

THE STRIKE
ΔXIS

EVERY ETH OPTION PRICES THE ODDS OF FINISHING
BEYOND ITS STRIKE. NINE $\partial/\partial K$ GREEKS READ THOSE ODDS.
THE SMILE COMPLETES THEM.

ETH

	10 OCT	16 OCT	23 OCT	27 NOV	25 DEC
3,600				3% -1.3	7% -1.7
3,400		0% -0.4	1% -0.7	6% -1.7	10% -1.8
3,200		0% -0.7	2% -1.2	11% -1.9	16% -1.8
3,000	0% -0.5	2% -1.5	5% -2.1	19% -1.8	24% -1.3
2,800	2% -1.7	12% -2.6	18% -2.5	32% -0.8	35% -0.2
2,600	59% -2.3	53% +1.8	52% -0.7	50% +1.2	49% -1.4
2,400	98% +2.5	92% +3.5	85% +4.0	69% +3.3	64% +3.0
2,200		99% +2.0	97% +3.3	83% +4.2	77% +4.1
2,000		100% +1.2		92% +3.8	87% +4.2

SPOT
2,615

THE MARKET'S ODDS OF ETH SETTLING ABOVE EACH STRIKE · 7 OCT 2026 08:00 UTC

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THE READ

Ask an options trader for the odds that ETH finishes above a strike and most of them will quote you the Delta. It sits on every screen, it runs from 0 to 1 and it looks like a probability. The textbook gives a different number, $N(d_2)$, which Cayø Largo publishes with a discount and a minus sign as Dual Delta Greek. It is one of nine Greeks we compute by moving the **strike** instead of the price. The first half of this Issue teaches all nine.

At first sight they look like a new family of Greeks though, in fact, they are not. Taken at each option's own volatility, every strike Greek is an exact rearrangement of the spot Greeks. In other words, we are looking at **two views of one surface**. The smile is what tells them apart. Read the **probability off the whole chain** rather than off one option. You can discover that at the 25-Delta put 30 days out, Dual Delta overstates the chance of a close below it by **4%** on the average day.

Pages 16 and 17 put all of it on one sheet. The **Odds Board** gives the market's own odds of ETH settling above every strike, at every listed expiry, with the smile read in. The cover shows you a corner of it, taken at 08:00 UTC this morning (Oct 7). Everything before the centrefold teaches you to read it. Everything after shows how it held up against what actually settled, how you can put it to work and the 13 months of data underneath.

THE SCREEN SHOWS YOU DELTA. THE TEXTBOOK GIVES YOU DUAL DELTA.
ONLY THE ODDS BOARD SHOWS WHAT THE MARKET ACTUALLY PAYS.

ETH · CONSTANT 30-DAY TENOR

WHERE THE WATER SITS

ARCHIVE READ 7 OCT 2026 · 08:00 UTC · ORANGE IS TODAY, P IS ITS PERCENTILE SINCE AUG 2025



ETH traded at 2,615 USD this morning, 7 October, more than a third below where it stood when our archive began in August 2025. Yet the options market had gone quiet. The 30-day At-The-Money Implied Volatility (ATM IV) read 45.3%, a level it went below on only five mornings, 15 to 19 August 2026. The 7-day ATM IV was lower still, at 40.9%.

The smile had gone quiet too. For most of the year ETH puts traded well over calls: the 30-day 25-Delta Risk Reversal (RR), i.e. call IV minus put IV, sat at a median of -3.4 volatility points. Since 23 September it had stayed within 0.8 volatility points of zero every morning and today it read -0.6. The market had almost stopped paying extra for downside protection.

Keep that **flat smile in mind, because the smile's lean is the subject of this Issue. It sets how far the market's odds drift from** Dual Delta. On a typical morning the put side carries almost all of that correction, about 4 percentage points against 1 at the call. Today the two sides shared it: 3.4 percentage points at the 25-Delta put and -2.2 at the 25-Delta call. The board on pages 16 and 17 shows what a flat smile does to the odds.

01 THE STRIKE AXIS MOVING THE STRIKE. NOT THE PRICE

Every Greek on your risk report answers the same kind of question, i.e. what happens to the option when any of option's three parameters (spot, volatility, time), sensitive to the market itself, moves? The fourth option's sensitivity, the strike, is different. Why? Nobody moves it once the trade is done. Differentiate by it anyway and the answers stop being about your position. They start being about the *market's probabilities*.

PROBABILITY

What the market pays for a strike to finish in the money

DUAL DELTA

$$\partial V / \partial K$$

The price of a bet that ETH settles beyond the strike, i.e. the discounted probability $N(d_2)$.

DUAL GAMMA

$$\partial^2 V / \partial K^2$$

The probability density at the strike: how much of the distribution sits there.

LIGHTNING*

$$\partial^3 V / \partial K^3$$

The slope of that density. It changes sign at the most likely settlement level.

VOLATILITY

How the probabilities respond when implied volatility moves

SURFACE VANNA*

$$\partial^2 V / \partial K \partial \sigma$$

How each strike's odds move when IV rises: up for far strikes, down near the money.

FLARE*

$$\partial^3 V / \partial K^2 \partial \sigma$$

How the density reshapes with IV, moving probability from the centre to the tails.

HALO*

$$\partial^3 V / \partial S \partial \sigma \partial K$$

How vanna changes from one strike to the next.

TIME

How the probabilities change as expiry approaches

SURFACE CHARM*

$$\partial^2 V / \partial K \partial t$$

The daily drain of each strike's odds: out of the money toward zero, in the money toward one.

DROPLET*

$$\partial^3 V / \partial K \partial \sigma \partial t$$

How surface vanna builds or fades into expiry.

AURORA*

$$\partial^4 V / \partial S \partial \sigma \partial K \partial t$$

How halo changes with time. Largest near spot in the final days.

Cayø Largo computes all nine of these Greeks for over 2,500 options on Deribit every ten minutes. In the table above, we group them by what they describe.

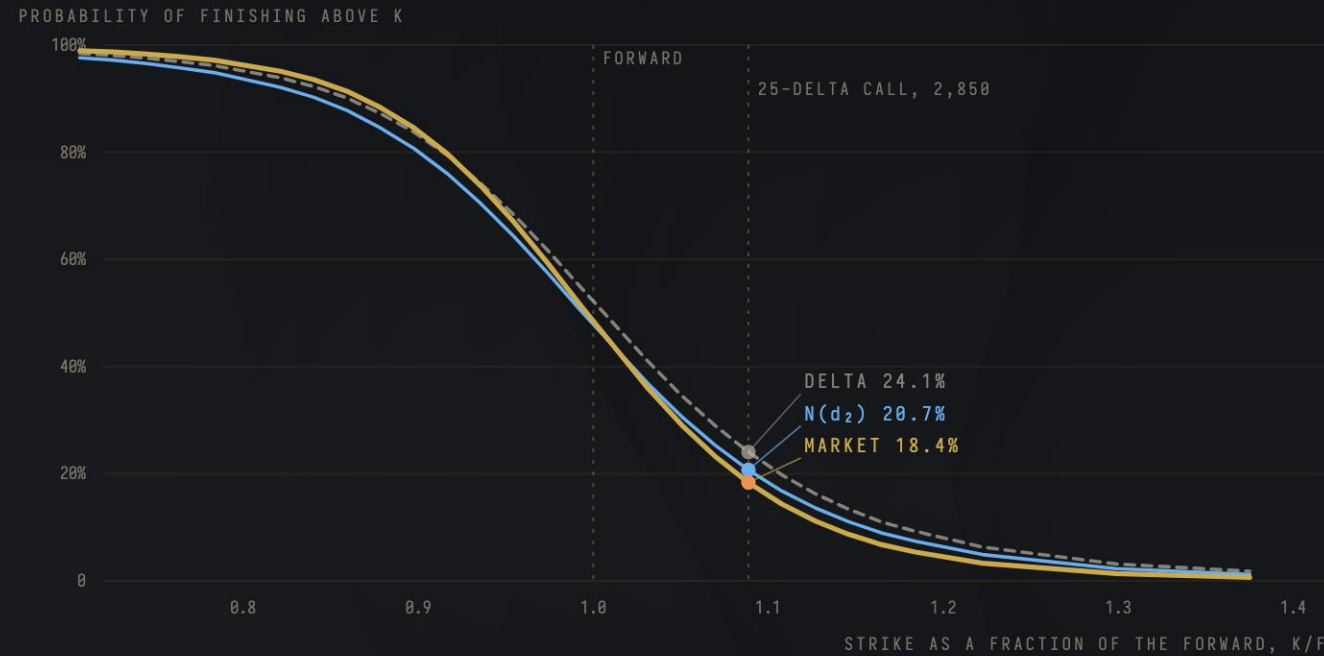
Over the next four pages we take the families in turn, each on real ETH expiries. Page 10 then shows why none of the nine stands on its own. Page 11 shows what separates them from the spot Greeks they mirror.

