foundational rule of the cosmos” [2 00:01:10–00:01:13][2 00:01:13–00:01:19].

By Fact-Checked Science · Published October 26, 2026

OUR ANALYSIS marks our own reasoning and calculations, and the verdicts are our assessment. Everything else comes from the numbered sources. For the paper [1], a preprint, p. gives a page of its second arXiv version, § a section, Table, Fig., Eq. and App. its tables, figures, equations and appendices, Abstract its abstract and Ack. its acknowledgements; the episode [2] is cited by time in the video.

A careful measurement and a real hint, at about 3σ; not yet a finding, and no broken rule

OUR ASSESSMENT

3.3σ

The preference for the two-parameter model, a dark energy that changes over time, over a cosmological constant, from Unite’s supernovae with BAO and the CMB, by the maximum a posteriori; 3.1σ by the maximum likelihood [1 Table 8]. Five sigma is the threshold “commonly accepted for establishing new physics” [5 §VII.3].

1.6 : 1

Our analysis: the Bayesian odds for that change, from the paper’s evidence values with its wide priors; the scale the paper adopts calls anything below about 3 to 1 inconclusive [1 Table 8][21 §4.2].

1.9σ

The supernovae on their own, against a cosmological constant. It comes from today’s w, about 2σ above −1, not from change: the paper finds them “consistent with a dark energy scenario without time evolution” [1 Table 8][1 §7.0.4].

THE CLAIMS

UNCONFIRMED

Dark energy changing over time

The presenter: “They’re once again scratching their heads because it’s looking like dark energy is changing over time.” [2 00:01:10–00:01:13]

A preliminary hint, not a finding. Combined with BAO and the CMB, Unite prefers a changing dark energy at 3.3σ, short of the 5σ bar, and its Bayesian evidence is “only weak” [1 Abstract][1 Table 8]: odds of about 1.6 to 1, by our arithmetic. The supernovae alone show no change over time [1 §7.0.4], the paper is an unreviewed preprint [1], and since 2024 the hint has ranged from 2.5σ to 4.2σ with the supernova sample used [6 Abstract][5 Table 6], and moved as the samples were recalibrated [8 Abstract]. Neither the paper nor the release describes confusion: the paper weighs systematic errors against “a more complex model” [1 §8.1], though DESI does call its own results “surprising” and the phantom crossing hard to explain [5 §VII.3][5 §VII]. See section 2 and section 4.

MISLEADING

A wrong rule, kept changing

The presenter: “This is what happens when you don’t get a foundational rule of the cosmos correct. You have to keep changing it.” [2 00:01:13–00:01:19]

The standard model may need revising, and cosmologists say so themselves [5 §IX][26 Abstract]. But nothing has been changed: the cosmological constant has been the model’s dark energy since supernovae revealed the accelerating expansion in 1998 [23 Abstract][22 Abstract], and Unite runs a test of it written down in 2001–2003 [27 Abstract][28 Abstract]. The authors keep “a more complex model” open alongside systematic errors [1 §8.1]; a confirmed change would swap that one ingredient inside the same expanding universe [5 §VII], not, in our reading, show a broken foundation. See section 6.

TRUE

Largest consistent SN sample

The paper: “Unite represents the most comprehensive and internally consistent SN Ia dataset currently available with 2884 likely SNe Ia.” [1 §10]

After the cuts of its Table 3 [1 Table 3], its 2,884 supernovae outnumber Union3’s 2,087 [16 Abstract], DES-SN5YR’s 1,829 and the 1,701 light curves of Pantheon+ [1 Table 2], and all share one calibration, light-curve model, host-galaxy method and bias correction [1 §4]. A quarter are nearby supernovae gathered by many different surveys, and the authors still call DES’s own recalibrated sample, DES-Dovekie, “the cleanest sample” [1 §10.2][1 §10.3]. See section 1.

TRUE

A 3.3σ hint, weak by Bayes

The paper: “The Bayesian evidence indicates only weak preference for time evolving dark energy, whereas frequentist analyses yield a preference over Flat-ΛCDM at a significance of 3.3σ (3.1σ)” [1 Abstract]

The numbers check out: converting the $\Delta\chi^2$ values of its Table 8 the way its Eq. 11 describes reproduces all 24 of its significances to within 0.06σ, by our arithmetic [1 Table 8]. Its evidence difference, 0.44, is odds of about 1.6 to 1 with the paper’s wide priors [1 Table 7], which the scale it adopts calls inconclusive [21 §4.2], so “only weak” is if anything generous. The first version’s 2.5σ was a mistake, corrected in the second [1 Ack.]. See section 2.

TRUE

Supernovae alone: no change

The paper: “Using Unite alone to constrain time-varying dark energy … we find consistency with a dark energy scenario without time evolution” [1 §10.1]

On its own, Unite gives w_a = −0.86, with an interval of +1.01 and −1.78 that includes zero: no sign that w changes over time [1 Table 8][1 §7.0.4]. What it does show is w_0 about 2σ above −1, a w that is constant but not that of a cosmological constant, and that is what gives its 1.9σ against ΛCDM [1 §8.2][1 Table 8]. Change over time shows only with other data: w_a is −0.47 (+0.41/−0.40) with BAO, −1.00 (+0.37/−0.36) with the CMB and −0.60 (+0.17/−0.19) with both, where the preference reaches 3.3σ [1 Table 8]. DESI’s BAO alone lean the same way only mildly, at 1.7σ [5 Table 6]. See section 2.

---

1 · THE PAPER

2,884 supernovae from two samples, analysed as one, in a preprint still under review

Ryan Camilleri, a PhD candidate at the University of Queensland, and 23 co-authors, many of them from the Pantheon+ and Dark Energy Survey (DES) supernova teams, merged two of the three largest modern samples into one Hubble diagram, which they call Unite [1 §1][3]. Type Ia supernovae are exploding white dwarf stars, “used to measure cosmic distances” [3]: set against redshift, their distances trace how the universe’s expansion has changed [1 §1], which is how the acceleration was found in 1998 [23 Abstract][24 Abstract].

STEP 1

Merge the samples

Pantheon+, 1,701 light curves of 1,550 spectroscopically confirmed supernovae at redshifts 0.001 to 2.26 from seventeen sources [1 §2.2][17 Abstract], and DES-SN5YR, 1,635 DES candidates classified from their light curves plus 194 nearby supernovae [1 §2.1][7 Abstract]; the overlap between them is reconciled [1 §2.3].

