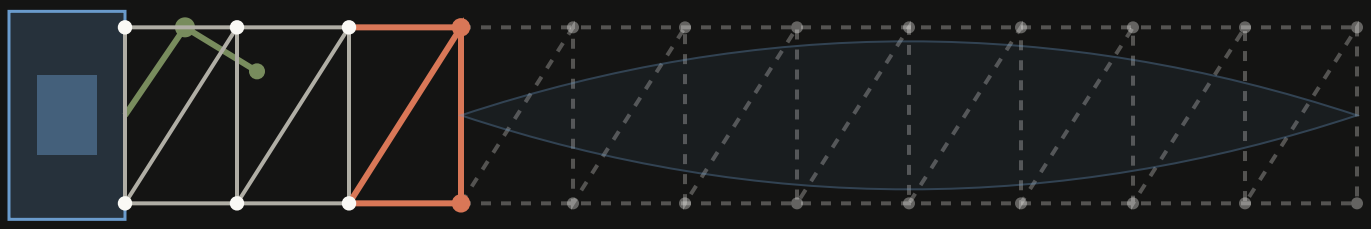
ISSUE 02 · DEEP DIVE

INFLECTION.

THE WEEKLY MAGAZINE OF INNOVATION

ISSUE 02 | FRIDAY, 13 NOVEMBER 2026 | DEEP DIVE — BUILDING IN ORBIT



2 PREBUILT BAYS

BAY 3 · BUILT IN ORBIT

8 BAYS STILL ON THE DRAWING BOARD

THE FAIRING PROBLEM

The rocket was never the limit. The *fairing* was.

In the first week of November, a Caltech robot assembled the first structure ever built autonomously in orbit, and a Polish-German startup printed the first rigid beam in open space. Both point to the same inversion: stop launching shapes, start launching recipes.

P.03 Why a half-finished antenna may matter more than a finished one

P.06 The Contrarian: the best case against building in space is a 9-metre rocket

P.07 Signals: a third kind of magnet, a vitamin battery, a $30 robot housekeeper

01 **Cover** 01
Building in Orbit

02 **Contents & Dispatch** 02
Ship the recipe, not the cake

03 **Feature — The Fairing Problem** 03
Two firsts in one week

04 **Feature — Breakthroughs** 04
A robot, a printer, and an asterisk

05 **Feature — So What** 05
Lab to market, plus Field Notes

06 **Against the Grain** 06
The Contrarian

07 **Signals** 07
Magnetism, batteries, humanoids

08 **By the Numbers** 08
Seven figures that frame the week

09 **The Long View** 09
Sources & Further Reading

10 **Back Cover** 10
Next issue and the Lens question

FROM THE EDITOR

Ship the recipe, not the cake.

Every launch is a bet that the thing you built on the ground will survive the ride. So large structures in space have been origami: solar arrays and telescope mirrors folded into a nose cone, then unfolded on arrival. The size of what we can build up there has been set, quietly, by the width of a rocket.

This week two teams stopped folding. One sent a robot arm and a box of struts. The other sent a printer and a tank of resin. Neither finished the job, and both said so. But each shipped something far denser than a finished shape: the instructions, and just enough feedstock to follow them.

That is the lens for this issue. When you read the feature, ask what in your own world is still being shipped as a finished shape that could travel as a recipe. We think the answer is more often than you expect, and less often than the press releases suggest. The Contrarian on page six makes that case against us.

— THE EDITORS

SPACE & ROBOTICS

The Fairing Problem

How two experiments, one with a robot arm and one with a printer, are testing a simple idea: if a rocket's nose cone limits what you can launch, stop launching the finished thing.

BY THE INFLECTION DESK · REPORTED FROM PUBLIC SOURCES, 13 NOVEMBER 2026

Imagine you have to ship a trampoline, but the only box you may use is a wardrobe. You could fold the trampoline very cleverly. Or you could pack the springs, the fabric and a person with a screwdriver, and build it at the other end. For six decades, spaceflight has chosen origami. This week, for the first time, someone chose the screwdriver, and the screwdriver worked, mostly.

THE CONSTRAINT

Whatever you launch must fit inside the fairing, the protective shell around a rocket's payload. As Caltech's release puts it, no matter how ambitious a design is, its components must somehow fit inside that confined space. Engineers have had two answers. Fold the structure into a compact package and hope it unfolds after reaching orbit, or launch separate components and have astronauts assemble them. Both approaches, Caltech notes, impose practical limits on the size and complexity of the finished structure.

