

SPACEX

'It changes the game': Astrophysicist speaks on Starlink impact to astronomy observation

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While Starlink has won accolades for expanding internet connectivity across the globe, including access even in remote locations, such as out at sea, the internet satellite constellation has caused a different kind of stir in the astronomy community.

The Starlink constellation has been quickly growing since 2019. Launching from Vandenberg, California and the Space Coast, Starlink launches sometimes occur as often as two-to-four times a week. Each launch contains 20 or more Starlink satellites as its payload, and there are currently more than 6000 in orbit already.

These satellites are intruding into the view of our universe, astronomers warn, making it more laborious to make scientific observations. The real concern, though, comes not in what's already up orbiting our skies but what will come as more and more satellite constellations are launched into Earth orbit, and not just by SpaceX.

“It’s not just Starlinks. It’s the totality of all the mega-constellations that are going to be launched over the next 10-20 years,” said Jonathan McDowell, who is an astrophysicist at the Harvard-Smithsonian Center for Astrophysics.

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Observing the problem with Starlink

Florida Tech astrophysicist Eric Perlman said since satellites have been launched, they have been a disturbance to astronomical observations. That's not new. However, with satellite constellations on the rise, it brings this disturbance to a new level.

"It's always been there, but when the occurrence goes from, you know, maybe one image every few nights to an image every 30 minutes, which literally is what has happened, it changes the game," he said.

While Starlink satellites move higher up in their orbit and further apart following deployment, Perlman said that because of their brightness and proximity, there is still an impact.

And there's no possible way for astronomers to predict when the field of view will be free of obstruction. A database that continuously keeps tracks of every single satellite in orbit just does not exist. McDowell does track all satellite constellations on his website.

While an official size has not been released, Sky and Telescope Magazine have described Starlink satellites as being around the size of a table.

Starlink states that its satellites orbit at a much lower altitude than traditional satellites to deliver enhanced internet speed. While the typical satellite orbits at 35,786 km, Starlink orbits at only 550 km above Earth. To put it in perspective, that's 341.75 miles — approximately the distance between Jacksonville and Miami.

"If you have an observation with a Starlink satellite going through the field, what happens is that you get this big streak that is brighter than any of the stars, basically," Perlman said. "You can see nothing through it. It's a streak at some odd angle, and it goes from end to end of your image. If what you're looking at is near it, you're out of luck."

Astronomers get creative to see night sky

With the increasing number of satellites over the years, astronomers had to become creative, especially when observing faint objects. Perlman said that astronomers take long exposures to observe dim objects so there is a high risk of multiple Starlink satellites entering the field of view. Astronomers needed a way to work around this obstacle.

"Let's say you're observing for an hour. So you think 60 one-minute frames. And if you take 60 one-minute frames, then you can find the two, three, four (image frames) that have the ;

Starlinks, and then just take them out,” he said.

There's a cost to the work arounds, starting with additional digital storage. Perlman said a 20-megapixel image takes hundreds of megabytes of disk storage. If an astronomer takes 100 images during an observation, that turns out to be 20 gigabytes of disk storage.

It's not just disk space, but time spent on the images as well.

“It also makes other subtle changes in terms of how efficiently you can observe as well. Because every time you do an observation, there's things that you don't see that take up a little bit of time,” said Perlman.

He explains that astronomers need to look at every pixel on the chip in order to get a good image. “Let's say it takes 10 seconds. Well, if you do that 60 times, that's 10 minutes. That's an extra 10 minutes your observation took,” said Perlman.

Astronomers didn't anticipate this when Starlink first began launching in 2019 but they've always grappled with the impact of satellites on their work.

“Basically, anytime you have a satellite, this is going to happen. It doesn't matter if it's a Starlink, or a weather satellite, or the space shuttle; it's going to happen because you got this bright thing (that) reflects a lot of light, and of course it's much, much, much nearer than any of the stars or planets or galaxies that you're trying to observe. And it goes fast,” Perlman said.

He explained that in a telescope field of view, that bright object will take around 10-15 seconds to move through. This doesn't disrupt just a few pixels, but the entire image.

