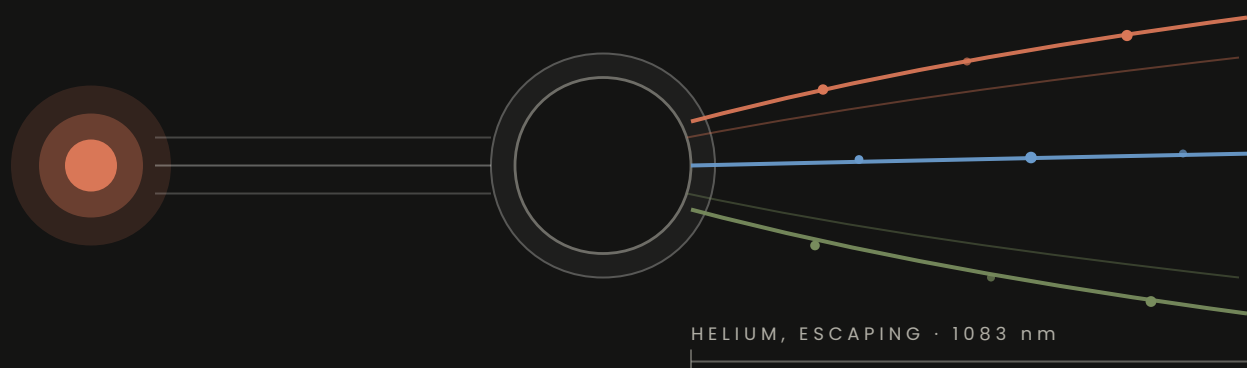


INFLECTION.

THE WEEKLY MAGAZINE OF INNOVATION

ISSUE 02 · FRIDAY, 31 JULY 2026 · DEEP DIVE — EXOPLANET ATMOSPHERES



THE HELIUM SIGNAL

We Found a Sky by Watching It *Leave*

For thirty years the plan was to build a bigger telescope and look for oxygen. The first confirmed atmosphere on a rocky world in another star's habitable zone arrived instead from a single night on a ground-based instrument in Chile — because a graduate student had already calculated exactly where to point it. The evidence was not the air. It was the leak.

AGAINST THE GRAIN

Why a sharp prior is worth more than a big aperture — and where that reasoning fails

SIGNALS

Two gigawatts of silicon, a molecule six years on the shelf, and 91 percent of a grid

BY THE NUMBERS

48 light-years, 1,083 nanometres, and exactly one confirmed sky

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DISPATCH

Resolution is what you buy when you don't know where to look.

There is a reflex in every technical organisation that says the answer to a hard measurement problem is a better instrument. More pixels. More parameters. More aperture. It is a reflex because it is usually true, and because it is always fundable. Nobody was ever fired for asking for a bigger telescope.

This week the reflex lost. The first confirmed atmosphere around a rocky planet in another star's habitable zone — the measurement that thirty years of exoplanet science has been organised around — was made not by the flagship observatory parked at L2 but by a twenty-four-year-old telescope on a Chilean mountain, in one night, on a target chosen in advance by a theoretical model that told the observers precisely which wavelength would light up.

The instrument did not get better. The prior did. And that is the trade every CTO is quietly making without naming it: every unit of uncertainty about *where* the signal lives has to be paid for in capability you buy to search blindly. Sharpen the hypothesis and the required instrument gets cheaper — sometimes by an order of magnitude, sometimes by an order of magnitude and a decade.

The reverse holds too, and it is the uncomfortable half. If you cannot say in advance what the measurement should look like, no amount of resolution will rescue you. It will only give you a higher-fidelity picture of your own confusion. Read on with that as the lens.

The Sky That Gave Itself Away

A helium leak, a 6.5-metre mirror, and one lucky night when two planets crossed the same star. How the most-wanted measurement in exoplanet science was made by prediction rather than by power.

BY THE EDITORS · REPORTED 22–29 JULY 2026

An atmosphere is the precondition for everything else. Liquid water needs pressure to stay liquid. Chemistry needs a medium. Life, as far as anyone can defend the claim, needs a sky. And so for three decades the central question of exoplanet science has not really been *are there other Earths* — we settled that, there are thousands — but the far more stubborn follow-up: has any of them managed to hold on to its air? On 16 July a paper in *Science* answered yes for the first time, and the way it got there is stranger and more instructive than the headline suggests.

