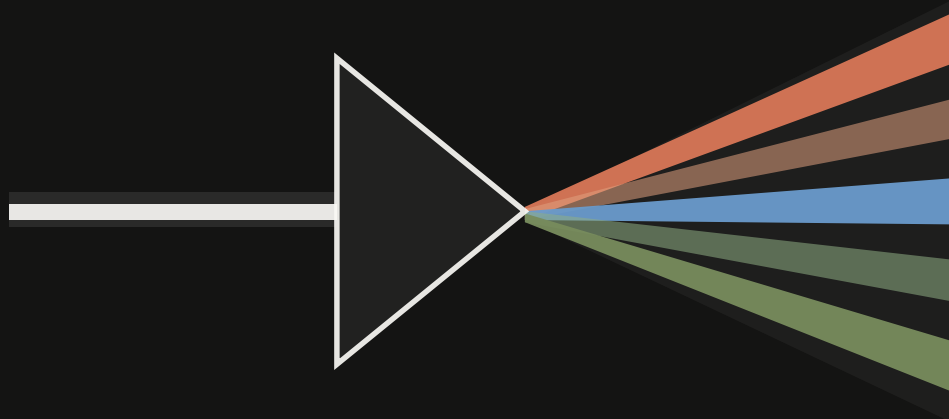


INFLECTION.

THE WEEKLY MAGAZINE OF INNOVATION

ISSUE 01 · WEEK OF JUNE 8, 2026 · DEEP DIVE — PHOTONIC COMPUTING



THE PHYSICS OF THE POSSIBLE

Computing Learns to Use *Light*

AI is racing toward an energy wall the size of a national power grid. The strangest way through it isn't more silicon — it's photons. Inside the quiet 2026 inflection where the lab finally caught up to the dream.

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DISPATCH · FROM THE EDITOR

Innovation is the art of trading the scarce for the abundant.

Every story in this issue is the same story wearing different clothes. A scarce thing is about to be swapped for an abundant one, and almost nobody is pricing the swap correctly yet.

Frontier AI is hitting a wall made of electricity. The fix the whole industry is reaching for is *more* — more chips, more megawatts, more concrete. This week the lab handed us a different idea: stop pushing electrons through copper and start moving information as light. Photons don't heat up wires. They are, in the most literal sense, abundant.

You'll see the same trade in our Signals pages — salt for lithium, a treatment built for one child instead of a market of millions. Read this issue with one question in your pocket: *what's the scarce input here, and what could replace it?* That question is where the next decade hides.

— THE EDITORS, INFLECTION

Computing at the Speed of *Light*

For sixty years we made computers faster by making electrons travel shorter distances. That game is nearly over. The 2026 way forward is to stop using electrons at all — and three breakthroughs this spring suggest the future arrived ahead of schedule.

BY THE EDITORS · REPORTING FROM THE NATURE PHOTONICS & NATURE PRINT RUN, MAY–JUNE 2026

A chip designer what keeps them up at night and they won't say speed. They'll say heat — and the power bill that comes with it. A modern AI data center is, thermodynamically, a very expensive way to turn a city's worth of electricity into warm air and a little matrix algebra.

The numbers have stopped being abstract. The International Energy Agency now projects that the world's data centers will draw roughly **1,100 terawatt-hours** in 2026 — about the entire annual electricity consumption of Japan. That figure is an 18% upward revision from the agency's own estimate just six months earlier. Electricity demand from AI-specific facilities grew an estimated **50%** in 2025 alone.

Here is the uncomfortable physics underneath the spreadsheet. Most of the energy a processor burns is not spent on computing. It's spent *moving data* — shoving electrons down copper wires that resist them, charging and discharging tiny capacitors billions of times a second. The compute is cheap. The commute is brutal.

So a heretical question has hung over the field for decades: what if information didn't commute as electric charge at all? What if it traveled as light?

Light is the best courier physics offers. Photons carry no charge, so they don't resist each other or warm the wire. Two beams can cross in the same waveguide without colliding. And the one operation AI does more than any other — multiplying a vector by a matrix — is something a beam of light performs almost for free, simply by passing through a carefully shaped piece of glass.

The catch has always been the plumbing. You can compute beautifully with light and still lose everything generating it, steering it, and reading it back out. For forty years, "optical computing" was the field that was always five years away.

This spring, the five years quietly ran out.