STEP 2

Put them on one footing

One cross-calibration of all the telescopes and filters, with the open-source code of the DES reanalysis [1 §4.1][30 Abstract]; a retrained light-curve model and one model of dust and scatter [1 §4.2][1 §4.3]; and host-galaxy masses re-measured with one method for more than 98% of the sample [1 §4.4][4 Abstract].

STEP 3

Correct for what isn’t seen

STEP 4

Fit four universes

Bias corrections from simulations of each survey [1 §4.5]; only DES supernovae with a probability above 0.8 of being type Ia [1 §4.6]; and, for the first time in a main analysis, a correction for each supernova's gravitational lensing [1 §4.7].

Flat with a cosmological constant (ΛCDM); curved; flat with a constant equation of state w; and flat with $w = w_0 + w_a(1 - a)$ changing over time [1 §3][1 Table 1]. The supernovae give relative distances only, with no Hubble constant [1 §3.1]; to sharpen the constraints they are combined with BAO from DES and DESI and the CMB from Planck, ACT and SPT [1 §2.4].

A preprint, still in review

The paper was posted to arXiv on September 4, 2026 and revised on September 9; the second version says it has been submitted to the *Publications of the Astronomical Society of Australia* (PASA) [1]. Neither arXiv nor Crossref showed a journal version or an acceptance on October 26 [1]. Its Hubble diagram, code and likelihood "will be publicly available upon acceptance of the paper" [1 p. 22], so nobody outside the team can re-run its fits yet. The first version's abstract put the MAP preference at 2.5σ; the second gives 3.3σ, because the team had "inadvertently used the MAP posterior, which includes a contribution from the prior volume" [1 Ack.]. The 3.1σ by maximum likelihood is the same in both.

Blinded, then checked

The team kept the cosmological results hidden from itself until predefined tests on simulated and real data were passed; four changes made after unblinding are disclosed, and they moved the fits by 0.3σ at most [1 §5.2]. Reanalysing DES's own sample in 2025 had turned up two errors in its 2024 analysis, which Unite corrects [1 §4.8][8 Abstract]. The paper lists its funders and has no competing-interests statement [1 Ack.].

OUR ANALYSIS

Counting the sample

The survey counts in the legend of Fig. 1, 1,549 from DES, 647 nearby, 256 from SDSS, 251 from Pan-STARRS, 171 from SNLS and 10 from the Hubble Space Telescope, add up to 2,884 [1 Fig. 1]. So do the cuts in Table 3, from 5,271 supernovae with converged light-curve fits down, except one row: "Detected host galaxy" discards 58 supernovae while the running total falls by 158, from 3,507 to 3,349 [1 Table 3]. Every later row is consistent with 3,349, so 58 is probably a misprint for 158. It changes nothing in the results. One caution on the count itself: the paper's Table 2 counts Pantheon+ by its 1,701 light curves, and Unite keeps repeat observations of the same supernova by different surveys [1 Table 2][1 §4.9], so its 2,884 may count a few supernovae more than once; the paper gives no count of distinct objects.

2 · THE RESULT

Alone, the supernovae show no change; with BAO and the CMB, a 3σ preference

Fitted alone, Unite gives a matter density of 0.310 in the standard model, and when w may change it finds "consistency with a dark energy scenario without time evolution", with w_0 about 2σ above −1 [1 §7.0.1][1 §10.1]. Combined with BAO and the CMB, it prefers $w_0 = -0.861$ and $w_a = -0.60$ over a cosmological constant at 3.3σ by the maximum a posteriori (MAP) and 3.1σ by the maximum likelihood (ML) [1 Abstract]. Its figure of merit, a measure that grows as the w_0–w_a error ellipse shrinks, is 315 [1 §7.0.4]: the ellipse is about 30% smaller than in DES's best combination, with 222 [9 Table 1], 29.5% by our arithmetic, and the authors call it the tightest constraint to date [1 §7.0.4].

The fits, alone and combined

DATA	MODEL	W OR W_0	W_a	ΔX^2 (MAP)	AGAINST ΛCDM	Δ LOG Z	ODDS
Unite alone	constant w	−0.764 +0.078/−0.096	–	−5.5	2.3σ	−0.42	1.5 :
Unite alone	changing w	−0.779 +0.099/−0.098	−0.86 +1.01/−1.78	−5.5	1.9σ	+0.36	1.4 :
Unite + BAO	changing w	−0.890 +0.057/−0.051	−0.47 +0.41/−0.40	−5.4	1.8σ	+2.46	12 : 1
Unite + CMB	changing w	−0.796 +0.073/−0.075	−1.00 +0.37/−0.36	−7.6	2.3σ	+1.83	6 : 1
Unite + BAO + CMB	**changing w**	**−0.861** +0.044/−0.042	**−0.60** +0.17/−0.19	**−13.6**	**3.3σ (ML 3.1σ)**	**−0.44**	**1.6 :**
Unite + BAO + CMB	constant w	−1.002 ±0.017	–	0	0σ	+4.14	63 : 1

From Table 8 of [1]: medians with 68% intervals; $\Delta\chi^2$ against flat ΛCDM at the MAP; the significance from it with one extra parameter (constant w) or two (changing w); Δ log Z the paper's difference in log Bayesian evidence, positive where flat ΛCDM is favoured (our reading of its sign, checked below). The odds, for or against the extended model, are our conversion, $e^{|\Delta \log Z|}$. The constant-w fit to all the data is greyed out in the paper, because the supernovae with BAO and the CMB pull it in opposite directions; their tension in that model is "strong" by its Suspiciousness test [1 §8.1].

OUR ANALYSIS

Checking the significance, and what it means

We converted every $\Delta\chi^2$ in Table 8 the way the paper's Eq. 11 describes: Wilks' theorem with one or two extra parameters gives a probability, and that is expressed as the equivalent number of Gaussian sigma. All 24 values, by MAP and ML, for four data combinations and three models, agree with the paper's to within 0.06σ, which is rounding [1 Table 8][1 Eq. 11]. The headline MAP $\Delta\chi^2$ of −13.6 corresponds to a probability of about 0.0011, one in 900, that a constant dark energy would give so large an improvement by chance if the errors are Gaussian and correctly estimated; the ML value, −12.4, to about one in 490. With two extra parameters, 3σ needs a $\Delta\chi^2$ of about −11.8 and 5σ about −28.7, twice Unite's.