The problem was never finding planets

The NASA Exoplanet Archive listed 6,128 confirmed worlds as of February. Several of them are rocky and sit in their star's habitable zone — the orbital band where surface water could in principle stay liquid. LHS 1140 b, roughly 48 light-years away in Cetus, has been one of the field's favourite targets since its discovery: 5.60 Earth masses, 1.73 Earth radii, a mean density of 5.9 g/cm³, an equilibrium temperature of 226 K, and a 24.7-day orbit around a small, quiet red dwarf.

What nobody could establish was whether any of these worlds had a sky. Red dwarfs are the problem. They are the most common stars in the galaxy and the easiest to observe planets around, but they are also violent in their youth — flaring, bathing close-in planets in extreme ultraviolet radiation for hundreds of millions of years. The dominant fear in the field has been that M-dwarf planets are all stripped bare: rocky, temperate, and airless.

Why the obvious approach stalled

The standard method is transmission spectroscopy. Wait for the planet to cross its star, and look for the star's light picking up absorption fingerprints as it filters through the planet's atmosphere. It works beautifully on hot, puffy gas

giants, whose atmospheres are enormous relative to the planet. On a compact rocky world the signal is a rounding error — parts per million against a noisy, spotted red star.

JWST tried. Two NIRISS transits of LHS 1140 b in 2024 ruled out the mini-Neptune scenario and produced a tantalising, unconfirmed hint of nitrogen. Six more transits were queued for Cycle 4. The published estimate was that *several years* of accumulated observations might be needed to nail down a secondary atmosphere — against a telescope with a finite fuel budget and a queue thousands of proposals deep.

That is the state of play the new result walks into: the best instrument humanity has ever built, pointed at the right planet, still years away from an answer.

And an irony to hold on to

The gas that would most convincingly announce a living world from a distance is oxygen, and oxygen is stubbornly hard to see. The signature that actually worked belongs to helium — chemically inert, biologically meaningless, the second-simplest element there is. It tells you nothing whatsoever about life. It only tells you there is a sky, and that the sky is going somewhere.

1 • A line the ground can see

Hydrogen escaping a planet shows up brightest at Lyman-alpha, deep in the ultraviolet, where Earth's atmosphere is opaque. That single fact has kept escape science locked inside space telescopes for a generation. Helium is the exception. Atoms parked in a metastable triplet state absorb at 1,083 nanometres — three closely spaced lines at 1082.909, 1083.025 and 1083.034 nm — squarely in the near-infrared, where the sky is transparent. Over the past few years that line has become the workhorse tracer of escaping atmospheres on hot gas giants. Nobody had pulled it off for a rocky planet.

The mechanism is a fortunate accident of atomic physics. The star's extreme ultraviolet ionises helium high in the atmosphere; as it recombines, some fraction of atoms land in a triplet state that decays slowly enough for a population to build up. You get a reservoir of atoms that are, for a while, willing to absorb at a wavelength the ground can see.

2 • A model that named the target first

Collin Cherubim, then finishing a doctorate in Earth and Planetary Sciences at Harvard, worked the problem from the other end. Rather than survey and hope, he built a theoretical model of upper-atmosphere chemistry and escape, ran the catalogue of known rocky planets through it, and asked which one should have a helium-rich exosphere bleeding into space at a detectable rate. The model returned LHS 1140 b. He then went and booked the telescope time to test it.

His advisor was not persuaded. David Charbonneau — who heads Harvard's astronomy department and has spent a career on exactly this measurement — was, in his own account, sceptical: the prediction came out of a calculation, and the signal had never been seen from a rocky world.

“Collin analysed the planets we knew about and predicted that this one would have a helium atmosphere. Then he organised telescope time, got the data, and the detection was statistically rock solid.”

