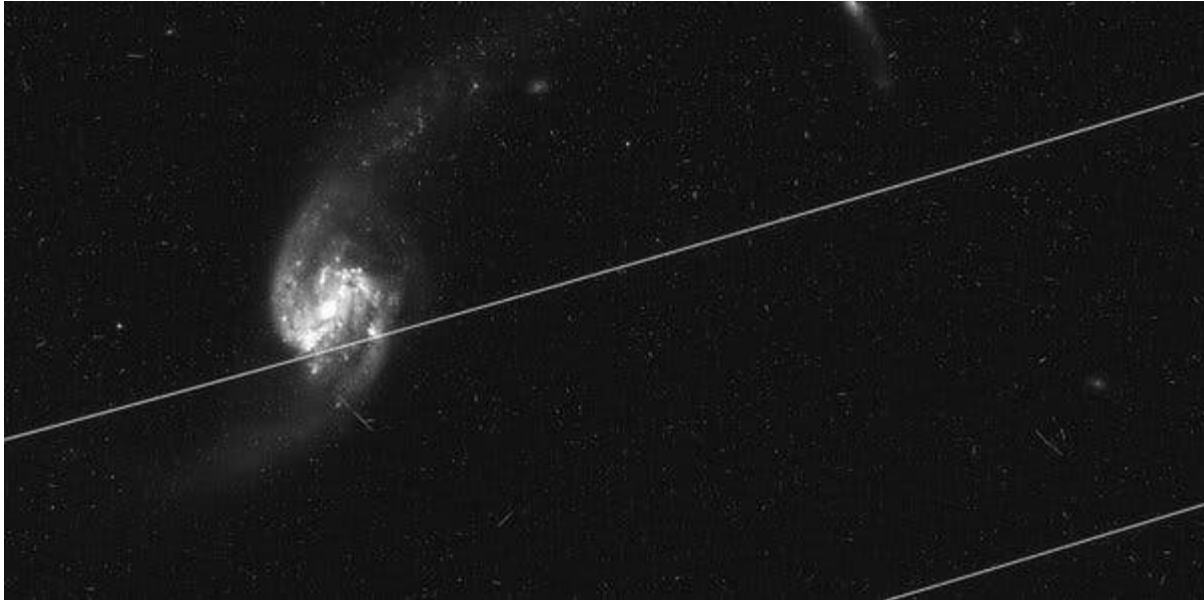


## ***Hubble Telescope Faces Threat From SpaceX and Other Companies' Satellites***

Scientists found that an increasing number of pictures made by the iconic orbital observatory are being disrupted by passing satellites.



The scientists' data went only through 2021, and thousands more satellites have been launched since then by SpaceX and other companies, with many more expected to go to orbit in the years ahead. Credit...NASA, ESA, Kruk et al.

By [Shannon Hall](#)

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5 MIN READ

The Hubble Space Telescope, known for recording awe-inspiring images of the cosmos while advancing the field of astronomy, is under threat.

Private companies are launching thousands of satellites that are photobombing the telescope — producing long bright streaks and curves of light that can be impossible to remove. And the problem is only getting worse.

A [study](#), published Thursday in the journal *Nature Astronomy*, reveals an increase in the percentage of images recorded by the Hubble that are spoiled by passing satellites. And the data goes only through 2021. Thousands more satellites have been launched since then by SpaceX and other companies, and many more are expected to go to orbit in the years ahead, affecting the Hubble and potentially other telescopes in space.

“We’re going to be living with this problem. And astronomy will be impacted,” said Jonathan McDowell, an astronomer at the Harvard-Smithsonian Center for

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Astrophysics who was not involved in the study. “There will be science that can’t be done. There will be science that’s significantly more expensive to do. There will be things that we miss.”

The [Hubble Space Telescope’s legacy cannot be overstated](#). Because of the observatory, we now know, for example, that the universe is 13.8 billion years old, that most galaxies contain a supermassive black hole at their centers and that stars form in violent processes. The Hubble’s images — including the gorgeous clouds of gas and dust in the “[pillars of creation](#)” and the view of nearly 10,000 galaxies in the “[Hubble ultra deep field](#)” — never fail to inspire.

But the number of satellites in orbit has significantly increased since the Hubble launched in 1990, and now it is staring at the cosmos through a field of satellites.

In May 2019, SpaceX launched its first batch of Starlink satellites, designed to broadcast internet signals across the globe. Soon after, an [outcry](#) emerged among astronomers who were concerned that Starlink’s streaks would jeopardize a number of campaigns to observe the universe from telescopes on Earth.

In response, Elon Musk, SpaceX’s founder and chief executive, [suggested](#) that astronomers bypass the issue by moving telescopes to orbit.