The Bayesian comparison weighs the fit against the room the extra parameters have to roam, so the odds depend on how much room the paper's priors allow: w_0 from −3 to −0.4 and w_a from −3 to 2 [1 Table 7]; as DESI puts it, Bayesian quantities "will always depend on the particular choice used" [5 §VII]. Its sign convention checks out: for the supernovae with the CMB, an extra constant w that improves the fit not at all costs 4.02 in log evidence, close to the 4.00 we estimate from the width of its prior and its posterior [1 Table 8][1 Table 7]. For all the data, the evidence difference of 0.44 in favour of changing dark energy is odds of about 1.6 to 1. On the scale of Trotta (2008), which the paper adopts, anything below 1 in log, odds of about 3 to 1, is "Inconclusive" [21 §4.2]; the same review warns that results in the 2–3σ range "can only support the more complex model in a very mild way at best" [21 §4.4]. The DES reanalysis, at 3.2σ, translates its result into odds of about 5 to 1 and calls it "only a weak preference for evolving dark energy" [8 Abstract].

How the authors qualify it

From the paper's own discussion, verbatim.

> *"Therefore using statistical techniques to estimate the significance of a deviation from ΛCDM is prone to over interpretation, and should be done with caution."*
>
> Camilleri et al. (2026) [1 §9.2.3]

> *"Although it remains important to consider whether the disagreements could arise from systematic errors in one or more of the analyses, we also take seriously the possibility that a more complex model may be needed."*
>
> Camilleri et al. (2026) [1 §8.1]

> *"According to model comparison statistics, Bayesian evidence indicates only weak preference for time evolving dark energy"*
>
> Camilleri et al. (2026) [1 §10.1]

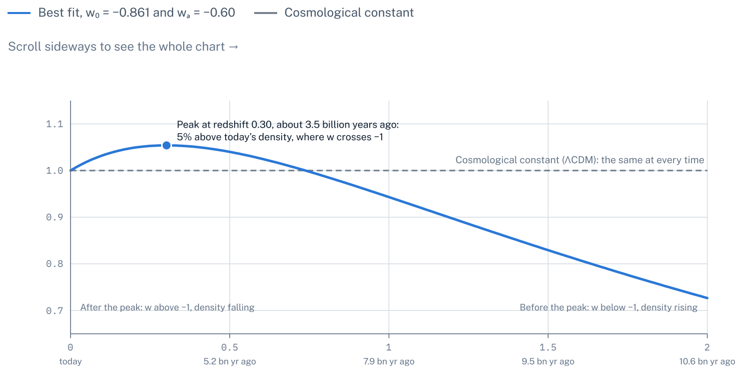
3 · WHAT "CHANGING" MEANS

In the best fit, dark energy peaked about 3.5 billion years ago and has thinned by about 5% since

The equation of state w is dark energy's pressure divided by its density. A cosmological constant has $w = -1$, and its density stays the same as the universe expands [1 §3][1 Table 1]. The paper lets w change in the two-parameter form $w = w_0 + w_a(1 - a)$, where a is the size of the universe relative to today [1 §3], a form introduced in 2001 and 2003 [27 Abstract][28 Abstract]. The chart shows what the best fit implies.

Dark-energy density relative to today, in Unite's best fit with BAO and the CMB

OUR ANALYSIS



Scroll sideways to see the whole chart →

Redshift, and how long ago the light left, in billions of years; density as a multiple of today's

−0.86
w today in the best fit, above the −1 of a cosmological constant `[1 Table 8]`

z ≈ 0.30
where w crosses −1 and the density peaks (68% range 0.25–0.36), about 3.5 billion years ago, by our arithmetic

−1.16
w at redshift 1, about 7.9 billion years ago, in the "phantom" range below −1, by our arithmetic

5%
how far the density has fallen since its peak, by our arithmetic; under a cosmological constant, none

Our computation from the central values in Table 8 of `[1]` ($w_0 = -0.861$, $w_a = -0.60$, $\Omega_m = 0.305$), not a redrawing of any figure; the paper is under arXiv's non-exclusive licence. The curve is the dark-energy density the two-parameter form implies, $\rho(a)/\rho(1) = a^{-3(1+w_0+w_a)} e^{-3w_a(1-a)}$. Lookback times assume a Hubble constant of 67.5 km/s/Mpc, because the paper reports no value of it `[1 §1]`. w_0 and w_a are strongly correlated, about −0.91 by our arithmetic from the figure of merit and the two intervals, so within this form the crossing is fairly well placed, at redshift 0.25–0.36 (68%, in a Gaussian approximation); the bigger caveat is the form itself, since two numbers can only draw one smooth curve.

OUR ANALYSIS

Reading the best fit, and what it rests on

Where w is above −1, dark energy thins as space expands; below −1, the so-called phantom case, it grows denser. In the best fit, w is −0.86 today, crosses −1 at redshift 0.30 (0.25–0.36 at 68%, given how tightly w_0 and w_a are correlated) and is −1.06 at redshift 0.5 and −1.16 at redshift 1 `[1 Table 8]`. So the density rose until about 3.5 billion years ago and has fallen by about 5% since; it was 0.94 times today's value at redshift 1 and 0.73 times at redshift 2. The other recent fits give the same shape, by the same arithmetic: a crossing at redshift 0.35–0.44 and a fall of 7–16% for DESI's second release with each of the three supernova samples `[5 §VII.1]`, about 9% for the DES reanalysis `[8 Abstract]` and about 8% for DES's all-probe fit `[9 Abstract]`.