Those limits are about to matter more. The same reporting notes that companies are racing to assemble giant constellations for phone coverage and AI compute, and TechCrunch observes that spacecraft meant to serve as orbital data centers will need larger arrays to generate power and larger surfaces to radiate heat into the vacuum, yet they must still fit in the nose cone of the rocket that carries them.

THE THIRD OPTION

Robotic construction offers a third possibility, in Caltech's words: instead of fitting an enormous telescope or antenna inside a rocket, transport its materials into orbit and assemble the complete system there. DARPA set up a programme in 2022, called NOM4D, to pursue exactly this. Its manager, Andrew Detor, says "very large" means hundreds of metres or kilometres. Nothing approaching that scale can be achieved today.

Then, within a few days of each other in early November, two very different teams reported first results from orbit. One assembled. One manufactured. The next page takes each in turn, including the parts that did not go to plan.

THE BREAKTHROUGHS

A robot, a printer, and an asterisk

ASTRA: THE FIRST AUTONOMOUS BUILD

ASTRA (Autonomous In-Space Tensioned Reflector Assembly) is a Caltech payload funded by DARPA. A robotic arm pulls composite-fibre tubes and aluminium connectors from motorised dispensers, joins them on an assembly plate into repeating sections called bays, and pushes each finished bay outward before starting the next. The target was a 1.4-metre reflector antenna made of 11 connected bays.

It launched on 30 March 2026 on SpaceX's Transporter-16 mission, aboard Momentus's Vigoride 7 vehicle, in a package of roughly one cubic metre. It carried two prebuilt bays and, once in orbit, built a third. "This is the first time that a structure has been autonomously constructed in space," said Caltech's Sergio Pellegrino.

THE ASTERISK ON "AUTONOMOUS"

The robot did the physical assembly, but three engineers on the ground sent commands and watched progress through photographs. The team could reach ASTRA only during about seven or eight windows a day, each roughly 15 minutes long. When something went wrong, they reproduced it on an identical flight spare in Pellegrino's lab, worked out a fix, and uploaded it. And they ran out of time: the team does not expect to finish all 11 bays before the mission ends in December.

> *Nothing approaching that scale can be achieved today.*
>
> ANDREW DETOR, DARPA PROGRAMME MANAGER FOR NOM4D

REPLICATOR 2: PRINTING IN A VACUUM

Orbital Matter, a Polish-German startup, flew a small satellite with four 3D printers. Each extrudes liquid resin in coils that an ultraviolet light cures into a rigid cylindrical beam, an approach the company likens to cement and water. Previously, 3D printing in space had happened only inside the pressurised International Space Station, and a 2023 NASA-funded beam-printing effort by Redwire took place in a vacuum chamber on Earth.

The result, reported on 3 November: a half-metre beam printed in open space, in what the company calls a first for a free-flying spacecraft. One of the two printers meant to deploy a flexible solar array suffered an anomaly and failed, but the boom the other printed did deploy the array. The CTO's explanation for flying four printers: they preferred to learn in orbit rather than spend years testing every possibility on the ground.

ASSEMBLE VERSUS MANUFACTURE

The two routes differ in what they carry. ASTRA ships precision parts and lets a robot join them; Orbital Matter ships feedstock and lets a printer shape it. An ESA manufacturing engineer quoted in Aerospace America expects large structures will likely need both methods combined.

SO WHAT

From lab to market

The honest timeline is long. ASTRA ends in December having shown the method and not the full antenna. DARPA's next-phase field is small: ASTRA is one of only two projects to reach orbital demonstration, the other being a University of Illinois Urbana-Champaign module on the International Space Station that hardens carbon tubes in space.

Orbital Matter's stated path is a bigger demonstration satellite in 2028 aiming at a 5 kW solar array, as a stepping stone toward 100+ kW per wing by 2030. It says it is working with satellite builders weighing its printer-assisted deployment system for solar panels and antennas, and it names ESA and Thales Alenia as partners. Its engineers believe 100-metre booms are feasible, against 20-metre arrays on SpaceX's Starlink V2 satellites.

The money is already moving: Space.com reports space startups raised a record $20.8 billion in the third quarter of 2026.