** Surface Vanna, Surface Charm, Lightning, Flare, Droplet, Halo and Aurora are names coined by Cayø Largo to describe and monitor how crypto options respond in a market this volatile. Dual Delta and Dual Gamma are the standard textbook terms (Wystup 2006; Haug 2007).*

02 DUAL DELTA THE PRICE OF A BET ON A STRIKE

ETH, 30 OCT 2026 EXPIRY, 23 DAYS OUT · 7 OCT 2026 08:00 UTC

--- DELTA, $N(d_1)$ — $N(d_2)$ FROM DUAL DELTA — MARKET, SMILE INCLUDED



Take the ETH options expiring on 30 October, 23 days to expiry, with ETH at 2,615 USD. Every call on that chain carries a Delta that sooner or later every trader reads as the chance of finishing in the money. At the 2,850 strike, the 25-delta call, the screen says **24.1%**.

The textbook disagrees. Delta is $N(d_1)$, the hedge ratio, while the probability under the same model is $N(d_2)$, which Cayø Largo calculates and stores as Dual Delta, namely the derivative of the option price with respect to the strike:

$$\partial C / \partial K = -e^{-rT} N(d_2)$$

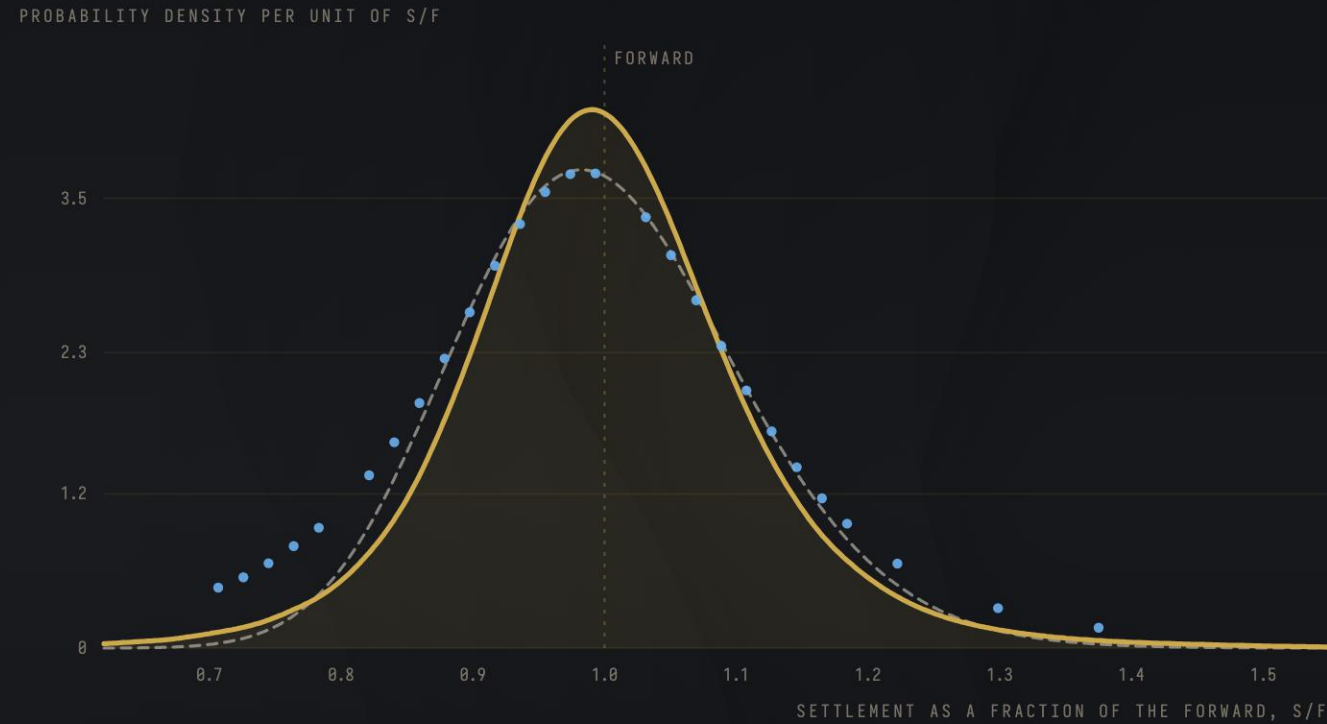
Since d_1 and d_2 differ by $\sigma\sqrt{T}$, Delta overstates the probability on every call by construction. Here that means 24.1% against **20.7%**. At the money the gap grows to 4.3 percentage points, 54.7% against 50.3%.

The gold line in the chart gives a third answer: the probability the market itself is paying for, once the whole smile is taken into account. Page 11 shows how we build it. At the 2,850 strike it reads 18.4%, which is 2.3 percentage points below Dual Delta and 5.7 below Delta. One question, three answers: 24.1% from Delta, 20.7% from Dual Delta and 18.4% from the market. The rest of this Issue is about the third one.

03 DUAL GAMMA Δ DISTRIBUTION. READ OFF THE STRIKES

THE SAME EXPIRY · WHAT THE MARKET PRICES FOR EACH SETTLEMENT LEVEL

— MARKET DENSITY, SMILE INCLUDED --- LOGNORMAL AT ATM IV — DUAL GAMMA AT EACH STRIKE'S OWN IV



Differentiate once more by the strike and you get Dual Gamma Greek, which is the probability density itself. Breeden and Litzenberger (1978) showed that the second strike derivative of the call price, compounded forward, is the **risk-neutral density** of the settlement price:

$$q(K) = e^{rT} \partial^2 C / \partial K^2$$

Let's make it tangible with a *butterfly option trading strategy. Buy the 2,500 and 2,600 calls and sell two 2,550s. You now own a small tent of payoff centred on 2,550. Its price is the density times the strike spacing squared. On 7 October that butterfly cost 3.92 USD*, what translates into about a 79% chance of ETH settling within that band on 30 October.

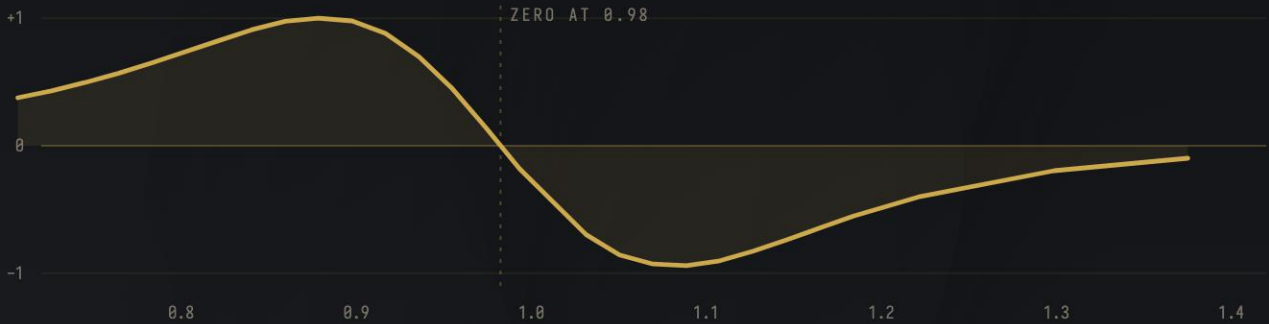
The blue dots are the trap. Cayø Largo's Dual Gamma is computed per option at its own implied volatility, so each dot is a lognormal density evaluated at a different volatility. They trace the right hump in the middle, yet joined together they are not one distribution. The gold curve is, since it integrates to 0.99 inside the listed strikes. Page 11 shows how the one becomes the other.

04 LIGHTNING AND FLARE

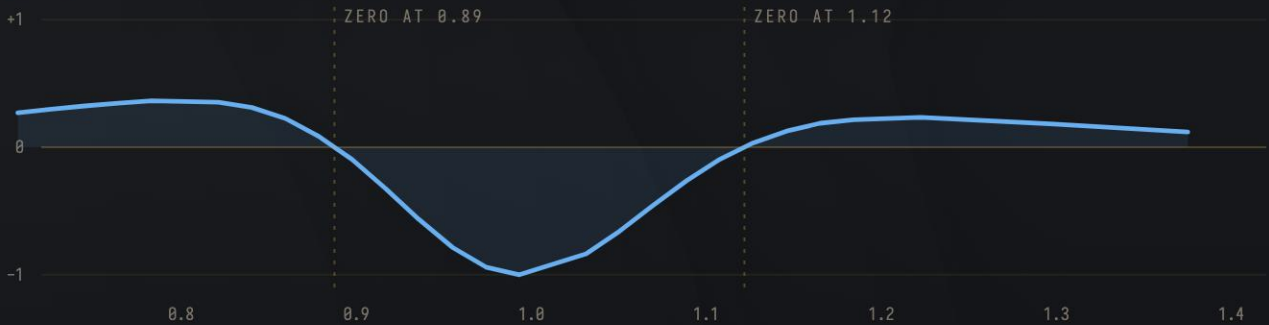
THE SLOPE OF THE DISTRIBUTION, AND HOW IT MOVES

THE SAME EXPIRY · EACH SCALED TO ITS OWN MAXIMUM

LIGHTNING, $\partial^3V/\partial K^3$: THE SLOPE OF THE DENSITY



FLARE, $\partial^3V/\partial K^2\partial\sigma$: HOW THE DENSITY MOVES WHEN IV RISES



Two more derivatives complete the probability family. Both are easier to read by where they change sign than by their size.

Lightning, the third strike derivative, is the slope of the density: positive below the peak, negative above it. Its zero therefore marks the most likely settlement level. On this chain it crosses at 0.982 of the forward. Keep in mind whose peak that is. It belongs to each option's own lognormal, while the market's density, the gold curve on the previous page, peaks at 0.991, ca. 22 USD higher.