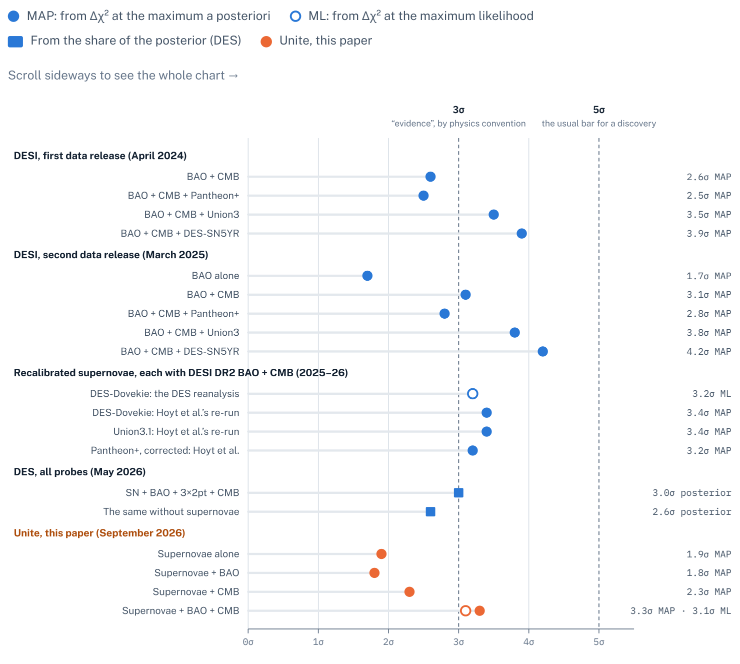
Three cautions. A crossing below −1 violates the null energy condition, which requires that dark energy's density not grow as the universe expands, and is a severe difficulty for the simplest, single-field models; DESI notes that models with several fields, extra internal degrees of freedom or a non-minimal coupling, and some modified-gravity models, can evade it `[5 §VII]`, and its extended analysis finds the crossing robust to method though models without one "cannot yet be ruled out" `[20 Abstract]`. Cortês and Liddle (2024) argue that conclusions about evolution depend strongly on the assumed priors `[19 Abstract]`, and the Unite team plans a different parametrisation, less prone to "projection effects" in the long, curved w_0–w_a contours `[1 §8.2]`. And the same combined data also prefer a slightly curved universe, at 2.6σ, an alternative extension the paper discusses, though its Bayesian evidence weakly disfavours curvature `[1 §8.2]`: a 3σ preference does not single out one explanation.

4 · HOW SOLID

The hint has ranged from 2.5σ to 4.2σ since 2024, and drawn together near 3.3σ as the supernovae were recalibrated

DESI's first data release found a preference of 2.6σ from BAO and the CMB in April 2024, and 2.5–3.9σ with each of three supernova samples `[6 Abstract]`; its second, in March 2025, gave 3.1σ and 2.8–4.2σ `[5 Table 6]`. The supernova samples have since been recalibrated and re-analysed `[8 Abstract][14 Abstract]`, and the numbers have drawn together near 3.2–3.4σ, Unite's included `[1 Table 8]`.

The preference for the two-parameter (w_0–w_a) model over a cosmological constant, as each analysis reports it



Scroll sideways to see the whole chart →

Significance, in Gaussian standard deviations (σ)

Each mark is a number an analysis reports for its own data, not a measurement we made, and the statistics differ, so the rows should not be read as one trend: Unite's combined fit gives 3.3σ by MAP and 3.1σ by ML from the same data `[1 Table 8]`. The CMB data differ too: DESI's analyses and Hoyt et al.'s re-runs use Planck with ACT's lensing `[5 §IV.2][14 Abstract]`, while the DES reanalysis and DES's all-probe analysis `[8 Abstract][9]`, and Unite `[1 §2.4]`, add ACT and SPT. Sources: DESI's first release `[6 Abstract]`; its second `[5 Table 6]`; for DES-Dovekie, 3.2σ by ML in the DES reanalysis itself `[8 Abstract]` and 3.4σ in Hoyt et al.'s re-run of DESI's combination `[14 Abstract]`; Union3.1 and the corrected Pantheon+ in the same re-runs `[14 Abstract]`, by MAP as Unite's introduction states for these two `[1 §1]` and, for the DES-Dovekie value, by our inference, since Hoyt et al. combine the data "exactly as done by DESI DR2", whose statistic is the MAP `[5 Table 6]`; DES's all-probe analysis, in which 3×2pt is DES's weak lensing and galaxy clustering and the significance is the share of the posterior inside the contour through ΛCDM `[9 Table 1]`; Unite `[1 Table 8]`.

The case against: the nearby supernovae

Efstathiou (2025) found that supernovae common to DES-SN5YR and Pantheon+ differ by about 0.04 magnitudes between low and high redshift, and that subtracting that from DES's nearby supernovae brings its sample into line with the standard model, "eliminating any need to invoke dynamical dark energy". To claim evolving dark energy, he concluded, the low-and high-redshift photometry must match to "substantially smaller than 0.04 mag" `[10 Abstract][10 §5]`. He called DES's explanation "not entirely satisfactory", noted that "no independent test of the accuracy of the BBC methodology and associated bias corrections" had been presented, and asked for "stringent control of systematic errors" `[10 §5]`; Unite uses the BBC method alone, with a comparison against another method left for later work `[1 §10.2]`. Notari et al. (2025) found 3.8σ or 2.5σ depending on which shared supernovae are dropped, and weaker evidence once the offset is allowed for `[12 Abstract]`; Huang et al. (2025), less than 2σ after correcting the nearby sample `[13 Abstract]`; Dhawan et al. (2025) that plausible calibration and dust errors push fits toward the DESI-like region `[18 Abstract]`. These critiques were made before DES's recalibration, which cut its own figure from 4.2σ to 3.2σ `[8 Abstract]`; and Unite's own analysis choices move its low-to-high-redshift offset against Pantheon+ by about 0.02 mag, from −0.0199 to 0.0002 when Pantheon+'s host masses and dust

The case for: explained offsets, other probes

Vincenzi et al. (2025), replying for the DES collaboration, traced 43% of the offset to improved modelling in DES-SN5YR and 38% to comparing samples selected in different ways; with Pantheon+'s choices, the DES evidence falls only from 3.9σ to 3.3σ, and they "confirm the validity" of the DES results `[11 Abstract]`. By our count from its author list, 18 of Unite's 24 authors, its lead author among them, co-signed that reply `[11]`, and Unite's introduction takes the same side `[1 §1]`. DESI finds 3.1σ with no supernovae at all, 2.7σ without CMB lensing and 2.4σ with only early-universe CMB priors, and a BAO error large enough to erase the BAO–CMB tension behind it would exceed its systematic budget six- to tenfold `[5 §VII.3]`. DES's all-probe analysis finds 2.6σ without supernovae `[9 Abstract]`. The recalibrations agree more closely: the DES reanalysis itself gives 3.2σ `[8 Abstract]`, and in Hoyt et al.'s re-runs of DESI's combination, Union3.1, the recalibrated DES sample and the corrected Pantheon+ give 3.4σ, 3.4σ and 3.2σ, "a significantly improved consistency between SN analyses" `[14 Abstract]`; a newer Union model gives about 3σ `[15 Abstract]`.

model are restored, the scale the critics worry about [1 §9.2].