Astrophysicist Jonathan McDowell agreed.

It doesn't make ground-based observations impossible, he said, but it can make things more difficult.

“Right now, we have around 6000 Starlinks up. That is enough to be annoying to astronomers, but not an existential threat,” said McDowell. “But, when you talk about, the prospect of, a decade or so from now of 60,000 or several hundred thousand satellites in orbit – then it starts to be very hard to see the sky through all these satellites.”

And it's not just Starlink.

Amazon Kuiper, a planned internet constellation of 3,236 satellites, is next on the radar. Amazon plans to begin launching as soon as this year, and has over 80 launches planned

with multiple companies, including: Blue Origin, SpaceX, ULA, and Arianespace. The company states that half of those 3,236 satellites will be in orbit by July 2026.

Could the impact on astronomy have been avoided?

FLORIDA TODAY asked Perlman if he believes SpaceX or Starlink teams could have done anything to prevent this impact.

“I guess from an astronomer’s point of view, we would have just liked it if (SpaceX Founder Elon) Musk or one of his people would have given one of the observatories a call and said ‘Hey guys, I’m putting these things up. This is going to happen. I want you all to tell me before they go up what the effect will be on what you do,’” said Perlman.

He believes a solution could have been found before the first launches a half of a decade ago.

McDowell noted that SpaceX has taken steps to help.

“SpaceX is putting a lot of effort into making them faint. They’ve done a good job, but not quite good enough all the time...there’s plenty of other satellites now in that range that are also bright enough to see.”

Perlman added that the more recent Starlink satellites have a slight change: different paint to reduce the amount of reflected light.

“Musk is onboard with a number of other things as far as astronomy goes. He is actually talking about, thinking about ways to use his rockets to possibly fix Hubble when the time comes,” said Perlman. “But nobody knows if that’s ever actually going to happen.”

According to NASA, Hubble, which has been in orbit since 1990, went into a safe mode in late May. NASA states that the issue was on the space telescope's gyroscopes, which measure the flow of power currency and control the direction in which the telescope points. The issue was resolved by reducing the space telescope to using only one gyroscope. This allows Hubble to still observe and send back data from a limited area. NASA states that Hubble has outlived over twice its life expectancy.

Shift4 business entrepreneur and Inspiration 4/Polaris Dawn commander, Jared Isaacman, has publicly mentioned his willingness to be involved with efforts to help Hubble and the

astronomy community. No official announcement of an organized effort has been made.

Supporters of Starlink also say it's worth noting that Musk has made efforts to use Starlink's connectivity in a beneficial way, such as assisting in natural disasters. Following the May 2024 flooding in Rio Grande do Sul, Brazil, Musk announced on X that he was donating 1000 Starlink terminals to first responders in the area, keeping them connected free of charge during the crisis.

The impact of Starlink on your night sky

While casual stargazers do not currently have need for concern, these satellites are visible at times to the human eye.

"The new Starlinks are twice as big as the original ones," said McDowell. "Typically once they're in their operational orbit, they are just below the level of brightness that you can see with the naked eye. Most of the time, but not all of the time. So, maybe like 20 percent of them at any given time are bright enough to see."

They are the non-blinking/non-twinkling points of light that may be seen moving across a dark sky.

The "trains" that can be seen on occasion are newly launched satellites traveling to their orbit, where they will spread out — and not be as visible.

Perlman said that for the casual stargazer, there probably isn't much of an impact. They might notice a few satellites here and there, but most will remain out of sight.

"They're just not big enough," said Perlman.

Jamie Tayar, an assistant professor of astronomy at University of Florida, likened the effects of satellites to that of light pollution. While people will still be able to see the stars, the occasional Starlinks that are visible could impact the experience just as light pollution does.

"These satellite constellations are starting to change what people see when they look up at the sky," Tayar said, "in the same way that light pollution has changed what most people can see of the sky from the cities and suburbs, and those changes together have meant that fewer people get to experience the wonder of looking at a truly dark and uncontaminated night, gazing at the Milky Way and looking for shooting stars."

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