DAVID CHARBONNEAU • CENTER FOR ASTROPHYSICS | HARVARD & SMITHSONIAN

3 • A night with a built-in control

The observation used WINERED — the Warm INfrared Echelle spectrograph — on the 6.5-metre Magellan Clay telescope at Las Campanas Observatory in Chile. Its Y band, 0.96 to 1.11 microns, sits directly on the helium triplet, and it is one of very few ground instruments with the resolving power to separate that line from a rocky planet's whisper of a signal.

Then came the luck, or the reward for patience. On the chosen night two planets in the LHS 1140 system transited the same star. One of them showed nothing at all. LHS 1140 b showed helium streaming off its upper atmosphere. That pairing is worth more than a marginal improvement in signal-to-noise, because it is a control built into the data itself: whatever instrumental drift, telluric contamination or stellar variability might fake a helium signal had to fake it for one planet and not the other, on the same night, through the same air, in the same detector.

The team's estimate is that this atmosphere has persisted for more than three billion years — meaning it survived the red dwarf's violent youth, which is precisely the scenario the field feared no rocky planet could survive.

Worth noting what made the signal detectable in the first place: an escaping envelope is enormously larger than the body it came from, puffed out and hot, blocking far more starlight than the rock ever could. The atmosphere is legible precisely *because* it is leaving. A sealed, well-behaved sky sitting quietly on the surface would have been invisible.

The measurement just got cheap

A single detection is a curiosity. A repeatable, ground-based technique is an industry. The authors are explicit that the point of the paper is model validation: the prediction worked, so the model can now be run forward across the catalogue to generate a queue of ranked targets. Ground time on 6-to-10-metre telescopes is comparatively abundant, comparatively cheap, and does not compete with a space observatory's queue.

That changes the economics of the search. Instead of spending scarce space-telescope hours confirming whether a planet has an atmosphere at all, you spend cheap ground hours triaging – and reserve the expensive instrument for the far harder question of what the atmosphere is made of. Triage on the commodity tier, adjudicate on the premium tier. It is the same architecture as a well-designed inference stack.

The expensive tier is still booked. Six further JWST transits of this system were selected for Cycle 4, aimed at the com-

position question the helium line cannot answer. The difference is that they now begin from a confirmed premise rather than an open one.

What it does not tell you

A helium signal probes the exosphere – the thin, hot outermost shell, thousands of kilometres above anything you would call a surface. It confirms that a substantial gas envelope exists and is being driven off. It says nothing directly about surface pressure, about the bulk composition underneath, about clouds, oceans or chemistry. Cherubim's stated next goals are the full composition and, eventually, whether there are surface oceans. Those are separate, harder measurements.

Nor is one detection a census. What the paper establishes is that a specific model made a specific, falsifiable prediction and survived contact with a telescope. That is the strongest thing a theory can do, and it is still a sample of one.

FIELD NOTES • HOW THE DETECTION WORKS

- 1 **Excite the helium.** The red dwarf's extreme-ultraviolet output ionises helium high in the planet's atmosphere. As it recombines, a fraction of atoms get stuck in a long-lived metastable triplet state – a chemically inert gas made briefly, conveniently visible.
- 2 **Catch it in silhouette.** Those metastable atoms absorb starlight at 1,083 nanometres. When the planet transits, its escaping envelope – far larger than the solid body – blots out a sliver of the star's light at exactly that wavelength, and nowhere else.
- 3 **Resolve the dip from the ground.** Because 1,083 nm is near-infrared, Earth's atmosphere is transparent to it. A high-dispersion spectrograph on a 6.5-metre mirror can isolate the three-line triplet and measure the absorption – no launch required.

GLOSSARY

Metastable helium	Helium in an excited state that decays slowly enough to accumulate and absorb at 1,083 nm. The reason escape is visible from the ground at all.
Transmission spectroscopy	Reading a planet's atmosphere from the fingerprints it leaves in starlight passing through it during a transit.
Habitable zone	The orbital band where a planet's surface temperature could allow liquid water. A statement about geometry and flux – not about life.
Secondary atmosphere	Air outgassed from a planet's interior after the primordial hydrogen envelope is lost. Earth has one. It is the kind worth finding.

The Cheap Telescope Problem

The non-obvious read: this result is not a story about astronomy. It is a pricing signal about the substitution rate between *modelling* and *capability* — and it points the wrong way for almost everyone's roadmap.

