

Google's proposed data center in orbit will face issues with space debris in an already crowded orbit

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This rendering shows satellites orbiting Earth.

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The rapid expansion of artificial intelligence and cloud services has led to a massive demand for computing power. The surge has strained data infrastructure, which requires lots of electricity to operate. A single, medium-sized data center here on Earth can consume enough electricity to power about 16,500 homes, with even larger facilities using as much as a small city.

Over the past few years, tech leaders have increasingly advocated for space-based AI infrastructure as a way to address the power requirements of data centers.

In space, sunshine – which solar panels can convert into electricity – is abundant and reliable. On Nov. 4, 2025, Google unveiled Project Suncatcher, a bold proposal to launch an 81-satellite constellation into low Earth orbit. It plans to use the constellation to harvest sunlight to power the next generation of AI data centers in space. So, instead of beaming power back to Earth, the constellation would beam data back to Earth.

For example, if you asked a chatbot how to bake sourdough bread, instead of firing up a data center in Virginia to craft a response, your query would be beamed up to the constellation in space, processed by chips running purely on solar energy, and the recipe sent back down to your device. Doing so would mean leaving the substantial heat generated behind in the cold vacuum of space.

As a technology entrepreneur, I applaud Google's ambitious plan. But as a space scientist, I predict that the company will soon have to reckon with a growing problem: space debris.

The mathematics of disaster

Space debris – the collection of defunct human-made objects in Earth's orbit – is already affecting space agencies, companies and astronauts. This debris includes large pieces, such as spent rocket stages and dead satellites, as well as tiny flecks of paint and other fragments from discontinued satellites.

Space debris travels at hypersonic speeds of approximately 17,500 miles per hour (28,000 km/h) in low Earth orbit. At this speed, colliding with a piece of debris the size of a blueberry would feel like being hit by a falling anvil.

Satellite breakups and anti-satellite tests have created an alarming amount of debris, a crisis now exacerbated by the rapid expansion of commercial constellations such as SpaceX's Starlink. The Starlink network has more than 7,500 satellites, which provide global high-speed internet.

The U.S. Space Force actively tracks over 40,000 objects larger than a softball using ground-based radar and optical telescopes. However, this number represents less than 1% of the lethal objects in orbit. The majority are too small for these telescopes to reliably identify and track.

In November 2025, three Chinese astronauts aboard the Tiangong space station were forced to delay their return to Earth because their capsule had been struck by a piece of space debris. Back in 2018, a similar incident on the International Space Station challenged relations between the United States and Russia, as Russian media speculated that a NASA astronaut may have deliberately sabotaged the station.

The orbital shell Google's project targets – a Sun-synchronous orbit approximately 400 miles (650 kilometers) above Earth – is a prime location for uninterrupted solar energy. At this orbit, the spacecraft's solar arrays will always be in direct sunshine, where they can generate electricity to power the onboard AI payload. But for this reason, Sun-synchronous orbit is also the single most congested highway in low Earth orbit, and objects in this orbit are the most likely to collide with other satellites or debris.

As new objects arrive and existing objects break apart, low Earth orbit could approach Kessler syndrome. In this theory, once the number of objects in low Earth orbit exceeds a critical threshold, collisions between objects generate a cascade of new debris. Eventually, this cascade of collisions could render certain orbits entirely unusable.

Implications for Project Suncatcher

Project Suncatcher proposes a cluster of satellites carrying large solar panels. They would fly with a radius of just one kilometer, each node spaced less than 200 meters apart. To put that in perspective, imagine a racetrack roughly the size of the Daytona International Speedway, where 81 cars race at 17,500 miles per hour – while separated by gaps about the distance you need to safely brake on the highway.

This ultradense formation is necessary for the satellites to transmit data to each other. The constellation splits complex AI workloads across all its 81 units, enabling them to “think” and process data simultaneously as a single, massive, distributed brain. Google is partnering with a space company to launch two prototype satellites by early 2027 to validate the hardware.

But in the vacuum of space, flying in formation is a constant battle against physics. While the atmosphere in low Earth orbit is incredibly thin, it is not empty. Sparse air particles create orbital drag on satellites – this force pushes against the spacecraft, slowing it down and forcing it to drop in altitude. Satellites with large surface areas have more issues with drag, as they can act like a sail catching the wind.

To add to this complexity, streams of particles and magnetic fields from the Sun – known as space weather – can cause the density of air particles in low Earth orbit to fluctuate in unpredictable ways. These fluctuations directly affect orbital drag.

When satellites are spaced less than 200 meters apart, the margin for error evaporates. A single impact could not only destroy one satellite but send it blasting into its neighbors, triggering a cascade that could wipe out the entire cluster and randomly scatter millions of new pieces of debris into an orbit that is already a minefield.

The importance of active avoidance

To prevent crashes and cascades, satellite companies could adopt a leave no trace standard, which means designing satellites that do not fragment, release debris or endanger their neighbors, and that can be safely removed from orbit. For a constellation as dense and intricate as Suncatcher, meeting this standard might require equipping the satellites with “reflexes” that autonomously detect and dance through a debris field. Suncatcher’s current design doesn’t include these active avoidance capabilities.

In the first six months of 2025 alone, SpaceX’s Starlink constellation performed a staggering 144,404 collision-avoidance maneuvers to dodge debris and other spacecraft. Similarly, Suncatcher would likely encounter debris larger than a grain of sand every five seconds.

Today’s object-tracking infrastructure is generally limited to debris larger than a softball, leaving millions of smaller debris pieces effectively invisible to satellite operators. Future constellations will need an onboard detection system that can actively spot these smaller threats and maneuver the satellite autonomously in real time.

Equipping Suncatcher with active collision avoidance capabilities would be an engineering feat. Because of the tight spacing, the constellation would need to respond as a single entity. Satellites would need to reposition in concert, similar to a synchronized flock of birds. Each satellite would need to react to the slightest shift of its neighbor.

Paying rent for the orbit

Technological solutions, however, can go only so far. In September 2022, the Federal Communications Commission created a rule requiring satellite operators to remove their spacecraft from orbit within five years of the mission’s completion. This typically involves a controlled de-orbit maneuver. Operators must now reserve enough fuel to fire the thrusters at the end of the mission to lower the satellite’s altitude, until atmospheric drag takes over and the spacecraft burns up in the atmosphere.

However, the rule does not address the debris already in space, nor any future debris, from accidents or mishaps. To tackle these issues, some policymakers have proposed a use-tax for space debris removal.

A use-tax or orbital-use fee would charge satellite operators a levy based on the orbital stress their constellation imposes, much like larger or heavier vehicles paying greater fees to use public roads. These funds would finance active debris removal missions, which capture and remove the most dangerous pieces of junk.

Avoiding collisions is a temporary technical fix, not a long-term solution to the space debris problem. As some companies look to space as a new home for data centers, and others continue to send satellite constellations into orbit, new policies and active debris removal programs can help keep low Earth orbit open for business.

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