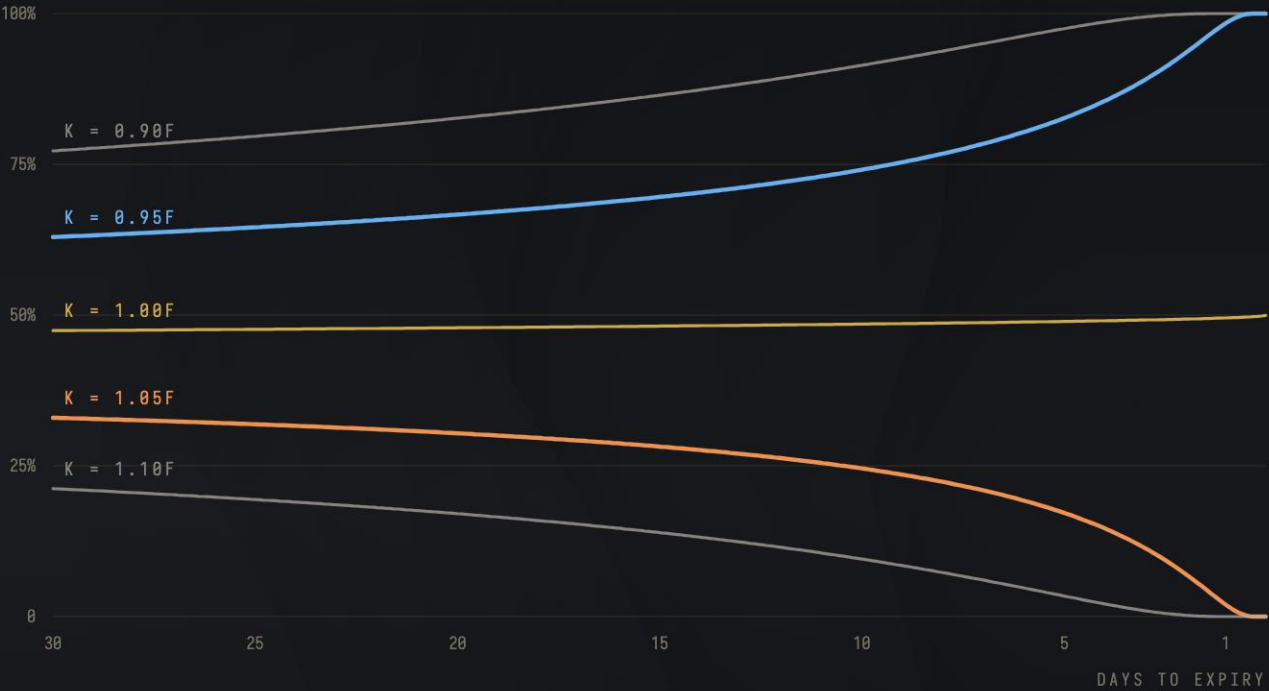
Flare measures how the density moves when implied volatility rises. It is negative between 0.888 and 1.122 of the forward and positive outside that band, i.e. a rise in volatility takes probability away from the middle of the distribution and hands it to the tails. If you are short the body of the distribution, through a butterfly or a short straddle, you are short Flare in exactly that band.

05 THE TIME FAMILY

HOW THE ODDS DRAIN INTO EXPIRY

ILLUSTRATION · FORWARD AND 30-DAY ATM IV HELD AT TODAY'S 45.3%

PROBABILITY OF FINISHING ABOVE K



The last family asks how these probabilities change with time alone. Let's hold the forward and the volatility still and let the calendar run, which is exactly what the chart does for five strikes around the forward, with 30-day ATM IV at its current 45.3%.

Thirty days out the odds are spread wide: 63% for a strike 5% below the forward, 33% for one 5% above. With a day to expiry they have nearly decided, 98.3% and 2.0%. The strike at the forward stays close to even the whole way. **Surface Charm** is the slope of each line, namely the daily change in a strike's probability of finishing in the money. Watch the last two days. The strikes 5% either side of the forward move by 5.0 and 5.1 percentage points, in opposite directions, like a coin that has stopped spinning and is choosing its side.

Droplet and Aurora follow the same logic one level up. **Droplet** is the daily change in Surface Vanna, **Aurora** the daily change in Halo. Both concentrate near spot in the final days. Page 26 shows Droplet at work in the live book.

TWO VIEWS

06 NINE IDENTITIES.
ONE SURFACE

EVERY STRIKE GREEK WRITTEN IN SPOT GREEKS · 674 ETH OPTIONS, 22 SEP 2026 12:00 UTC

STRIKE GREEK	EQUALS, IN SPOT GREEKS	MEDIAN GAP	LARGEST GAP
Dual Delta	$(V - S \cdot \Delta) / K$	4.3×10^{-16}	5.9×10^{-14}
Dual Gamma	$(S/K)^2 \cdot \Gamma$	7.6×10^{-16}	3.9×10^{-14}
Lightning	$-(S/K)^2 (3\Gamma + S \cdot \text{Speed}) / K$	2.0×10^{-15}	1.5×10^{-12}
Surface Vanna	$(\text{Vega} - S \cdot \text{Vanna}) / K$	8.1×10^{-16}	1.8×10^{-14}
Flare	$(S/K)^2 \cdot \text{Zomma}$	2.2×10^{-15}	1.2×10^{-12}
Halo	$-(S/K) \cdot \text{Zomma}$	1.6×10^{-15}	7.5×10^{-13}
Surface Charm	$(\Theta - S \cdot \text{Charm}) / K$	1.1×10^{-15}	1.0×10^{-13}
Droplet	$(\text{Veta} - S \cdot \text{Vannacay}) / K$	2.4×10^{-15}	4.0×10^{-13}
Aurora	$-(S/K) \cdot \text{Instability}$	2.3×10^{-15}	1.3×10^{-12}

Here is the property the first half of this Issue turns on. Scale the spot price and the strike by the same factor and a Black-Scholes price scales with them. In Euler's language the price is homogeneous of degree one in S and K, what gives

$$V = S \partial V / \partial S + K \partial V / \partial K$$

Differentiate that identity and every strike Greek falls out as an exact combination of spot Greeks. The table lists all nine as Cayø Largo stores them, checked on each of 674 ETH options in one cycle. The largest gap is 1.5×10^{-12} , i.e. rounding error in double precision.

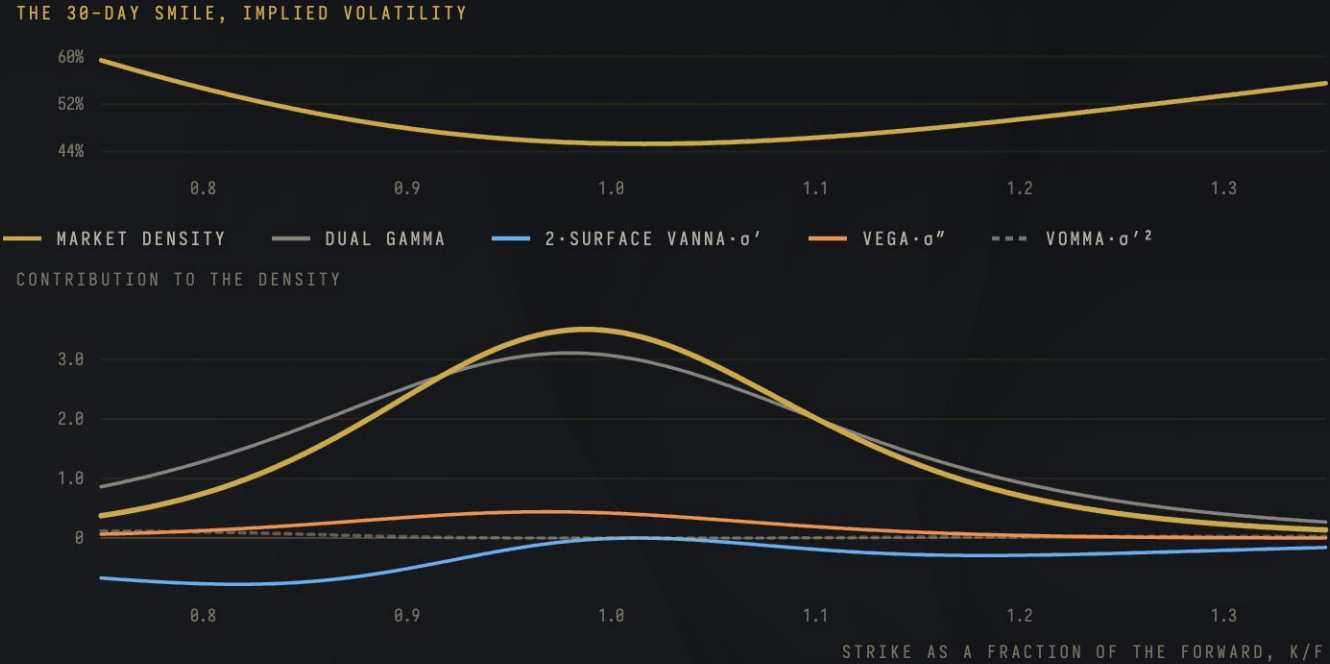
Nobody trades one option, so we checked the book as well. Cayø Largo sums these Greeks per strike, weighted by open interest and signed for the dealer. Every option in a strike row shares the same K and S, so the identity survives the sum (on 46,156 ETH strike rows net dual gamma equals $(S/K)^2$ times net gamma on 99.998% of them).