Every capital plan in technology encodes an implicit exchange rate: how much instrument do I need to buy per unit of ignorance about where my answer lives? The industry default is to treat that rate as fixed and simply buy more instrument. LHS 1140 b says the rate is not fixed. It is elastic, and it is set by the quality of your forward model.

Consider what was actually substituted here — and note the detail that makes it unanswerable. The Magellan Clay telescope, first light September 2002, has a primary mirror 6.5 metres across. JWST's segmented primary is equivalent to a 6.5-metre telescope. The apertures are the same. One sits on a mountain in the Atacama; the other is parked a million miles out at L2. The mountain won this round in a single night, on a question the flagship had been chipping at for two years.

So the differential was not photons, and it was not even engineering. It was that one team knew in advance — to three decimal places — which wavelength would carry the signal and which planet would emit it. Prediction collapsed the search space, and the search space was the entire cost.

Translate it. If your team's answer to a hard observability problem is more telemetry, more retention, a bigger cluster, a longer context — ask first whether you can name the signal. You detect a container by measuring its leak, not by inspecting its contents; the loss channel is almost always narrower, better characterised, and cheaper to instrument than the state itself. That is why error budgets outperform dashboards and why tail latency tells you more than mean throughput. The organisations that scale worst are the ones that buy resolution to avoid doing the modelling.

Aperture is what you purchase in place of a hypothesis. It is the most expensive form of not knowing.

THE CONTRARIAN

Now the case against

The consensus is not being stupid, and four objections are serious. First, **n equals one**. A single validated prediction on a single favourable target is not a demonstrated method. The technique's generality is genuinely untested, and the field has been burned before by first-detection claims that thinned on replication.

Second, **the selection effect is built in**. The 1,083 nm line only lights up when the host star produces enough extreme-ultraviolet flux to populate the metastable state. You will find helium where the star cooperates — which is not the same as finding atmospheres where they exist. Ground-based escape spectroscopy may scale into a badly biased census.

Third, **escape is also the failure mode**. The single greatest worry about planets around red dwarfs is that stellar radiation strips their atmospheres away. The measurement that proves this planet has air is a direct measurement of that air departing. Both readings are supported by the same data.

Fourth, **this is not an Earth twin**. At 5.6 Earth masses, 1.73 Earth radii and an equilibrium temperature of 226 K — roughly minus 47 Celsius — LHS 1140 b is a cold super-Earth that prior work suggests may be substantially water or ice by mass. "Habitable zone" is doing considerable work in the headline. And the detection probes an exosphere thousands of kilometres up; the surface remains entirely unobserved.

The honest synthesis: the modelling-beats-aperture trade is real and underpriced, but it is a claim about *triage*, not about answers. Cheap prediction tells you where to aim the expensive instrument. It does not replace it. Anyone reading this result as a case for buying less capability has inverted it.

2 GW

COMPUTE

AI INFRASTRUCTURE

The rack, not the chip, is now the product

On 22 July, AMD and Anthropic announced a strategic partnership to deploy up to two gigawatts of AMD Instinct MI450 Series GPUs, with the first gigawatt beginning in the first half of 2027. A day later at Advancing AI 2026, AMD launched the Helios rack-scale system it will run on — 72 Instinct MI455X GPUs and 18 sixth-generation EPYC "Venice" CPUs co-optimised as a single unit, claiming up to 30% more inference tokens per dollar than the leading competing rack. Note the unit of account: not FLOPS, not chips, but gigawatts and tokens per dollar. The industry has quietly stopped selling semiconductors and started selling power envelopes.

SOURCE · AMD, "AAI 2026: AMD DELIVERS FULL-STACK COMPUTE FOR THE AGENTIC AI ERA," 23 JULY 2026

6 yrs

MEDICINE

ANTIMICROBIALS

The antibiotic fix was already on the shelf

Cold Spring Harbor Laboratory and Scripps Research reported in *Nature Communications* that pairing vancomycin with a small molecule called pghi-4 restores the drug's ability to kill vancomycin-resistant *Enterococcus faecium*. The molecule inhibits SagA, a bacterial enzyme that remodels the cell wall. The striking part is provenance: pghi-4 was first made in John Moses's lab in 2020, as a by-product of pure reaction-development work, and sat in a 150-compound library for six years before anyone knew what it broke. No human data yet — this is mouse and culture work. But the strategy of reviving failing drugs with adjuvants sidesteps the economics that killed novel antibiotic discovery.