The week the lab caught up

BREAKTHROUGH ONE — THE ALL-IN-ONE CHIP

On 25 May, a team at Monash University reported in *Nature Photonics* something the field had never managed to put in one place: a single nanoscale circuit that can **generate, steer, and read** light-based information — the three jobs that usually demand three separate, bulky pieces of equipment.

Their trick is to encode data not just in light's brightness or color but in a subtle quantum property called the "valley" degree of freedom, using atomically thin materials. The emerging discipline has a name — *valleytronics* — and the point is plumbing: if one millimeter of chip can do all three jobs, the dream of a self-contained optical processor stops needing a laboratory bench around it.

BREAKTHROUGH TWO — THE HOLY GRAIL LASER

Then, in early June, came the piece everyone said couldn't be miniaturized. A group led by Tobias Kippenberg at EPFL published in *Nature* the first integrated ultrafast laser to rival a tabletop instrument: pulses as short as **147 femtoseconds** carrying **1.05 nanojoules**, from a cavity shrunk to the millimeter scale.

For more than twenty years a high-energy femtosecond laser on a chip was, in the field's own words, "a holy grail of integrated photonics." A femtosecond is to one second as one second is to about 32 million years. Until now, making pulses that short with usable energy meant a rack of mirrors in a temperature-controlled room. Now it fits beside the circuit it feeds.

"For more than twenty years, a femtosecond laser on a chip was regarded as a holy grail of integrated photonics."

Put the two together and the picture sharpens. One lab proved you can run the whole optical signal chain on a single chip; another proved you can put a lab-grade light source right next to it. Neither is a fin-

ished product. Both close a gap that had been declared structural — the reason light computing "couldn't" leave the bench.

From the bench to the data center

Academic milestones don't pay power bills. The reason 2026 feels different is that the commercial wedge is already shipping — and it's smarter than "replace the GPU." A Boston company, **Lightmatter**, is attacking the part of the problem where light already wins decisively: not the math, but the *movement* between chips.

Its Passage platform uses light to carry data between processors, hitting a record **1.6 terabits per second** per optical fiber. A new interconnect, the Passage L20, pushes 6.4 Tbps and is slated to sample late in 2026. The framing from this year's Computex was blunt: the bottleneck in frontier AI has shifted from compute to *interconnect*. Light is the obvious tool for moving bits between racks — and that beachhead is where the optical era actually begins.

FIELD NOTES

How do you compute with light?

- 1 Encode.** Turn numbers into beams — varying a beam's brightness, phase, or color so each photon stream carries a value.
- 2 Interfere.** Pass the beams through a mesh of tiny splitters. Where light waves overlap they add and cancel — and that interference is multiplication and addition, done at the speed of light, with no switching energy.
- 3 Read.** A detector measures the brightness coming out. That number is your answer — one matrix multiply, the core motion of every neural network, computed in a single pass.

Why it matters: an electronic chip recomputes that motion step by step, paying energy each time. Light pays once, on the way through.

GLOSSARY

Femtosecond — a quadrillionth of a second; the timescale of moving electrons and atoms.

Valleytronics — encoding data in a quantum "valley" state of electrons in ultrathin crystals.

Co-packaged optics — putting the light engine in the same package as the chip, not across the board.

MAC — multiply-accumulate, the single operation AI performs trillions of times. Light's home turf.

The consensus bet is to stack more GPUs. The move *no strong player is supposed to play* is to compute in a medium we spent forty years failing to tame.

WHY THIS LOOKS LIKE A BLUNDER

Optical computing has the worst track record in hardware. It has been "about to win" since the 1980s, and it keeps losing to silicon for honest reasons, not hype cycles. Three of them are brutal.

Analog resolution. Light computes in the analog domain. Brightness is continuous, and continuous values are noisy — you get maybe 8 bits of precision where a digital chip gives you 32 flawless ones.

Nonlinearity. Neural networks need a nonlinear step between layers. Light, gloriously, is linear — beams pass through each other untouched. That same purity means light *can't* natively do the one nonlinear thing the math demands.

Noise that compounds. Chain optical operations together and phase and amplitude error accumulate, capping how deep an all-optical system can go before the signal drowns. Worse, you pay a heavy power tax

at the edges, in the converters that translate light back to digital.

WHERE THE REAL MOVE HIDES

So here is the non-obvious read. The winning move isn't to throw light at the whole computer. It's to deploy light *only where it already beats copper* by 10× — moving data between chips — and let silicon keep the messy, nonlinear, high-precision middle.