Any sailor knows the feeling. Turn the chart so that south sits at the top and not a single depth changes. Computed at each option's own volatility, the strike Greeks carry no information the spot Greeks do not. That is precisely why they can be trusted. Their value is the question they answer. Spot Greeks say how your position moves, strike Greeks say what the market prices: Dual Delta is the price of a bet on a strike, Dual Gamma how much probability sits there, with no algebra in between. Page 11 lets the smile in and that is where something new appears.

WHERE THE SYMMETRY BREAKS

07 THE SMILE AND
THE FOUR TERMS

ETH, CONSTANT 30-DAY TENOR, 7 OCT 2026



The symmetry holds only while each option keeps its own volatility fixed. The market does not work that way. Move the strike and you move along the smile, so the volatility changes with the strike too. Differentiate the call price with that in mind and the chain rule adds three terms, all built from Greeks Cayø Largo already stores:

$$\partial^2 C / \partial K^2 = \text{Dual Gamma} + 2 \text{Surface Vanna } \sigma' + \text{Vomma } \sigma'^2 + \text{Vega } \sigma''$$

Here σ' and σ'' are the slope and the curvature of the smile at the strike. What we get is the market's density. It is the one place where the strike Greeks say something the spot Greeks cannot.

The chart takes it apart on the 30-day ETH smile of 7 October. Dual Gamma still carries the bulk, 89% of the peak. The slope term, twice Surface Vanna times the skew, reaches 22% of the peak on the downside wing, where the smile is steepest. The curvature term adds 13% near the money, while Vomma times the squared slope barely registers. The four terms sum to the density on page 14 to within 0.001%.

Only four Greeks enter because the density is a second derivative in the strike. It needs Dual Gamma plus the Greeks that carry the smile's slope and curvature: Surface Vanna, Vomma and Vega. The rest describe how the density moves rather than what it is. Lightning and Flare reshape it, the time family drains it. They return on pages 25 and 26.

08

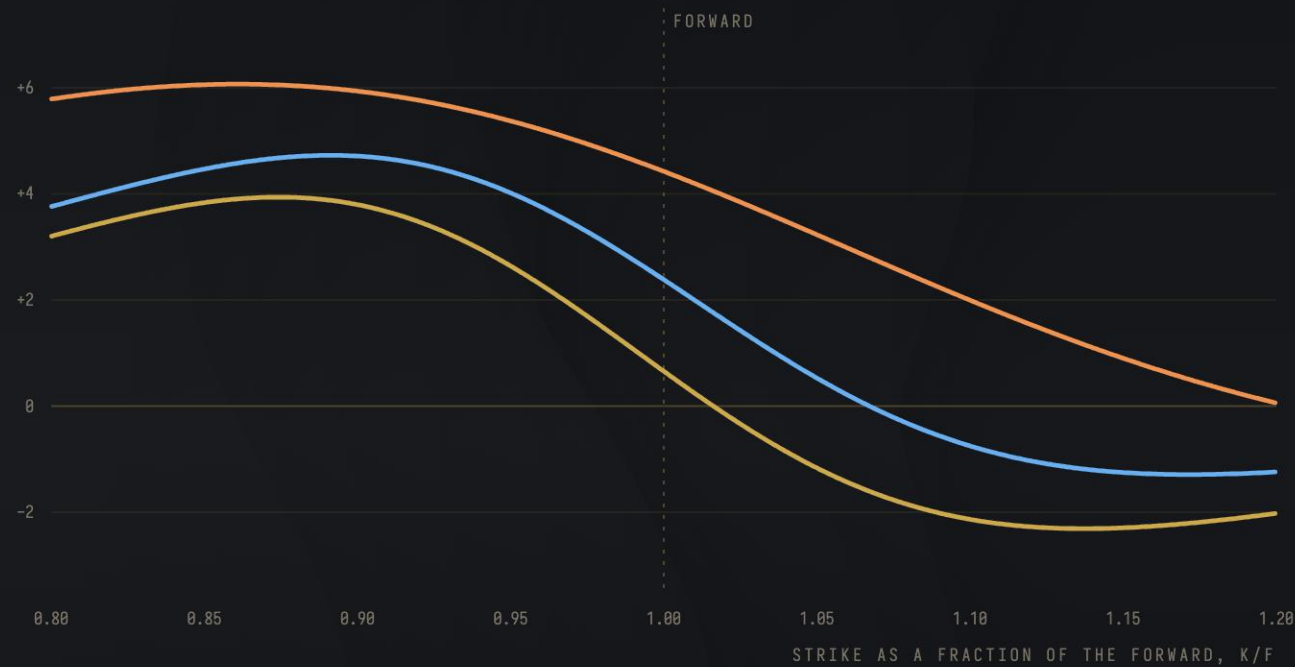
MARKET AGAINST TEXTBOOK

THE CORRECTION.
STRIKE BY STRIKE

ETH, CONSTANT 30-DAY TENOR · THREE DAYS CHOSEN BY 30-DAY ATM IV

06 FEB 2026, STRESSED, 30-DAY ATM IV 82% 17 AUG 2026, QUIET, 30-DAY ATM IV 44%
07 OCT 2026, TODAY, 30-DAY ATM IV 45%

MARKET MINUS DUAL DELTA, PERCENTAGE POINTS



Page 11 let the smile into the density. One step down, the same chain rule reaches the probability itself. The market's probability of finishing above a strike is Dual Delta plus a single smile term:

$$P(S(T) > K) = N(d_2) - e^{rT} Vega \sigma'$$

In words: take the textbook probability and correct it by Vega times the slope of the smile at that strike. The chart shows that correction, market minus Dual Delta, across strikes on three days picked by 30-day ATM IV: the highest in our archive (82.1% on 6 February 2026), the lowest (43.5% on 17 August) and this morning, 7 October, at 45.3%. All three are read at a constant 30-day horizon, interpolated between listed expiries, so you compare like with like.

Below the forward the correction is positive on every day. The skew lifts put-side volatility and with it the chance of finishing low that Dual Delta reads. The slope term takes part of it back. Above the forward the sign follows the smile's lean. On 6 February, with puts priced 10.7 volatility points over calls, the correction stayed positive almost everywhere. This morning, with the smile nearly level, calls lost up to 2.3 percentage points.

08

MARKET AGAINST TEXTBOOK

THIRTEEN MONTHS, AND
WHAT DRIVES IT

ETH, 25-DELTA STRIKES, EVERY DAY AT 08:00 UTC · BELOW: PUT-STRIKE CORRECTION BY THIRDS, PP

25-DELTA PUT, 30-DAY 25-DELTA CALL, 30-DAY THIN LINES: 7-DAY

MARKET MINUS DUAL DELTA, PERCENTAGE POINTS



	30-DAY ATM IV 44 TO 53%	30-DAY ATM IV 53 TO 67%	30-DAY ATM IV 67 TO 82%
Risk Reversal -10.7 to -4.3 vol pts	+5.5 n=28	+5.4 n=48	+4.9 n=60
Risk Reversal -4.3 to -2.4 vol pts	+4.2 n=49	+3.7 n=46	+3.8 n=40
Risk Reversal -2.4 to +3.0 vol pts	+3.1 n=59	+3.0 n=41	+2.9 n=36

One day could be a coincidence. Thirteen months cannot. The chart reads the correction every morning at 08:00 UTC at the two 25-Delta strikes, 30 days out in bold and 7 days out in the faint lines. At the put strike it averaged +4.0 percentage points and ranged from 1.7 to 7.1. It stayed above 2 percentage points on 99% of days and never once reached zero. At the call strike it averaged -1.0 percentage point and changed sign whenever the smile changed its lean.

The obvious suspect is the level of volatility. If the correction were a volatility effect, it would grow as implied volatility rises. It does not. The table splits the 407 days into thirds by 30-day ATM IV and by the 25-Delta Risk Reversal (RR). Read across a row and the put correction barely moves. Read down a column and it falls from about 5.5 to about 3.0 percentage points. Its correlation with the RR is -0.92, with ATM IV only 0.05.