OUR ANALYSIS

Where that leaves the hint

No combination has reached 5σ; DESI’s second release says none exceeded 4.2σ [5 §IX], and the recalibrated samples sit in a narrow band of 3.2–3.4σ, 3.2σ in the DES reanalysis and 3.2–3.4σ in Hoyt et al.’s re-runs [8 Abstract][14 Abstract], with Unite at 3.3σ [1 Table 8]. The spread between statistics for the same data, 0.2σ, is as large as some differences between analyses, and the companion paper shows how much one input can move: its re-measured host masses raise the Pantheon+ part of Unite from 3.4σ to 4.0σ with BAO and the CMB [4 Abstract]. The objection that matters most for Unite is the one about nearby supernovae, which the paper itself raises: its standard-model fit shifts by about 2σ when the 687 below redshift 0.1 are left out, they come from “numerous surveys with differing instruments, calibrations, and selection functions”, and it does not report the combined significance without them [1 §9.1][1 §10.3].

5 · THE RELEASE

The press release hedges as the paper does, apart from its headline

The University of Queensland’s release of September 8, 2026, the episode’s link, quotes the lead author and the astrophysicist Tamara Davis and links both preprints [3]. It came out between the paper’s two versions and quotes no significance [3][1].

In the release’s words

Quoted from the University of Queensland’s news release [3].

> *“Instead of confirming the standard model of cosmology which assumes dark energy is fixed and unchanging, we have more evidence that dark energy may change over time.”*
>
> Ryan Camilleri, in the release [3]

> *“this new compilation also sees a deviation from the standard model although in a slightly different direction”*
>
> Tamara Davis, in the release [3]

> *“So, 2 completely independent measurements have found hints of time variation in dark energy, challenging the standard model that dark energy doesn’t change.”*
>
> Tamara Davis, in the release [3]

The release beside the paper

THE RELEASE SAYS	THE PAPER AND THE DATA	OUR VERDICT
Headline: “Big supernova dataset challenges dark energy theory” [3]	A 3.3σ frequentist preference with “only weak” Bayesian evidence [1 Abstract]; the DES teams call their own similar results a “weak preference” [8 Abstract][9 Abstract], while DESI writes that ΛCDM “is being challenged” [5 Abstract].	Not rated, as a headline. Our description: strong for the evidence, though DESI uses the same word.
The dataset “provides more evidence that dark energy may not be constant but instead be changing over time” [3]	Matches the paper’s abstract and conclusions [1 Abstract][1 §10.1].	TRUE
“2,884 Type Ia supernovae” [3]	2,884 “likely” type Ia supernovae: the DES part is classified from light curves [1 §10][1 §4.6].	TRUE The paper says “likely”.
Davis: the new compilation deviates from the standard model “although in a slightly different direction” [3]	Alone, Unite is about 2σ from ΛCDM toward larger w_0, not, as DES-SN5YR was, toward larger w_0 and strongly negative w_a, the “bottom right” of the w_0–w_a plane [1 §8.2].	TRUE
Davis: “2 completely independent measurements have found hints of time variation in dark energy” [3]	**Supernovae and DESI’s BAO are independent data, and with the CMB each favours w_0 above −1 and w_a below zero: 2.3σ for Unite, 3.1σ for DESI** [1 Table 8][5 Table 6]**. Alone, each leans that way only weakly: DES’s 2024 supernovae gave $w_a = -8.8\ (+3.7/-4.5)$** [7 Abstract]**, DESI’s BAO 1.7σ** [5 Table 6]**, and Unite alone shows no time variation** [1 §7.0.4].	PARTLY TRUE **Two independent data sets lean the same way, but only weakly on their own; the clearer hints each come from adding the same CMB data.**
More nearby supernovae are coming from DEBASS [3]	More than 400 at redshifts below 0.08, taken with the DES camera, which the paper wants as a cross-check [1 §10.3].	TRUE

6 · A CHANGING RULE?

The cosmological constant has not been changed since 1998, and a planned test of it is under way

The episode’s second sentence says that cosmologists got “a foundational rule of the cosmos” wrong and “have to keep changing it” [2 00:01:13–00:01:19]. It does not say which rule. If it is the cosmological constant, the record is a short list of changes, each forced by observations, and a test designed long before its first hints.

The cosmological constant, 1917–2026

WHEN	WHAT HAPPENED
1917	Einstein adds the cosmological constant to general relativity, to describe a universe assumed to be static [22 Abstract].
After the expansion is discovered	The term falls from favour; historians find it was “never truly banished from theoretical models” but sidelined by astronomers “for reasons of convenience” [22 Abstract].
1988	Theorists publish models of a rolling scalar field, a cosmic energy that changes over time [29].
1998–1999	Two teams’ distant supernovae show the expansion accelerating, and the constant returns [23 Abstract][24 Abstract], along with other evidence from the CMB and the Hubble Space Telescope [22 Abstract].
2001–2003	The two-parameter form $w_0 + w_a(1 - a)$ is introduced to look for a changing w [27 Abstract][28 Abstract].
2006	The Dark Energy Task Force calls for an ambitious observing programme, and its figure of merit in the w_0–w_a plane becomes the yardstick by which dark-energy projects such as DESI are judged [26 Abstract][10 §5].
2018–2024	Planck finds “no compelling evidence for extensions to the base-ΛCDM model” [25 Abstract]; Pantheon+ and DES-SN5YR find w consistent with −1, within about 2σ [17 Abstract][7 Abstract].
2024–2026	**DESI and the supernova samples find hints of change at 2.5–4.2σ** [6 Abstract][5 §IX]**, about 3.2–3.4σ after recalibration** [14 Abstract][1 Table 8]**; none at 5σ.**

What a confirmed change would mean

The constant would no longer be the whole story of dark energy: something dynamical would take its place, such as several fields, a non-minimal coupling or a change to gravity itself [5 §VII][20 Abstract]. Cosmologists have long expected surprises here: the Dark Energy Task Force wrote in 2006 that the acceleration shows that “our theories of fundamental particles and gravity are either incorrect or incomplete” [26 Abstract], DESI writes that a confirmation could “herald yet another radical transformation” [5 §IX], and Davis links the work to the problem of joining gravity and quantum physics [3].