SOURCE · COLD SPRING HARBOR LABORATORY / *NATURE COMMUNICATIONS*, REPORTED 22 JULY 2026

91%

ENERGY

GRID

The American grid stopped adding anything else

Solar and storage accounted for 91% of new U.S. grid capacity in the first quarter of 2026, per figures published on 22 July. Cumulative installed solar has passed 300 GW-DC. The operational numbers are more telling than the installation numbers: on the evening of 9 July, batteries in the California ISO footprint discharged a record 12.99 GW, covering 36% of regional demand; the next afternoon CAISO set a solar record of 23 GW, meeting 72% of demand. Storage has quietly become the thing that makes the rest of it dispatchable — and the evening peak is where that gets proven.

SOURCE · PV MAGAZINE USA, 22 JULY 2026; ESS-NEWS, 23 JULY 2026

48

Light-years from Earth to LHS 1140 b — near enough that follow-up is realistic, far enough that nobody is going.

CENTER FOR ASTROPHYSICS

1,083_{nm}

The metastable helium line that gave the atmosphere away. Near-infrared — which is the entire reason a ground telescope could see it.

ASTRONOMY & ASTROPHYSICS

6.5_m

Aperture of the Magellan Clay telescope in Chile that made the detection, using the WINERED spectrograph.

LAS CAMPANAS OBSERVATORY

3 bn

Years this atmosphere has likely survived — through the flaring youth of a red dwarf that was supposed to strip it.

CENTER FOR ASTROPHYSICS

226_K

Equilibrium temperature of LHS 1140 b: about -47°C . Habitable zone, yes. Temperate, not quite.

NASA EXOPLANET ARCHIVE

6,128

Confirmed exoplanets in the NASA archive as of February 2026. Exactly one now has a confirmed habitable-zone rocky atmosphere.

NASA EXOPLANET ARCHIVE

72

GPUs co-optimised inside a single AMD Helios rack, alongside 18 sixth-generation EPYC CPUs — the week's other reminder that the unit of engineering keeps getting larger.

AMD, ADVANCING AI 2026

Everything in this issue was found by watching something leave.

A planet's atmosphere, detected as it escapes. A bacterium's resistance, defeated by blocking an enzyme it secretes — the thing it emits rather than the thing it is. A power grid, understood not by nameplate capacity but by what discharges out of it at 8 p.m. on a July evening. Even the compute story is a leak story: the industry now prices itself in gigawatts, which is to say in heat, which is to say in the energy that escapes rather than the work that gets done.

This is not a coincidence so much as a property of measurement. Systems are hard to inspect from the inside and easy to characterise from what crosses their boundary. The state space is enormous; the flux is one-dimensional. If you want to know whether a thing exists, find its exhaust.

Which sets up the harder observation. The reason Cherubim's prediction worked is that he had a model of the boundary — of what should be leaking, at what rate, at what wavelength — before he had any data. The instrument only confirmed a number he had already computed. That sequencing is the whole lesson, and it is almost exactly backwards from how most technical organisations operate, where we collect first and model afterwards, then buy more collection when the model disappoints.

There is a version of the next decade in which the binding constraint on discovery is not sensors or compute but the quality of the priors we bring to them. That version is cheaper and faster than the one being budgeted for. It is also harder, because you cannot procure a good hypothesis.

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INFLECTION.

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THE LENS

What in your system are you measuring by *inspection* that you could be measuring by leak?

The container is expensive to open. The exhaust is already leaving, already narrow, already instrumented if you know its wavelength. Most observability budgets are spent on the wrong side of that boundary — and most of them were sized before anyone wrote down what the signal should look like.

NEXT ISSUE · FRIDAY

A new deep dive, three signals, and the numbers that mattered. Same rotation, different domain.

RESEARCHED, WRITTEN & DESIGNED WITH CLAUDE.
TYPESET IN POPPINS & LORA ON THE ANTHROPIC PALETTE.
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