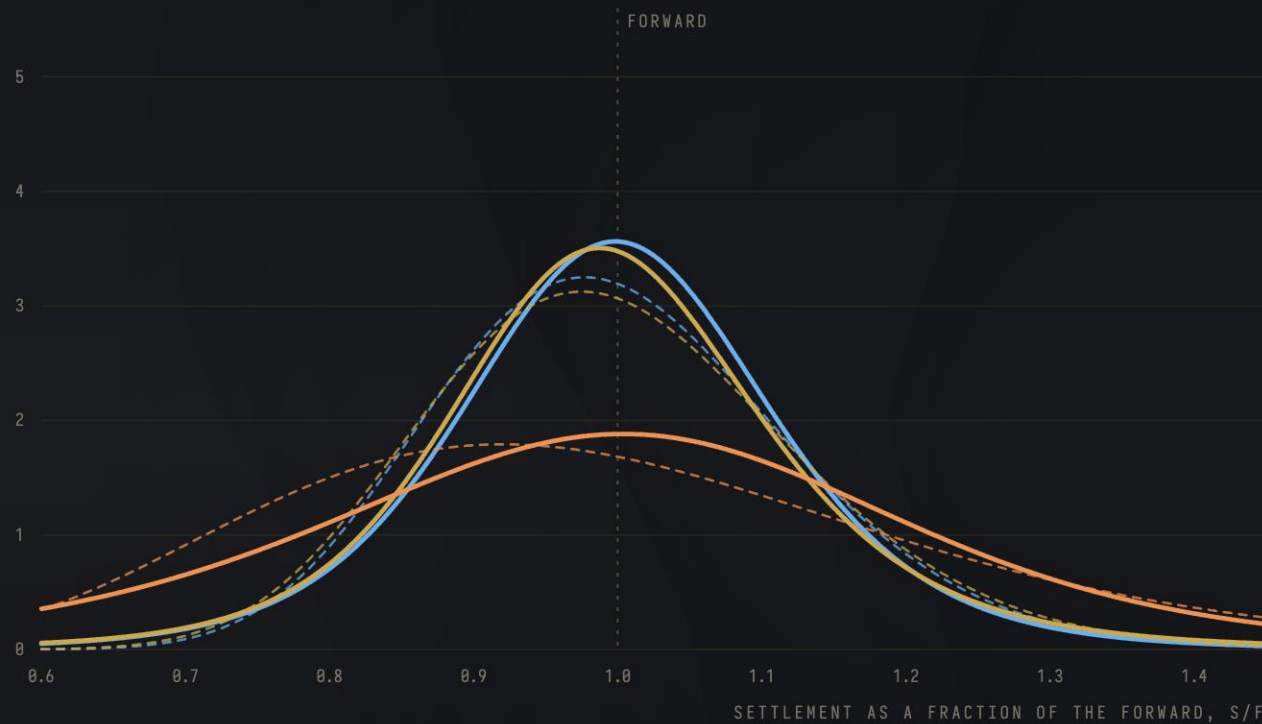
No wonder why: the correction is Vega times the slope of the smile, exactly as the formula on page 12 says. It is a skew effect, not a volatility effect. The shaded band in December and January is a gap in our Greeks archive, left visible rather than bridged.

THE DISTRIBUTION
09 WHAT ETH TRADES ON,
THIRTY DAYS OUT

ETH, CONSTANT 30-DAY TENOR · THE SAME THREE DAYS AS PAGE 12

06 FEB 2026, STRESSED, 30-DAY ATM IV 82% 17 AUG 2026, QUIET, 30-DAY ATM IV 44%
07 OCT 2026, TODAY, 30-DAY ATM IV 45% --- DASHED: LOGNORMAL AT THE SAME ATM IV

PROBABILITY DENSITY PER UNIT OF S/F



Put the four density terms of page 11 together and we can draw the distribution the market actually prices. Let's set it against the lognormal a single volatility would imply: solid lines are the market, dashed lines the lognormal at the same 30-day ATM IV.

The difference is not where most people look for it. Within 15% of the forward the market puts **less** probability than the lognormal: on 7 October, 11.0% against 11.8% for a fall of more than 15% in thirty days. Beyond 30% it puts more. Much more. On 7 October a fall of more than 30% was priced at 1.66% against 0.37%. On the quiet day in August it was 1.61% against 0.26%, six times as much.

In other words, the smile takes probability out of the shoulders of the distribution and moves it into the far tails. If you sell a 15% out-of-the-money put and your neighbour sells a 30% one, you are not doing the same trade at two sizes. Against a lognormal, yours is sold cheap and theirs is sold rich.

THE DISTRIBUTION
09 THE TAILS,
SEVEN DAYS OUT

PROBABILITY OF A 15% MOVE IN 7 DAYS, SMILE MINUS LOGNORMAL · 226 DAYS

— FALL OF MORE THAN 15% IN 7 DAYS — RISE OF MORE THAN 15% IN 7 DAYS

SMILE MINUS LOGNORMAL, PERCENTAGE POINTS



Thirty days out a 15% move is less than one standard deviation, so the previous page was reading the shoulder. Seven days out it is closer to two, since the average 7-day move priced by ATM IV is about 8.2%. A week is therefore the right horizon to test the tails. The chart plots the market's probability minus the lognormal's, for a fall and for a rise. The answer is not symmetric.

On the downside the market priced a fall of more than 15% at **4.3%** on the average day, against 3.2% for the lognormal. Fatter on 98% of the 226 days with strikes quoted far enough out. On the upside the picture reverses: 4.2% against 4.5%, fatter on only 40% of days.

The ETH options book pays for crashes. It does not pay for rallies. It is the same lean the RR shows on page 13, only now written as probabilities you can hold against your own view. Whether that price was right is a different question. Pages 19 and 20 take it up against what settled.

10

THE ODDS BOARD

THE MARKET'S ODDS,
STRIKE BY STRIKE

THE MARKET'S ODDS OF ETH SETTLING ABOVE EACH STRIKE, AT EVERY LISTED EXPIRY, SMILE INCLUDED. DERIBIT, 7 OCTOBER 2026, 08:00 UTC.

	08 OCT	09 OCT	10 OCT	11 OCT	16 OCT	23 OCT	30 OCT	27 NOV	25 DEC
3,600							1% -0.6	3% -1.3	7% -1.7
3,500							1% -0.8	5% -1.5	8% -1.8
3,400					0% -0.4	1% -0.7	1% -1.0	6% -1.7	10% -1.8
3,300					0% -0.5	1% -0.9	2% -1.3	8% -1.8	12% -1.8
3,200					0% -0.7	2% -1.2	3% -1.6	11% -1.9	16% -1.8
3,100			0% -0.4		1% -1.0	3% -1.6	5% -2.0	14% -2.0	19% -1.6
3,000		0% -0.5	0% -0.5	1% -0.8	2% -1.5	5% -2.1	9% -2.3	19% -1.8	24% -1.3
2,900		0% -0.7	0% -0.9	2% -1.3	5% -2.2	10% -2.6	14% -2.5	25% -1.5	29% -0.8
2,800	0% -0.5	1% -1.3	2% -1.7	7% -2.0	12% -2.6	18% -2.5	23% -2.1	32% -0.8	35% -0.2
2,700	4% -1.5	11% -2.3	15% -2.4	23% -1.7	28% -1.8	33% -1.5	36% -0.9	40% +0.1	42% +0.6
2,600	65% +3.8	60% +2.3	59% +2.3	55% +1.2	53% +1.0	52% +0.7	51% +0.9	50% +1.2	49% +1.4
2,500	98% +2.4	94% +3.2	92% +4.1	84% +3.1	78% +3.4	71% +2.9	67% +2.7	59% +2.3	57% +2.2
2,400	100% +1.0	99% +1.5	98% +2.5	96% +2.4	92% +3.5	85% +4.0	80% +3.7	69% +3.3	64% +3.0
2,300	100% +0.7	100% +0.8	100% +1.7	99% +1.4	97% +2.7	93% +3.9	88% +3.8	77% +3.9	71% +3.6
2,200		100% +0.5		100% +0.9	99% +2.0	97% +3.3	94% +3.3	83% +4.2	77% +4.1
2,100		100% +0.4			99% +1.5		96% +2.7	88% +4.1	83% +4.2
2,000					100% +1.2		98% +2.0	92% +3.8	87% +4.2

SPOT
2,615

THE ODDS BOARD

HOW TO READ IT,
AND WHAT IT SAYS

Think of the board as a chart of soundings. Each cell is one depth reading: what the options market pays, today, for ETH to settle above this strike on this date. Read across a row and you see how the odds of one level change with time. Read down a column and you see the market's whole distribution for one expiry, from near-certain at the bottom to near-impossible at the top. The small figure is the smile at work, namely the market's odds minus Dual Delta's, in percentage points. Blank cells are strikes Deribit does not list for that date, so the board narrows at the front and widens with time.

Three readings from this morning's board.

The even-money level starts just above spot and edges lower with time: 2,625 for tomorrow, 2,608 for 30 October, 2,598 for 27 November and 2,589 for 25 December, against spot at 2,615. That is not a bearish call. The forward is an average. A price that cannot fall below zero but can rise without limit keeps its average above its middle. The further out, the wider that gap.

The short end is tight. For Friday's expiry the market gives 99% odds of a settlement above 2,400 and 1% above 2,800, i.e. 98% odds that ETH settles between the two.

The smile works harder below spot than above it. Below spot the market prices up to 4.2 percentage points more than Dual Delta on 27 November and 25 December. Saturday's expiry already shows 4.1. Above spot it never prices more than 2.6 less.

None of this is a forecast. It is what the market charges, read to the percentage point. Page 19 shows how such odds have fared against what actually settled.

THE ODDS BOARD

10 HOW THE BOARD IS BUILT

WHAT THE BOARD HAS BEEN CHECKED AGAINST

CHECKED AGAINST	RESULT	MEASURED
Tradable call spreads, 30 Oct 2026	the board's odds match them within	0.15 to 0.24 pp
Deribit's marks, every morning	butterflies priced at zero or more	99.2% of 53,434
Every fitted smile, every morning	free of butterfly arbitrage	100.0% of 3,315
101 ETH settlements	calibration error, lowest of the three readings	0.00099
Nine strike Greeks	identities with the spot Greeks hold to	1.5×10^{-12}

Every cell on the board comes out of the same five steps, run every ten minutes on every ETH option Deribit lists.