What it would not undo

Every fit on this page assumes an expanding universe under general relativity with matter and a dark-energy component; the question is only whether that component is constant [1 Table 1]. The expansion and its acceleration are measured, not assumed: DES’s supernovae alone require acceleration, within the standard model’s fit, at more than 5σ [7 Abstract]. And each of the other two probes, taken alone, is well described by the standard model; it is combining them with each other and with the supernovae that strains it [25 Abstract][5 Abstract].

OUR ANALYSIS

Is that “keep changing it”?

The episode’s sentence has something true in it: the standard model’s dark energy may turn out to be wrong, and cosmologists say as much. But it leaves the impression of a rule repeatedly patched because it was wrong from the start. The record shows one constant, introduced, sidelined and restored over a century as observations required, and unchanged for the 28 years since 1998 [22 Abstract]; the w_0–w_a test that Unite runs was defined in 2001–2003 [27 Abstract][28 Abstract] and has been the yardstick of dark-energy projects since 2006 [26 Abstract][10 §5], so testing it is the plan, not a patch. The test’s answer is not in, at 3.3σ with odds of about 1.6 to 1 [1 Table 8], and the authors keep both a systematic error and “a more complex model” open [1 §8.1]. If the change is confirmed, cosmology will have changed its description of dark energy once, on the evidence.

7 · THE EPISODE

What the episode said, beside the paper

S0 News of October 26, 2026 promised “a bit of cosmological physics” in its line-up [2 00:00:20] and reached the paper through the release, its second science item, under the link label “Dark Energy Changes” [2][3]. The two sentences it spent on it come straight after its item on Estonia’s growing season, which our check of the Estonian paper covers.

The episode’s statements beside the paper

THE EPISODE SAID	THE PAPER, AND THE RECORD	OUR VERDICT
“They’re once again scratching their heads because it’s looking like dark energy is changing over time.” `[2 00:01:10–00:01:13]`	A 3.3σ preference from three data sets combined, Bayesian evidence “only weak”, no change in the supernovae alone, an unreviewed preprint `[1 Abstract][1 Table 8]`. The release reports Davis calling the dataset an exciting step `[3]`; neither it nor the paper describes confusion, though DESI calls its own results “surprising” `[5 §VII.3]`.	**Unconfirmed**
“This is what happens when you don’t get a foundational rule of the cosmos correct. You have to keep changing it.” `[2 00:01:13–00:01:19]`	The cosmological constant has not been changed since 1998 `[22 Abstract]`; the test of it was planned in 2001–2006 `[27 Abstract][26 Abstract]`; the authors keep “a more complex model” open `[1 §8.1]`; a confirmed change would, in our reading, extend the model rather than show a broken foundation.	**Misleading**

Quoted from the episode’s automatically generated transcript; a time range runs from the start of the first line quoted to the start of the last, so the two sentences share the line that starts at 00:01:13 `[2]`. The transcript’s “geoysically”, just before these sentences, is unclear and carries no claim. The same two sentences carry the same labels on our review of the episode.

8 · READ WITH CARE

A careful analysis that states its own limits

The limits below are our reading; all but the first are stated in the paper.

Not yet peer reviewed

The paper is a preprint submitted to PASA; its numbers can still change, as its MAP significance did between versions `[1][1 Ack.]`.

Half the error is systematic

The systematic uncertainty about equals the statistical one, and systematic errors “are not statistical”, which is why the authors call σ values “prone to over interpretation” `[1 §6][1 §9.2.3]`.

Supernova physics still settling

The standardisation parameters drift with redshift at about 3σ; the data prefer a host-mass step at $10^{10.2}$ rather than 10^{10} solar masses ($\Delta\chi^2 = -8.4$), not adopted because it biased simulated fits; and the dust variants used for systematics “may not accurately capture the range of systematic uncertainty” `[1 §6.2][1 App. B]`.

Data not yet public

The Hubble diagram, code and likelihood are to be released on acceptance, so the fits cannot be checked independently yet `[1 p. 22]`.

The nearby supernovae

A quarter of the sample, gathered by many surveys, with a strong pull on the fit; leaving out those below redshift 0.1 shifts the standard-model fit by about 2σ `[1 §9.1][1 §10.3]`.

One method, one form of w

Only one analysis framework, BBC (BEAMS with Bias Corrections), is used; a comparison with the UNITY method is promised `[1 §4.5][1 §10.2]`. The w_0–w_a form is prone to projection effects, and a different parametrisation is planned `[1 §8.2]`.

What would change these verdicts

01
Peer review and the release of Unite’s Hubble diagram and likelihood, so that others can re-run its fits `[1 p. 22]`.

02
A uniform nearby sample: DEBASS, with more than 400 supernovae taken with the DES camera, and later ZTF and Rubin data, to test the low-redshift end that the critics question `[1 §10.3][5 §VII.3]`.

03
DESI’s later data and other probes: a combination that passes 5σ would make “Dark energy changing over time” True; a hint that fades as data improve would make it False `[5 §VII.3]`.

Sources

Bracketed numbers refer to this list. For the paper [1], p. gives a page of its second arXiv version (26 pages), § a section, Table, Fig., Eq. and App. one of its tables, figures, equations or appendices, Abstract its abstract and Ack. its acknowledgements. For the episode [2], times are positions in the video (hours:minutes:seconds), the starts of the lines of its automatically generated transcript. For the other sources, § names a section, Table a table and Abstract the abstract; where only an abstract or a record was read, the entry says so. Links checked October 26, 2026.