That's exactly the wedge shipping in 2026: optical interconnect first, optical math later. The contrarian isn't betting that light replaces the transistor. They're betting the industry has been measuring the wrong bottleneck — and that the first trillion dollars of value is in the wires, not the logic.

Move 37 wasn't a better version of a known move. It was a move that looked like a mistake until the board proved otherwise. "Compute with light" still looks like a mistake. Watch the interconnect.

700%

ROBOTICS

The year humanoids clock in

TrendForce calls 2026 the commercialization year for humanoid robots: global shipments are projected to pass **50,000 units**, a roughly **700%** jump year-over-year. The story isn't the walking — it's the shift from stage-demo "showpiece" to factory "workforce," led by U.S. system integration and Chinese scale, with China's output alone set to rise 94%.

SOURCE — TRENDFORCE, DEC 2025 & APR 2026

175

ENERGY

Cars that run on salt

CATL begins mass production of sodium-ion EV batteries in 2026, with Changan's Nevo A06 poised to be the first mass-produced passenger EV running on them. Next-gen cells reach **175 Wh/kg** and ~500 km of range. Sodium is cheap and everywhere; lithium is scarce and mined in a handful of countries. Same trade as our cover — abundant for scarce.

SOURCE — MIT TECHNOLOGY REVIEW; ELECTREK; CATL, 2026

N=5

BIOTECH

A medicine built for one child

Baby KJ, the first patient ever treated with a bespoke CRISPR base-editing therapy at CHOP, is now walking and talking a year on. The team plans a 2026 trial spanning seven urea-cycle disorders — and the FDA has agreed a protocol that could win approval with **as few as five patients**. Personalized medicine is quietly rewriting what a clinical trial even is.

SOURCE — MIT TECHNOLOGY REVIEW; CHILDREN'S HOSPITAL OF PHILADELPHIA

1,100_{TWh}

Projected 2026 data-center electricity — roughly Japan's entire annual consumption.

147_{fs}

Shortest pulse from EPFL's chip-scale ultrafast laser — a lab on a millimeter.

20_{yrs}

How long an on-chip femtosecond laser stood as photonics' "holy grail."

1.6_{Tbps}

Record data throughput per optical fiber in Lightmatter's Passage platform.

700%

Year-over-year growth in humanoid-robot shipments projected for 2026.

175_{Wh/kg}

Specific energy of CATL's next-gen sodium-ion cells — salt, not lithium.

5_{patients}

The trial size the FDA has agreed could be enough to approve a personalized gene-editing platform — the "N-of-few" era of medicine.

If there's a single pattern worth carrying out of this issue, it's this: *the future tends to belong to whoever swaps a scarce input for an abundant one before the market notices the swap.*

Electrons are scarce in the way that matters — every one you move costs heat and power. Photons are abundant. Lithium is scarce and geopolitically tangled; sodium is in seawater. A drug for a disease that affects millions is a market; a drug for a disease that affects five children was, until this year, an impossibility — and now it's a protocol.

None of these are finished. Optical computing still can't do nonlinearity cleanly. Sodium batteries are

heavier than lithium. Bespoke medicine has to solve cost before it scales. But the direction of travel is consistent, and consistent direction is the most actionable thing a builder can have. Find the scarce input in your own field. Ask what abundant thing could stand in for it. Then ask why it hasn't yet — the answer is usually a plumbing problem, and plumbing problems get solved.

See you Friday, with a new inflection.

SOURCES & FURTHER READING

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3. EPFL / Nature — "An ultrafast laser on a chip" (Kippenberg lab; 147 fs, 1.05 nJ, June 2026). actu.epfl.ch/news/a-ultrafast-laser-on-a-chip
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5. PhotonDelta / arXiv — limitations of optical computing: analog resolution, nonlinearity, storage, noise accumulation.
6. TrendForce — Humanoid robots: 2026 commercialization year, >50,000 units, ~700% YoY. trendforce.com
7. MIT Technology Review & Electrek — Sodium-ion batteries 2026 (CATL; Changan Nevo A06; ~175 Wh/kg).
8. MIT Technology Review & Children's Hospital of Philadelphia — Baby KJ; 2026 urea-cycle CRISPR trial; FDA "as few as five patients."

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NEXT ISSUE · FRIDAY

A new rotating deep dive, picked from the week's most consequential breakthrough — plus fresh Signals, a new contrarian read, and the numbers that matter. Each Friday at 4pm.

THE LENS

One question, every week: *what's the scarce input — and what abundant thing could replace it?* That's where we go looking.