OUR READ: WHAT A CTO SHOULD TAKE FROM THIS

1. Structure becomes software. Once the build is a procedure, the interesting asset is the procedure: the sequence, the error handling, the fixes uploaded between 15-minute windows.

2. Feedstock beats form. Struts and resin pack densely. A supply chain that ships raw material by the kilogram looks very different from one that ships finished shapes by the cubic metre.

3. Watch the iteration loop. ASTRA's twin on Earth and Orbital Matter's four printers both bought learning speed. That is a transferable pattern for any hardware you cannot reach.

FIELD NOTES · HOW ASTRA BUILDS

1. **Fetch.** A robotic arm takes tubes and connectors from motorised storage dispensers.
2. **Join.** It positions the parts on an assembly plate and connects them into one new truss bay.
3. **Extend.** The finished bay is pushed outward into space, and the arm starts the next one.

Fairing — the shell at a rocket's tip that encloses the payload during launch.

Truss bay — one repeating frame section; chain them and you have a girder.

UV-cured resin — liquid plastic that hardens when ultraviolet light hits it.

Tensioned reflector — a thin reflective surface held taut across a frame, as in an antenna.

THE CONTRARIAN

The prize isn't bigger. It's *thinner*.

THE MOVE THAT LOOKS WRONG

The consensus read of this week is about scale: kilometre-class antennas, 100-metre booms, giant telescopes. Our read is different, and we flag it as our own inference rather than a reported finding. A structure built in orbit never has to survive being launched. It can be designed only for the quiet conditions it will actually live in. Hints of this sit in the sources: Caltech says its perforated reflective film needs less tension than knitted metallic mesh, which reduces the supporting structure and could make the assembly substantially lighter. DARPA's own programme name ends in "Mass-efficient Design." If that is right, the commercial value is not the size you can reach but the mass you no longer have to carry.

WHY THE CONSENSUS DISAGREES, AND WHERE IT HAS A POINT

The rocket is catching up. Starship's payload fairing is 9 metres wide, against 5.2 metres for Falcon 9, according to New Space Economy. If volume becomes cheap, folding and launching a big thing may beat building it, and in-orbit assembly would have to win on mass alone.

The proof is partial. ASTRA built one bay beyond its two prebuilt ones, of 11 planned, and will not finish. Its "autonomy" depended on a ground team and a twin robot in a lab. Orbital Matter lost one of its four printers, and its half-metre beam is 200 times shorter than the 100 metres its engineers believe feasible. That is a claim about the future, not a result.

The demand case is conditional. TechCrunch ties the need for larger arrays to spacecraft that might serve as orbital data centres. If that market stalls, so does part of the pull. A record $20.8 billion of startup funding in one quarter also tells you the field is hot, which is not the same as proven.

WHAT WOULD CHANGE OUR MIND

Three observations. A multi-bay structure completed autonomously, with fewer ground interventions. A second printing mission that repeats the result with all printers working. And evidence that an in-orbit-built structure is lighter than a launched one for the same job. Until then, treat this as a credible first proof, and the thinness thesis as a hypothesis worth testing.

3rd

PHYSICS & MATERIALS

Magnetism gets a third category, after nearly 90 years

A SLAC-led team reported in *Science* that manganese telluride, long filed as an antiferromagnet, shows a handed, spiral-like magnetic structure that marks it as an altermagnet. They read it with circularly polarised X-rays at the ESRF in France. Altermagnets have zero net magnetisation, so stray fields do not scramble them, yet they can still generate the spin-polarised currents needed to read data. Practical devices, the team says, still need significant development.

SOURCE · ScienceDaily / SLAC, 4 Nov 2026 · sciencedaily.com/releases/2026/11/261104012256.htm

250

ENERGY

A rechargeable zinc-air battery with vitamin B12 as its catalyst

University of Córdoba researchers anchored vitamin B12 to single-walled carbon nanotubes to catalyse oxygen reactions in both directions, reaching up to 250 charge and discharge cycles. Zinc-air cells use abundant zinc and non-flammable aqueous electrolytes. Two caveats: 250 cycles is a laboratory count, and the paper is a prototype, not a product.