One expiry at a time. Each listed expiry keeps its own smile. Nothing is borrowed from its neighbours and nothing is averaged across dates.

A smile that cannot contradict itself. The smile we fit is checked at every strike for butterfly arbitrage, the condition a real distribution must meet. All 3,315 smiles in the archive pass across their quoted strikes.

Odds from the whole curve. A cell is read from how the price of the whole chain changes with the strike, not from one option's volatility. That is where the smile enters and where the board parts company with Dual Delta.

No extrapolation. Where Deribit lists no strike, the board shows no number. Just beyond the quoted range the same smiles would fail the arbitrage check in 0.42% of cases, so we stop where the market stops.

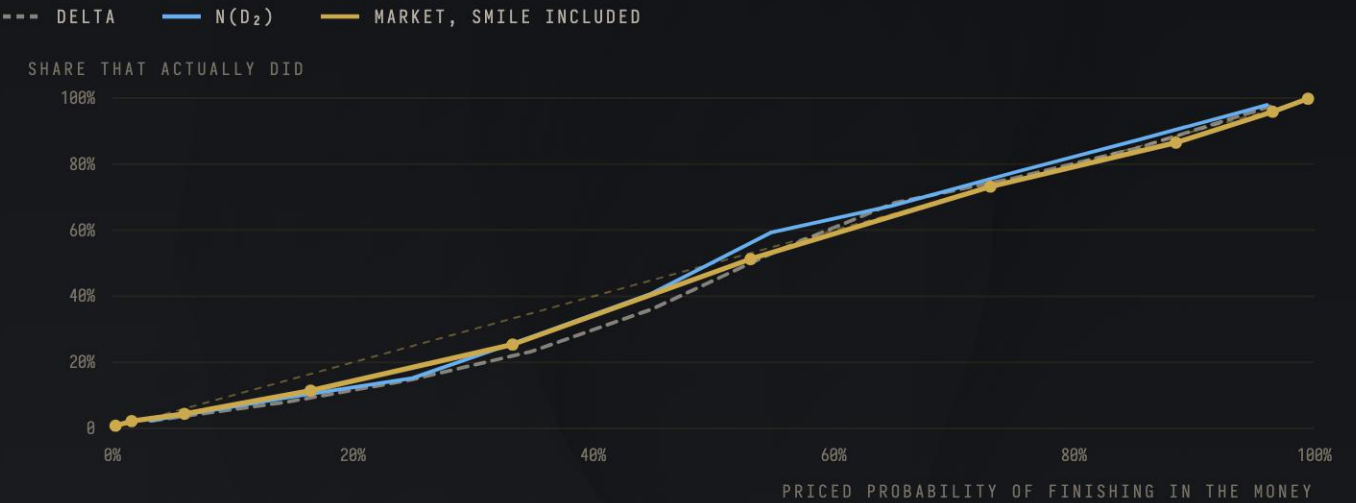
Checked against what can be traded and what settled. The table lists what the board has been held to so far.

What you will not find in these pages is the machinery that turns those five steps into numbers every ten minutes. It took thirteen months to build. Every cycle since has been a test of it.

PROVEN AGAINST WHAT HAPPENED

11 THREE READINGS. 101 SETTLEMENTS

ETH CALLS 1, 3, 7 AND 14 DAYS BEFORE SETTLEMENT · AUG 2025 TO SEP 2026



BRIER SCORE	ALL	1 DAY	3 DAYS	7 DAYS	14 DAYS
Delta	0.0971	0.0832	0.1033	0.0837	0.1246
N(d ₂)	0.0962	0.0828	0.1029	0.0829	0.1215
Smile	0.0962	0.0836	0.1030	0.0816	0.1209
Expiries	101	99	97	51	50

A probability is only worth publishing if it survives contact with outcomes. We graded three readings of the odds against every ETH expiry from 11 August 2025 to 22 September 2026: Delta, N(d₂) from Dual Delta and the market's own with the smile. Each call was read 1, 3, 7 and 14 days before settlement and marked by whether it finished in the money, using Deribit's official delivery prices. That is 101 expiries and 6,300 observations.

A perfect probability sits on the diagonal. Measured by how far each line strays from it on average, the ranking runs the way the theory says: Delta 0.00221, N(d₂) 0.00129, the market's odds 0.00099. The Brier scores agree in order, 0.0971, 0.0962 and 0.0962. Brier (1950) built his score to grade weather forecasts and it grades option prices just as well, though here the differences are small next to the noise of one year. All strikes of one expiry share one outcome, so the honest sample is 101, not 6,300.

One gap we cannot yet explain. Seven days out, out-of-the-money calls were priced to finish in the money 14.3% of the time and did so 7.0%. ETH fell 36.3% across the sample, which alone would do that. The puts lean the same way, which a falling market would not. A second year of settlements will tell the two apart.

11 THE ODDS BAND. EVERY MORNING

THE MARKET'S 30-DAY ODDS FOR ETH, READ EACH MORNING, AGAINST WHERE ETH WAS 30 DAYS LATER

MARKET MEDIAN, 30 DAYS OUT ETH THAT MORNING SHADED: 10-90% AND 25-75% OF THE MARKET'S ODDS DOTS: ETH 30 DAYS LATER



The board is one morning. The archive holds every morning, so we can ask how the market's odds have fared as a whole. Each day we read the 30-day board and marked the strikes that split it into the market's own percentiles. The shaded bands hold the middle 50% and 80% of the odds. The dots are where ETH actually was thirty days later.

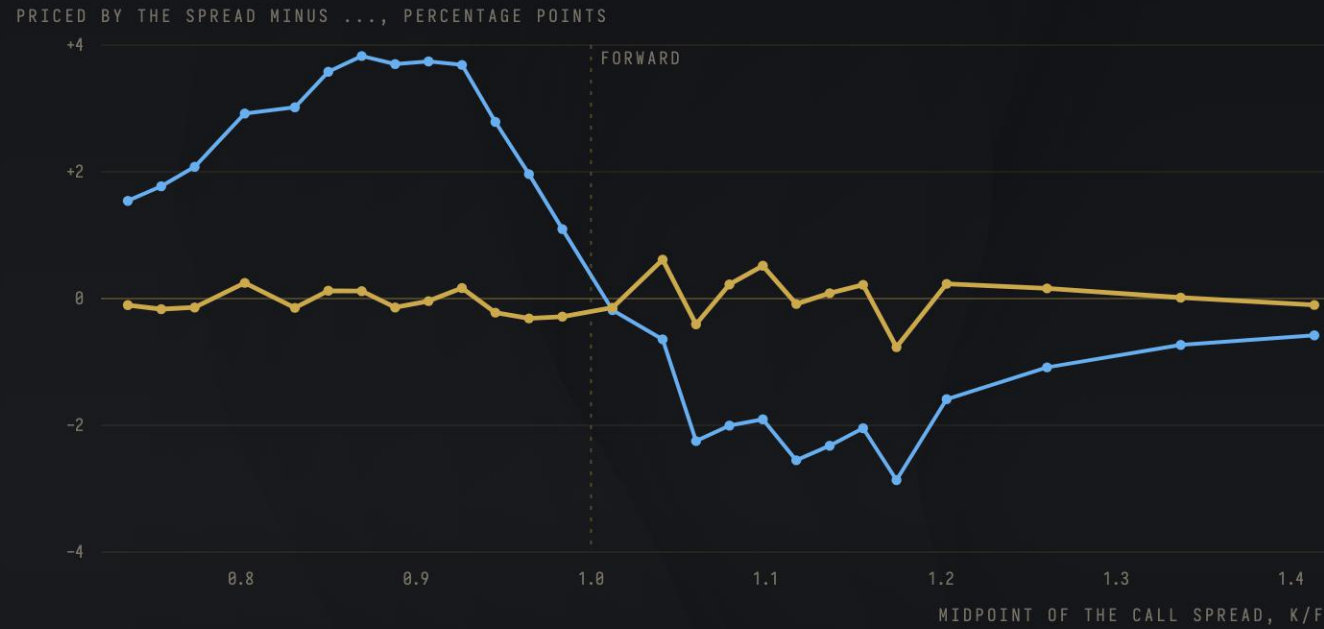
On 290 mornings that can be graded, ETH landed inside the market's 10% to 90% band 71.4% of the time, against the 80% the odds implied. The whole shortfall sits on the downside. ETH finished below the market's 10th percentile on 20.0% of mornings and above its 90th on 8.6%, close to the 10% priced. Dual Delta's band is wider, the thin shoulders of page 14 again. It caught 76.6%.

Keep two things in mind before you read this as a verdict. These are prices, not forecasts. A year in which ETH fell 38.7% is exactly the year to leave the lower tail short. And thirty-day windows read every morning overlap heavily, so the sample holds about ten independent months. We publish the band because it sets the market's odds against reality every day for a year, which no one else can draw. The archive behind it is available through Cayø Largo at cayolargo.fi. Page 31 shows how to start.