1 Camilleri, R., Lee, J., Davis, T. M., Rubin, D., Shah, P., Scolnic, D., Lidman, C., Popovic, B., Grech, K., Vincenzi, M., Brout, D., et al. (2026). Supernovae Unite: Combining Pantheon+ and DES-SN5YR. arXiv:2609.05053 [astro-ph.CO]: version 1 posted September 4, 2026, version 2 September 9, 2026. A preprint, not peer reviewed; version 2 says it was submitted to the *Publications of the Astronomical Society of Australia*, and neither arXiv nor Crossref showed a journal version on October 26, 2026. Distributed under arXiv’s non-exclusive licence, so we redrew no figure and chart only numbers from its text and tables. We read version 2 in full, as its PDF (26 pages) and as arXiv’s HTML rendering, and compared version 1’s abstract and Table 8.

2 SpaceWeatherNews (S0) (October 26, 2026). Galactic Magnetic Reversal Flipping Earth Field | S0 News Oct.26.2026. YouTube video. Quoted from the automatically generated transcript; times are positions in the video. The label “Dark Energy Changes” is the episode’s own, on its link to the release in the video’s description.

3 The University of Queensland (September 8, 2026). Big supernova dataset challenges dark energy theory. UQ News, news release; the episode’s link to the paper. Read in full; quoted briefly, © The University of Queensland.

4 Lee, J., Camilleri, R., Davis, T. M., Rubin, D., et al. (2026). Supernovae Unite: Host-Galaxy Mass Measurements of Type Ia Supernovae and Their Impact on Cosmology. arXiv:2609.05321, version 2, September 9, 2026; a preprint, submitted to *The Astrophysical Journal*. The companion paper, linked by the release. Abstract only.

5 DESI Collaboration, Abdul Karim, M., et al. (2025). DESI DR2 results. II. Measurements of baryon acoustic oscillations and cosmological constraints. *Physical Review D* 112, 083515. CC BY 4.0. We read sections IV.2 and VII–IX and Tables 5 and 6 in the arXiv version (arXiv:2503.14738, version 3), which matches the published one.

6 DESI Collaboration, Adame, A. G., et al. (2025). DESI 2024 VI: cosmological constraints from the measurements of baryon acoustic oscillations. *Journal of Cosmology and Astroparticle Physics* 2025(02), 021. CC BY 4.0. Abstract only.

7 DES Collaboration, Abbott, T. M. C., et al. (2024). The Dark Energy Survey: cosmology results with ~1500 new high-redshift type Ia supernovae using the full 5 yr data set. *The Astrophysical Journal Letters* 973, L14. CC BY 4.0. The DES-SN5YR analysis. Abstract only.

8 Popovic, B., Shah, P., Kenworthy, W. D., Kessler, R., et al. (2026). The Dark Energy Survey supernova program: a reanalysis of cosmology results and evidence for evolving dark energy with an updated type Ia supernova calibration. *Monthly Notices of the Royal Astronomical Society* 548, stag632. CC BY 4.0. The DES-Dovekie reanalysis. Abstract only, with the Unite paper’s account of it.

9 DES Collaboration (2026). Constraints on dynamical dark energy from multiple probes in the full Dark Energy Survey. arXiv:2605.27221, version 2, June 2, 2026; a preprint, submitted to *Physical Review Letters*. We read the abstract, the results and Table 1.

10 Efstathiou, G. (2025). Evolving dark energy or supernovae systematics? *Monthly Notices of the Royal Astronomical Society* 538, 875–882. CC BY 4.0. We read the abstract and section 5, its discussion and conclusions, in the arXiv version (arXiv:2408.07175, version 3).

11 Vincenzi, M., Kessler, R., Shah, P., et al. (2025). Comparing the DES-SN5YR and Pantheon+ SN cosmology analyses: investigation based on ‘evolving dark energy or supernovae systematics?’ *Monthly Notices of the Royal Astronomical Society* 541, 2585–2593. CC BY 4.0. The DES collaboration’s reply to Efstathiou; by our count from its Crossref author list, 18 of the Unite paper’s 24 authors are among its co-authors. We read the abstract and the conclusions in the arXiv version (arXiv:2501.06664).

12 Notari, A., Redi, M., and Tesi, A. (2025). BAO vs. SN evidence for evolving dark energy. *Journal of Cosmology and Astroparticle Physics* 2025(04), 048. CC BY 4.0. Abstract only.

13 Huang, L., Cai, R.-G., and Wang, S.-J. (2025). The DESI DR1/DR2 evidence for dynamical dark energy is biased by low-redshift supernovae. *Science China Physics, Mechanics & Astronomy* 68, 100413. Abstract only.

14 Hoyt, T. J., Rubin, D., Aldering, G., Perlmutter, S., Cuceu, A., and Gupta, R. (2026). Union3.1: reducing systematics in supernova cosmology with self-consistent measurements of host galaxy properties for 2000 type Ia supernovae. arXiv:2601.19424; a preprint. Abstract only.

15 Rubin, D., Hoyt, T., Aldering, G., and Perlmutter, S. (2026). Banana split: improved cosmological constraints with two light-curve-shape and color populations using Union3.1+UNITY1.8. arXiv:2601.19854, version 2, October 6, 2026: accepted for publication in *The Astrophysical Journal*, not yet published; Crossref had no record of it, and so no DOI, on October 26, 2026. Abstract only.

16 Rubin, D., Aldering, G., Betoule, M., et al. (2025). Union through UNITY: cosmology with 2,000 SNe using a unified Bayesian framework. *The Astrophysical Journal* 986, 231. CC BY 4.0. The Union3 compilation. Abstract only.

17 Brout, D., Scolnic, D., Popovic, B., et al. (2022). The Pantheon+ analysis: cosmological constraints. *The Astrophysical Journal* 938, 110. CC BY 4.0. Abstract only.

18 Dhawan, S., Popovic, B., and Goobar, A. (2025). The axis of systematic bias in SN Ia cosmology and implications for DESI 2024 results. *Monthly Notices of the Royal Astronomical Society* 540(2), 1626–1634, published online May 16, 2025. CC BY 4.0. Abstract only (the arXiv version’s, arXiv:2409.18668, which matches the published one).

19 Cortês, M., and Liddle, A. R. (2024). Interpreting DESI’s evidence for evolving dark energy. *Journal of Cosmology and Astroparticle Physics* 2024(12), 007. Abstract only.

20 Lodha, K., et al. (2025). Extended dark energy analysis using DESI DR2 BAO measurements. *Physical Review D* 112, 083511. CC BY 4.0. Abstract only.

