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Astronomy

Massive satellite could outshine all the stars and planets in the night sky

Jonathan O'Callaghan

A LARGE satellite that launched to space last week could become brighter than any other object in the night sky except the moon, raising concerns about its impact on astronomy.

The BlueWalker 3 satellite, built by Texas-based firm AST SpaceMobile, launched on a SpaceX Falcon 9 rocket on 10 September. The satellite is designed to test the company's technology to beam a cellular connection, including 4G or 5G internet, directly from a satellite to mobile phones, enabling users to receive mobile coverage in remote locations.

Orbiting 500 kilometres above Earth, the 1500-kilogram satellite is set to deploy a huge antenna spanning 8 metres across, with a surface area of 64 square metres – about the size of a squash court. This large, flat surface will reflect a lot of sunlight, which could make the satellite extremely visible to observers on the ground.

For astronomers, it could create bright streaks across images from ground-based

"I would really see this as an infringement on astronomers' rights to explore space"

telescopes, potentially making them unusable for observing more distant objects.

"We are concerned," says John Barentine, an astronomer at Dark Sky Consulting in Tucson, Arizona. "It could be the brightest object in the night sky [other than the moon], potentially brighter than the planet Venus."

Barentine says there are also worries about the direct-to-mobile technology of the satellite, which involves a powerful radio beam connecting with a phone. That could disrupt radio astronomy, which requires very sensitive instruments to study the universe. "We're concerned about the amount of energy in that beam," he says. AST SpaceMobile didn't respond to a request for comment.

The firm is one of several companies developing new direct-to-mobile services. Starting from next year, AST SpaceMobile plans to launch more than 100 larger satellites called BlueBirds. These could be more than twice the size of BlueWalker 3, and could appear even brighter in the sky. "The brighter these objects get, the more damage they will do to images of the night sky," says Barentine.

Chris Johnson, a space law adviser at the Secure World Foundation in the US, says that while there are no restraints under international law on the size of satellites, the launch could highlight the limitations in existing regulations. "I would really see this as an infringement on astronomers' rights to explore space," he says.

The Federal Communications Commission (FCC) in the US has issued an experimental licence for BlueWalker 3, but a full licence for AST SpaceMobile's later satellites may depend on the performance and impact of BlueWalker 3. "The FCC appears willing to see how it goes and decide on a full licence later," says Tim Farrar, a satellite communications consultant in the UK. The FCC declined a request to comment. ▮

Neuroscience

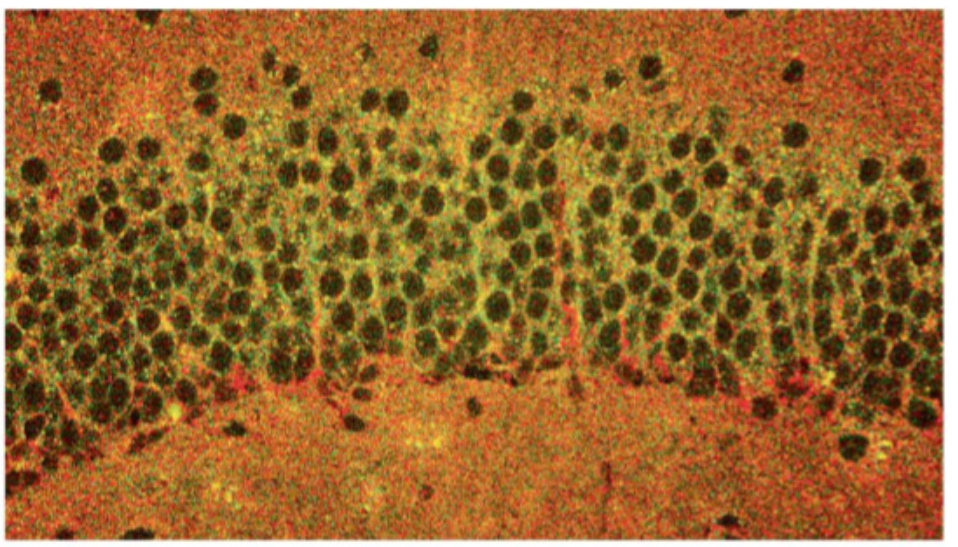
Quantum diamond used to measure neural activity

A BRAIN-recording device with a quantum diamond sensor has been used to measure neural activity in mouse brain tissue. The method could one day be useful for non-invasive brain scanning.

The most common way to study how neurons interact is to measure their electrical signal, typically by inserting tiny wires into a tissue sample. But this might alter neural activity, so a non-invasive method would be preferable.

One possible technique is by using a modified diamond that shines more or less brightly depending on the brain-generated magnetic field passing through it due to a quantum mechanical quirk: certain defects in the diamond have their electron spin affected by external fields, which shows up as luminescence. This has been previously done with giant squid and worm tissue.

Now, Alexander Huck at the Technical University of Denmark near Copenhagen and his colleagues have created a quantum diamond sensor to measure the activity of mouse nerve cells. They tested it on nerve fibres in a slice of brain from a region known as the corpus callosum. By placing the scanner over the tissue sample, after 300 trials, the team recorded neural activity that largely agreed with data from inserted wires (arxiv.org/abs/2208.14068).



SHUTTERSTOCK/OLEG SENKOV

Neurons from the hippocampus of a mouse brain

It can only detect the signal from groups of neurons rather than individual ones, but Huck says an improved sensor could help us observe what happens in brain samples at the microscopic scale.

The inability to see what is happening in single neurons means the method is unlikely to replace current brain-imaging techniques, says Tim Viney at the University of Oxford. However, developing the quantum diamond sensor could result in new techniques, he says. ▮

Alex Wilkins