12 CALL SPREADS PRICE THE BOARD

36 ADJACENT CALL SPREADS, 30 OCT 2026, DERIBIT MARKS

... MINUS $N(d_2)$, THE DUAL DELTA READING ... MINUS THE SMILE-CONSISTENT PROBABILITY



The cleanest way to trade a probability on Deribit is a tight call spread. Buy the call at one strike, sell it at the next and divide by the distance between them. What you hold is a digital paying one if ETH settles above the midpoint (Reiner and Rubinstein 1991).

We priced all 36 adjacent pairs on the 30 October chain from Deribit's marks and compared each with two readings. Against $N(d_2)$ from Dual Delta the spread differs by 2.1 percentage points on average below the forward and 1.3 above it. Against the smile-consistent probability, by 0.15 and 0.24. Same marks, a very different fit.

Have a look at two of them. The 2,800/2,850 spread, near the 25-Delta call, cost 10.46 USD, which prices 20.9%. Dual Delta at the midpoint says 22.9%, the smile says 20.7%. Near the 25-Delta put, the 2,400/2,450 spread prices 77.0% against 73.3% and 76.8%. Both readings come off the same marks, so this is a consistency check rather than new evidence. It still carries the practical point: the price you pay for a spread is the market's probability, not the textbook's.

USING THE BOARD

12 BUTTERFLIES ARE SLICES OF THE DISTRIBUTION

27 BUTTERFLIES, 30 OCT 2026 · SHOWN FROM 0.85 OF THE FORWARD

RICHER THAN THE LOGNORMAL CHEAPER



If a call spread is a probability, a butterfly is a slice of the distribution (Carr and Madan 2001). Its price divided by the strike spacing squared is the density at the centre. Compare each butterfly with what a single lognormal volatility would charge for it and you see where the market's distribution is fatter or thinner than the textbook's.

On the 30 October chain the pattern matches page 14 closely. Butterflies centred between 0.85 and 0.95 of the forward cost 11% less than the lognormal would charge. The two between 0.95 and 1.05 cost 9% more. Between 1.05 and 1.15 they sit close to it, 4% below on average. The 2,500/2,550/2,600 butterfly cost 3.92 USD against a lognormal 3.53 USD, a ratio of 1.11.

We cut the chart at 0.85 of the forward on purpose. Below it the calls are deep in the money and a butterfly becomes a small difference of large prices. The readings there are mark noise, including two butterflies priced below zero, at 1,600 and 1,750. The chart stops at 1.3 for the mirror reason: further out the butterflies cost one or two price ticks and the ratios run past 100. A butterfly is only as good as the three marks it is made of.

USING THE BOARD

12 PIN RISK. AT ONE STRIKE

18 SEP 2026 WEEKLY · STRIKES 2,460, 2,480 AND 2,500 · SETTLED AT 2,489.15



The strike Greeks matter most in the last hours of an expiry. The 18 September weekly shows why. It carried the largest open interest of any ETH expiry settling between 2 and 22 September. Settlement came at 2,489.15 USD, nine dollars above the 2,480 strike. Close enough to matter.

In its final 24 hours $N(d_2)$ at that strike swung between 2.8% and 93.4%. In the final six hours it still ranged from 7.1% to 93.4%. The largest single move came at 05:10 UTC, three hours before settlement: +22.9 percentage points in ten minutes, with the index at 2,488.99, while ETH moved by a few dollars. This is Dual Gamma near expiry in plain view. The density piles up over a band a few dollars wide. A strike inside it behaves like a ball balanced on a ridge, where the slightest push decides the side.

If you are short that strike, your hedge ratio swings the same way: the pin risk Taleb (1997) describes. We make no claim here about where the price will settle next time. What we measured is how violently the probability moves when it sits on top of a strike.

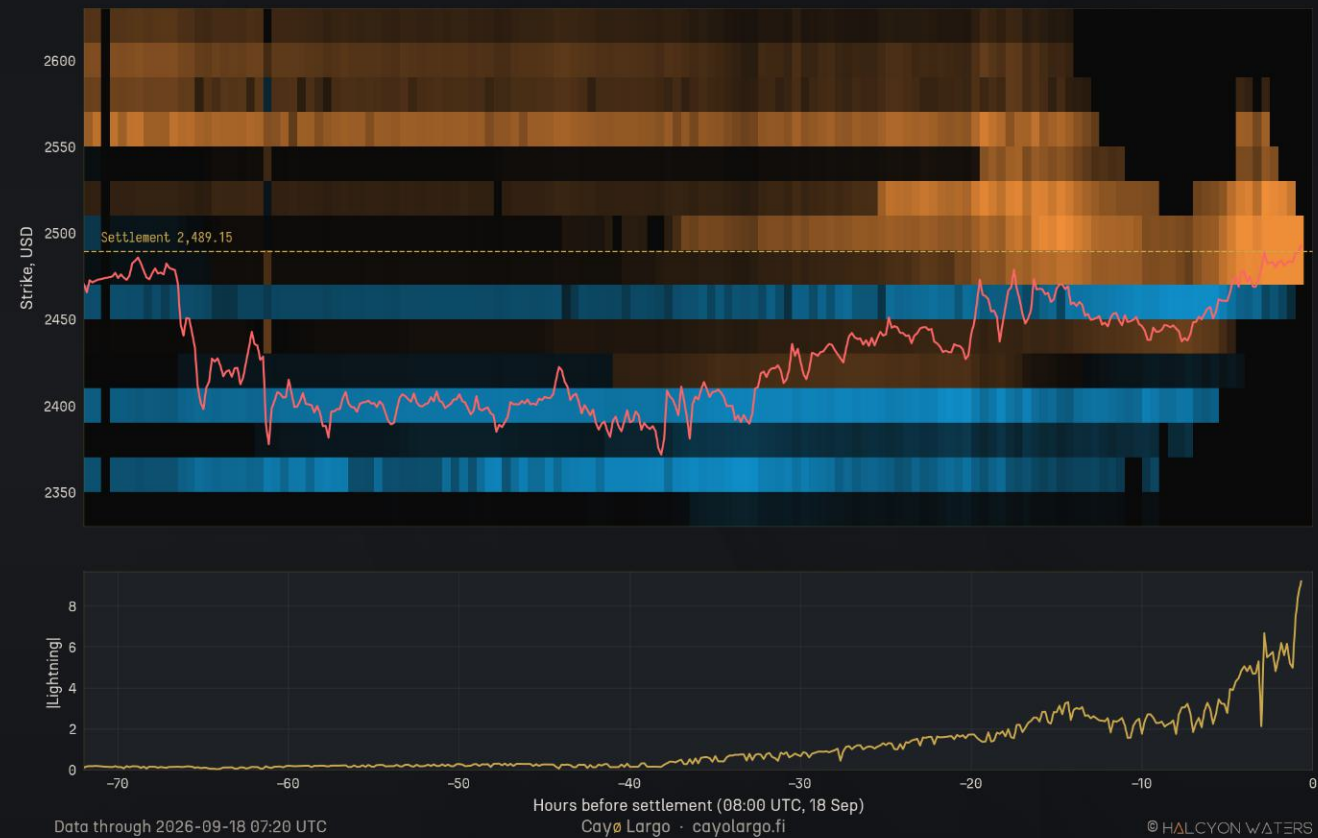
THE BOARD IN THE BOOK

13 ONE EXPIRY'S LAST 72 HOURS

18 SEP 2026 WEEKLY · NET DUAL GAMMA × OI BY STRIKE, 30-MINUTE COLUMNS

Dual Gamma by Strike into Settlement: ETH 18 September 2026 Expiry

Net dual gamma x open interest per 20 USD strike band, final 72 hours. Spot in coral, settlement in gold. Below: total |lightning x OI| within 5% of spot.



Pull back from one strike to the whole expiry and the picture sharpens. The chart shows the 18 September weekly as net Dual Gamma times open interest, strike by strike, every thirty minutes over the last 72 hours, with ETH's index drawn over it and settlement at 2,489.15 USD. Page 23 followed one of its strikes. Here is all of it.

The concentration is the story. Seventy-two hours out, 11.4% of the expiry's Dual Gamma sat within 2% of spot. At 24 hours it was 44.3% and at six hours 92.4%. In the final hour it was all of it. The density of this expiry collapsed from a wide hill into a band a few dollars wide, while its open interest fell from 106,040 to 11,565 contracts as positions were closed or rolled.