SOURCE · EurekAlert / University of Córdoba, 4 Nov 2026 · eurekalert.org/news-releases/1150476 (J. Mater. Chem. A)

$30

ROBOTICS

A humanoid housekeeper, priced like a data-collection programme

Tau Robotics offers hour-long humanoid cleaning visits in San Francisco for $30, in a pilot aimed at 1,000 households. Each robot is jointly controlled by a human operator and AI, and the company says video from the visits is not optional and trains its models. The price makes more sense once you read it as the cost of acquiring training data.

SOURCE · CBS News; KTVU · cbsnews.com/news/tau-robotics-humanoid-ai-cleaning-robots-san-francisco

1.4 m

Width of the antenna reflector ASTRA set out to build in orbit.
CALTECH VIA SCIENCEDAILY

11

Bays in the full ASTRA design. Two flew prebuilt; one was built in orbit.
CALTECH VIA SCIENCEDAILY

15 min

Length of each ground contact, about seven or eight times a day.
CALTECH VIA SCIENCEDAILY

0.5 m

Beam Orbital Matter printed in open space, a first for a free-flying spacecraft.
TECHCRUNCH

100 m

Boom length its engineers believe feasible, against 20 m arrays on Starlink V2.
TECHCRUNCH

9 m

Starship's fairing width, versus 5.2 m for Falcon 9.
NEW SPACE ECONOMY

$20.8B

Record raised by space startups in Q3 2026.
SPACE.COM

What a recipe asks of you

Look across the issue and one habit repeats. An altermagnet is a material defined by the arrangement of its atoms, not by its stuff. A B12 battery is a catalyst anchored in the right place. A $30 humanoid is a cheap body wrapped around an expensive learning loop. And an antenna built in orbit is a procedure executed in space. In each, the valuable thing is the arrangement and the process, and the matter is almost incidental.

That is a useful discipline for any technical leader: separate what you ship from what you know. The parts of a product that travel as instructions can be copied, updated and repaired remotely, as ASTRA's team did with fixes sent between 15-minute windows. The parts that travel as finished shapes are bound by whatever box they must fit in.

None of this is settled. A bigger rocket could make the whole argument moot, and the proofs this week are small and partial. But the direction is clear enough to plan around, and cheap enough to test: pick one thing you ship as a shape, and sketch what it would take to ship it as a recipe.

SOURCES & FURTHER READING

1. **Caltech robot makes history by building a structure in space** — ScienceDaily (Caltech), 9 Nov 2026 — https://sciencedaily.com/releases/2026/11/261108233043.htm
2. **A robot just built a structure autonomously in space for the 1st time ever** — Space.com, 10 Nov 2026 — https://space.com/technology/a-robot-just-built-a-structure-autonomously-in-space-for-the-1st-time-ever
3. **Orbital Matter 3D-printed the first rigid beam in the vacuum of space** — TechCrunch, 3 Nov 2026 — https://techcrunch.com/2026/11/03/orbital-matter-3d-printed-the-first-rigid-beam-in-the-vacuum-of-space/
4. **Startup tests 3D printing concept for building large-scale space structures** — Aerospace America — https://aerospaceamerica.aiaa.org/startup-tests-3d-printing-concept-for-building-large-scale-space-structures/
5. **Starship's commercial moment** — New Space Economy, 13 Apr 2026 — https://newspaceeconomy.ca/2026/04/13/starships-commercial-moment/
6. **SLAC scientists find conclusive proof of a mysterious third type of magnetism** — ScienceDaily, 4 Nov 2026 — https://sciencedaily.com/releases/2026/11/261104012256.htm
7. **The UCO develops a rechargeable battery that runs on vitamin B-12** — EurekAlert, 4 Nov 2026 — https://www.eurekalert.org/news-releases/1150476
8. **Are humanoid robots ready to scrub your kitchen?** — CBS News — https://cbsnews.com/news/tau-robotics-humanoid-ai-cleaning-robots-san-francisco
9. **Robot house cleaning service is being offered in this Bay Area city** — KTVU — https://www.ktvu.com/news/robot-house-cleaning-service-is-being-offered-bay-area-city

INFLECTION.

THE WEEKLY MAGAZINE OF INNOVATION

NEXT ISSUE · FRIDAY, 20 NOVEMBER 2026

THE LENS

What in your world is still shipped as a finished shape that could travel as a recipe?

Researched, written & designed with Claude. Typeset in Poppins & Lora on the Anthropic palette.
Issue 02 · 13 November 2026