## Peering Into Space With the Hubble Telescope

Since its launch in 1990, the Hubble Space Telescope has recorded awe-inspiring images of the cosmos while advancing the field of astronomy.

But Hubble, which lives in low-Earth orbit roughly 335 miles above Earth’s surface, actually resides less than 10 miles below most Starlink satellites. That means that the observatory and other orbital space telescopes are still facing interference from satellite constellations. “Not only do you have to put your telescopes in space, but you also have to put them above all the other traffic,” Dr. McDowell said.

“I think we’ll be forced to do that in the decades to come,” he said. But that isn’t possible for current telescopes in low-Earth orbit or spacecraft that governments are building and launching in the coming years.

To quantify the effect of satellite constellations on Hubble, Sandor Kruk, an astronomer at the Max Planck Institute for Extraterrestrial Physics in Germany, and his colleagues analyzed an archive of images taken from 2002 through 2021.

They had help from hundreds of citizen scientists who pored through images to tag those with clear satellite streaks. That dataset was then used as a training set for a machine-learning algorithm that analyzed more than 100,000 individual Hubble photos. Their results show that the chance of seeing a satellite in a Hubble image from 2009 to 2020 is only 3.7 percent. But the chance of seeing one in 2021 is 5.9 percent —

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an increase that they say corresponds to Starlink. By the date of the analysis, 1,562 Starlink satellites were in orbit. Another company, OneWeb, had lofted 320 satellites.

Even if only 100,000 satellites launch in coming years — and many more are scheduled — that would increase the number of satellites by a factor of 10 since the study took place. Roughly 50 percent of Hubble’s images would spot one. Credit...NASA, ESA, Kruk et al.

Mark McCaughrean, an astronomer at the European Space Agency and a co-author on the new study, is confident in their analysis, but notes that this is only a minor issue at the moment. Typically, Hubble takes multiple images that are stacked on top of one another — a technique that will erase any satellites.

And NASA agrees. “While such analyses may show a gradual increase in detected satellite trails over time, most of these streaks are readily removed using standard data reduction techniques, and the majority of affected images are still usable,” a spokeswoman said in regard to the latest study. “Satellite streaks do not currently pose a significant threat to Hubble’s science efficiency and data analysis.”

That threat is higher when the Hubble surveys a large swath of the sky. Then it might take only one or two images before redirecting its camera. If a satellite photobombs one of those images, the image might have to be tossed.

In addition, the satellites could pose a serious threat to a telescope that hasn’t launched yet. At the end of this year, China plans to send Xuntian, also known as the Chinese Survey Space Telescope, into low-Earth orbit. Xuntian will have a larger field of view than Hubble, making it much harder for satellites to slip by undetected.

“It’s going to be very severely affected by these satellites right off the bat,” Dr. McDowell said.

And Xuntian can’t simply launch into a higher orbit. China’s plan is for the telescope to share an orbit with the Tiangong space station so that astronauts can refurbish it if necessary.

An unknown satellite streaked the Hubble’s field of view. SpaceX said it has tried a variety of methods to darken its satellites, but also hopes to eventually expand the size of its fleet to 42,000 Starlink satellites. Credit...NASA, ESA, Kruk et al.

A spokesman from SpaceX declined to comment on the new study, but pointed toward the company’s past efforts to mitigate the effects of Starlink. The company has tried a variety of methods to darken its satellites, including a [mirror film](#) designed to direct light away from the ground. But Meg Schwamb, a planetary scientist at Queen’s University Belfast who was not involved in the study, worries that the light will be directed up instead and could potentially worsen the situation for space-based telescopes.

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There are simply too many unknowns at the moment, including the ultimate number of satellites.

SpaceX hopes to eventually expand the size of its fleet to 42,000 Starlink satellites. Many other companies are in the market, too: Amazon, the British satellite provider OneWeb, a Chinese company called Galaxy Space, and even governments. A combined [431,713 satellites](#) are planned to launch in the coming years.

“It’s a bit of a feeding frenzy at the moment,” Dr. McCaughrean said.

That estimate is based on filings with the U.S. Federal Communications Commission and the International Telecommunication Union. But even if only 100,000 satellites launched, that would increase the number of satellites in orbit by a factor of 10 since the new study took place — meaning that roughly 50 percent of Hubble’s images would spot a satellite. And if every other image had a satellite streak, the researchers worry about how much usable science could be gathered.

“When will Hubble not be useful anymore?” Dr. McCaughrean asked. “That might be 10 or 20 years away, but it’s not inconceivable that there’s a point at which you say, ‘Let’s not bother anymore.’”