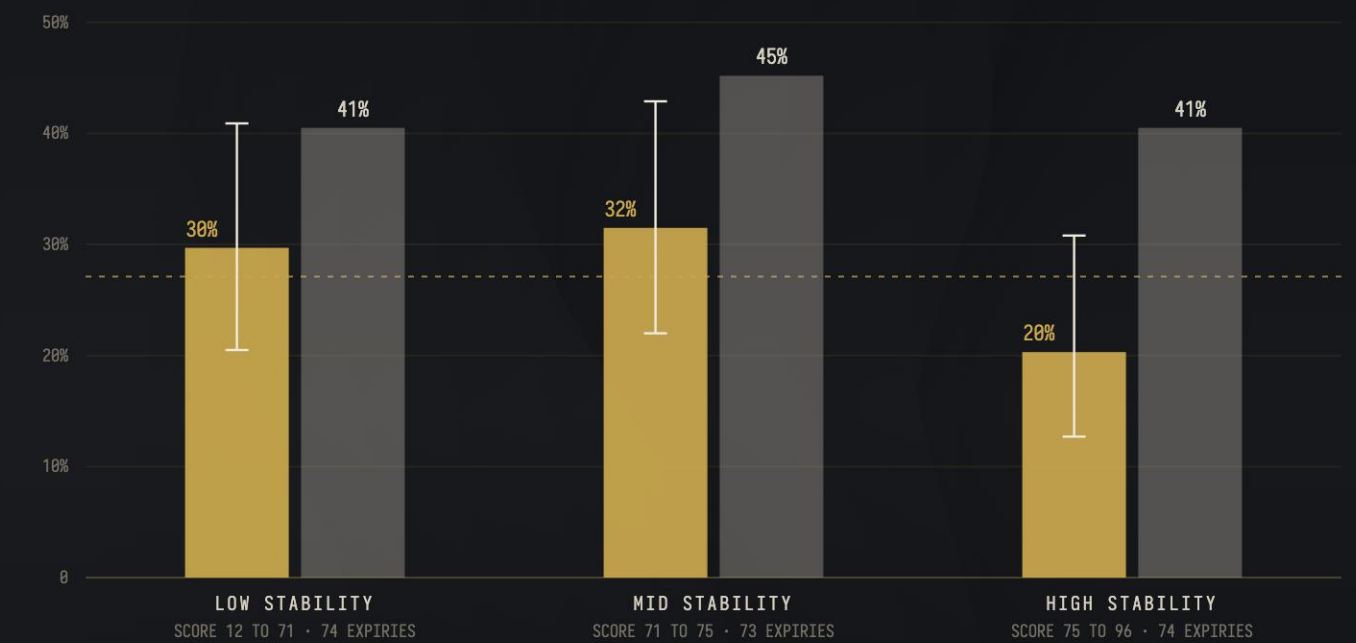
Lightning, the slope of that density, tells the same story from another angle: its size within 5% of spot rose 77-fold between 72 hours out and the final cycle. The steeper the density, the more a small move in ETH moves the odds at the nearest strike.

THE BOARD IN THE BOOK

13 PINNING, READ THROUGH THE STRIKE GREEKS

221 ETH EXPIRIES, READ 24 HOURS BEFORE SETTLEMENT

— SETTLED WITHIN 1% OF THE MAGNETIC STRIKE, 95% INTERVAL
— SETTLED WITHIN 1% OF SPOT 24 HOURS EARLIER — ALL EXPIRIES, NEAR THE MAGNET: 27.1%



Cayo Largo's pinning layer is built from the strike Greeks. Its stability score weighs Surface Vanna, Flare and Halo against Dual Gamma at the magnetic strike, the strike the layer identifies as the book's centre of gravity for that expiry. Its persistence score weighs Surface Charm and Droplet. Both describe how firmly the book is set around that strike.

Keep in mind what they are not. Neither is a forecast of where ETH settles. We checked: they should not be read as one. Across 221 ETH expiries, read 24 hours before settlement, 27.1% settled within 1% of the magnetic strike and 42.1% within 1% of where spot already was. Splitting the expiries into thirds by stability score leaves the share near the magnet between 20% and 32%, with intervals that overlap.

What the scores do separate is character. Expiries that did settle near their magnet had higher persistence (a median of 35.5 against 26.0) and a longer projected half-life (7.5 hours against 3.0). We read them as a description of the terrain, the same way the rest of this issue reads the Greeks.

13 THE BOARD IN THE BOOK SURFACE CHARM AND DEALER FLOW. LIVE

CAYOLARGO.FI · GREEK EXPOSURE SURFACE, 48 HOURS · BELOW: DEALER FLOW SIMULATOR, 7 OCT 2026



The same Greeks drive two more views on cayolargo.fi. The Greek Exposure Surface sums Surface Charm across the ETH book per strike, weighted by open interest: the daily drain of each strike's odds times the money resting on it. Over the 48 hours to 7 October it was brightest at 2,740, 2,720 and 2,680, all above spot. Blue, the negative side, came in brief patches until ETH fell through 2,700 early on 7 October, then held at 2,700 and 2,640.

The Dealer Flow Simulator turns them into hedging flow. On top of Charm and Vanna it adds two strike terms. Surface Charm covers how positioning migrates along the strikes as time passes. Surface Vanna, corrected by Droplet, covers how it migrates after a volatility shock. On a calm day the largest flow sat at 2,500, 110 million USD of estimated selling. In a volatility spike it stayed at 2,500 and grew to 165 million. The support at 2,600, just above spot, nearly doubled from 16.1 to 29.6 million.

Both are signed for the dealer, which is an assumption about who holds what. Both are scenario and structure views. Maps, not forecasts.

14 WHAT STANDS BEHIND IT THIRTEEN MONTHS. EVERY TEN MINUTES

THE CAYØ LARGO GREEKS ARCHIVE, 9 AUG 2025 TO 6 OCT 2026

147 MILLION
option snapshots in the Greeks archive, 6 coins

61,193
ten-minute ETH cycles on file

EVERY 10 MINUTES
the archive grows, since August 2025

5.4 BILLION
Greek values, 37 per snapshot

41 MILLION
ETH option snapshots alone

407
days of ETH, one database partition each

A board like the one on page 16 cannot be assembled from a download. It needs a history of the whole book, taken often enough to catch the market between moves and kept long enough to be graded against what settled.

Since 9 August 2025 Cayø Largo has read every Deribit option on six coins every ten minutes. For each one it recomputes all 37 Greeks. The Greeks archive now holds 147 million option snapshots and 5.4 billion Greek values. ETH alone accounts for 41 million snapshots across 61,193 cycles. That is thirteen months of the market's odds at every strike, filed as they were priced. Nothing is revised after the fact. An astrophysicist would call it a lightcurve that never closes.

Every number in this issue was drawn from that archive and can be drawn again. The identities on page 10 were checked on it to twelve decimal places. The smiles behind the board were checked at every strike. The odds were graded against 101 settlements. The archive grows by another cycle every ten minutes, so each issue of Soundings is measured on more history than the one before.

THE LIMITS

WHAT WE DID NOT TEST?

As usual, our research rests on assumptions and has limits. Four of them are worth naming before anyone trades on this issue.

The smile we fit is Deribit's mark implied volatility, not traded prices. Marks are the exchange's own model, so a probability read off them is Deribit's view of the market, refreshed every ten minutes. It can lag a fast book. Our fit is a raw SVI (Gatheral 2004) per expiry. We did not run the full archive through a second method, so how far the correction depends on the choice of fit is not measured.

Everything is read once a day at 08:00 UTC, when Deribit settles. That keeps the horizon exact. It also means we measured nothing intraday except the single expiry on pages 23 and 24. Our Greeks archive has a gap from 22 December 2025 to 9 January 2026, which we left visible rather than filling.

The calibration covers 101 expiries in a year when ETH fell 36.3%. A risk premium and a drift look alike in a sample like that. We could not separate them. Finally, the pinning and flow pages describe the book as Cayø Largo signs it for dealers, which is an assumption about who is on the other side, not an observation.

WHERE THIS GOES

15 FROM READING THE ODDS TO TESTING THEM

The Odds Board reads the market's odds this morning. Every ten minutes Cayø Largo files another copy of it. The archive behind this issue already holds thirteen months of them. That changes the question you can ask. Not only "what does the market charge for 3,000 by November?" but "when it charged this much before, in a book shaped like this, what happened to a trade built on it?"

That second question is the one **Punta Ållen** is being designed to answer: a strategy backtester that will run on the Cayø Largo archive, options first, with futures and perpetuals for the hedge, tested against every cycle the archive has recorded rather than against a textbook's assumptions. The same discipline applies as in this issue. Every result will be graded against what actually settled. Every limit will be stated before anyone trades on it.

We started with the data because nothing else in this chain is possible without it. The board on page 16 is the first public view of what that data makes possible. It is not the last. The archive behind it is available today through Cayø Largo. Punta Ållen comes after.

SOURCES

REFERENCES

Brier, G. W. (1950). Verification of Forecasts Expressed in Terms of Probability. Monthly Weather Review, 78(1), 1 to 3.

Breeden, D. T. and Litzenberger, R. H. (1978). Prices of State-Contingent Claims Implicit in Option Prices. Journal of Business, 51(4), 621 to 651.

Reiner, E. and Rubinstein, M. (1991). Unscrambling the Binary Code. Risk, 4(9), 75 to 83.

Taleb, N. N. (1997). Dynamic Hedging: Managing Vanilla and Exotic Options. Wiley.

Carr, P. and Madan, D. (2001). Optimal Positioning in Derivative Securities. Quantitative Finance, 1(1), 19 to 37.

Gatheral, J. (2004). A Parsimonious Arbitrage-Free Implied Volatility Parameterization with Application to the Valuation of Volatility Derivatives. Global Derivatives and Risk Management, Madrid.

Wystup, U. (2006). FX Options and Structured Products. Wiley.

Haug, E. G. (2007). The Complete Guide to Option Pricing Formulas, 2nd edition. McGraw-Hill.

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Cayø Largo

Halcyon Waters' crypto-options analytics and valuation platform, reading Deribit's book every ten minutes into volatility and positioning intelligence across six crypto-assets, with all 37 Greeks and their formulae published openly.

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