21 Trotta, R. (2008). Bayes in the sky: Bayesian inference and model selection in cosmology. *Contemporary Physics* 49(2), 71–104. The scale for Bayes factors that the Unite paper adopts; we read its Table 1, in section 4.2, and section 4.4 in the arXiv version (arXiv:0803.4089).

22 O’Raifeartaigh, C., O’Keeffe, M., Nahm, W., and Mitton, S. (2018). One hundred years of the cosmological constant: from “superfluous stunt” to dark energy. *The European Physical Journal H* 43, 73–117. Abstract only.

23 Riess, A. G., et al. (1998). Observational evidence from supernovae for an accelerating universe and a cosmological constant. *The Astronomical Journal* 116, 1009–1038. Abstract only.

24 Perlmutter, S., et al. (1999). Measurements of Ω and Λ from 42 high-redshift supernovae. *The Astrophysical Journal* 517, 565–586. Abstract only.

25 Planck Collaboration, Aghanim, N., et al. (2020). Planck 2018 results. VI. Cosmological parameters. *Astronomy & Astrophysics* 641, A6. Abstract only.

26 Albrecht, A., et al. (2006). Report of the Dark Energy Task Force. arXiv:astro-ph/0609591. Abstract only; its figure of merit as Efstathiou (2025) describes it.

27 Chevallier, M., and Polarski, D. (2001). Accelerating universes with scaling dark matter. *International Journal of Modern Physics D* 10, 213–223. Abstract only.

28 Linder, E. V. (2003). Exploring the expansion history of the universe. *Physical Review Letters* 90, 091301. Abstract only.

29 Ratra, B., and Peebles, P. J. E. (1988). Cosmological consequences of a rolling homogeneous scalar field. *Physical Review D* 37, 3406–3427. Cited for its date and subject; we read only its Crossref record.

30 Popovic, B., Kenworthy, W. D., Ginolin, M., Goobar, A., et al. (2026). A reassessment of the Pantheon+ and DES 5YR calibration uncertainties: Dovekie. *Astronomy & Astrophysics* 712, A131. CC BY 4.0. The cross-calibration and its open-source code. Abstract only.

METHOD

How this was checked

On October 26, 2026, we checked every statement, number, quotation and citation on this page against its source. We read the paper's second arXiv version in full, as its PDF and as arXiv's HTML rendering, and the abstract and Table 8 of its first version, where the corrected significance differs [1]; its arXiv record and Crossref, including the 19 articles PASA had registered with Crossref since September 1, none of them this paper; and, in full, the University of Queensland's release, the episode's link [3]. Of the 27 other sources we read parts of five (DESI's second-release paper, DES's all-probe paper, Efstathiou's and Vincenzi et al.'s papers and Trotta's review), the abstracts of 21 and the record of one; each entry says which. The episode is quoted from its automatically generated transcript [2]. No site blocked our tools, and every journal DOI was resolved through Crossref.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They include the conversion of the paper's $\Delta\chi^2$ values into significances and of its evidence values into odds, judged on the scale it adopts, with a check of the sign of those values; the figure-of-merit arithmetic behind its "~30%"; the count of its sample and the one row of its Table 3 that does not add up; what its best fit implies for dark energy's density over time, with the correlation of w_0 and w_a that its figure of merit implies and the same arithmetic for the comparison fits; the comparison of significances across analyses; and our reading of the episode's two sentences against the history of the cosmological constant.

Nothing was re-run: the paper's Hubble diagram, code and likelihood are to be released only on acceptance [1 p. 22]. Our arithmetic uses numbers typed from the sources' text and tables, in short scripts kept with our verification notes. The significance conversions reproduce all 24 of the paper's values to within 0.06σ; the density curve uses the central values of w_0 and w_a, the two-parameter form and, for the lookback times, an assumed Hubble constant of 67.5 km/s/Mpc; the range of the crossing redshift, 0.25–0.36, comes from a Gaussian approximation with the correlation of about −0.91 implied by the figure of merit. Both charts are our own; no figure of the paper, which is under arXiv's non-exclusive licence, is redrawn. We could not check the tension values the paper shows only in its Fig. 12, or the combined significance without its nearby supernovae, which it does not report.

A fresh reviewer then read the built page against the sources and re-ran our arithmetic independently, reproducing every number. The changes that followed: the DES reanalysis's own 3.2σ and Hoyt et al.'s 3.4σ re-run of the same sample are now credited separately, in the text and the chart; claim 5 and its tile say that the supernovae's 1.9σ comes from today's w sitting about 2σ above −1, not from change over time; the release's statements are rated on the site's scale and its headline is described rather than rated; the critics' case is fuller (Efstathiou's 0.04 mag threshold and his point about the untested bias corrections) and the page says that Vincenzi et al.'s reply came from the DES collaboration, with most of Unite's authors among its co-authors; the Bayesian odds are given with the priors they depend on; Dhawan et al. is cited in its published version and Rubin et al. as accepted; the paper's second version has 26 pages, not 27; and several smaller wordings, locators and explanations were tightened.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

The verdicts on this page

MISLEADING	Contains something true but leaves a false impression, usually by leaving out key context.
UNCONFIRMED	Rests on a preliminary result that hasn't been confirmed.
PARTLY TRUE	Part of the claim holds up and part doesn't.
TRUE	The evidence supports the claim.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

If we get something wrong, we fix it and record the change below with the date. If a correction changes a verdict, the log says what the old verdict was.

Change log

Oct 26, 2026	Published on factchecked.science after a full check against the sources. Built from our verification of the Unite preprint (arXiv:2609.05053, version 2), the University of Queensland's release and the S0 News episode of October 26, 2026: five claims rated in the panel, two of them the episode's and three the paper's, and five of the release's statements rated in section 5; both charts are our own, from numbers in the sources' text and tables. After a fresh review the same day, the DES reanalysis's 3.2σ and Hoyt et al.'s 3.4σ re-run are credited separately, the supernovae-alone claim says its 1.9σ comes from today's w rather than from change, the release table uses only the site's scale, and the critics' case, the priors behind the Bayesian odds and two sources' publication status were updated.

Fact-Checked Science is independent. It isn't affiliated with the channels, presenters or authors whose claims it checks.