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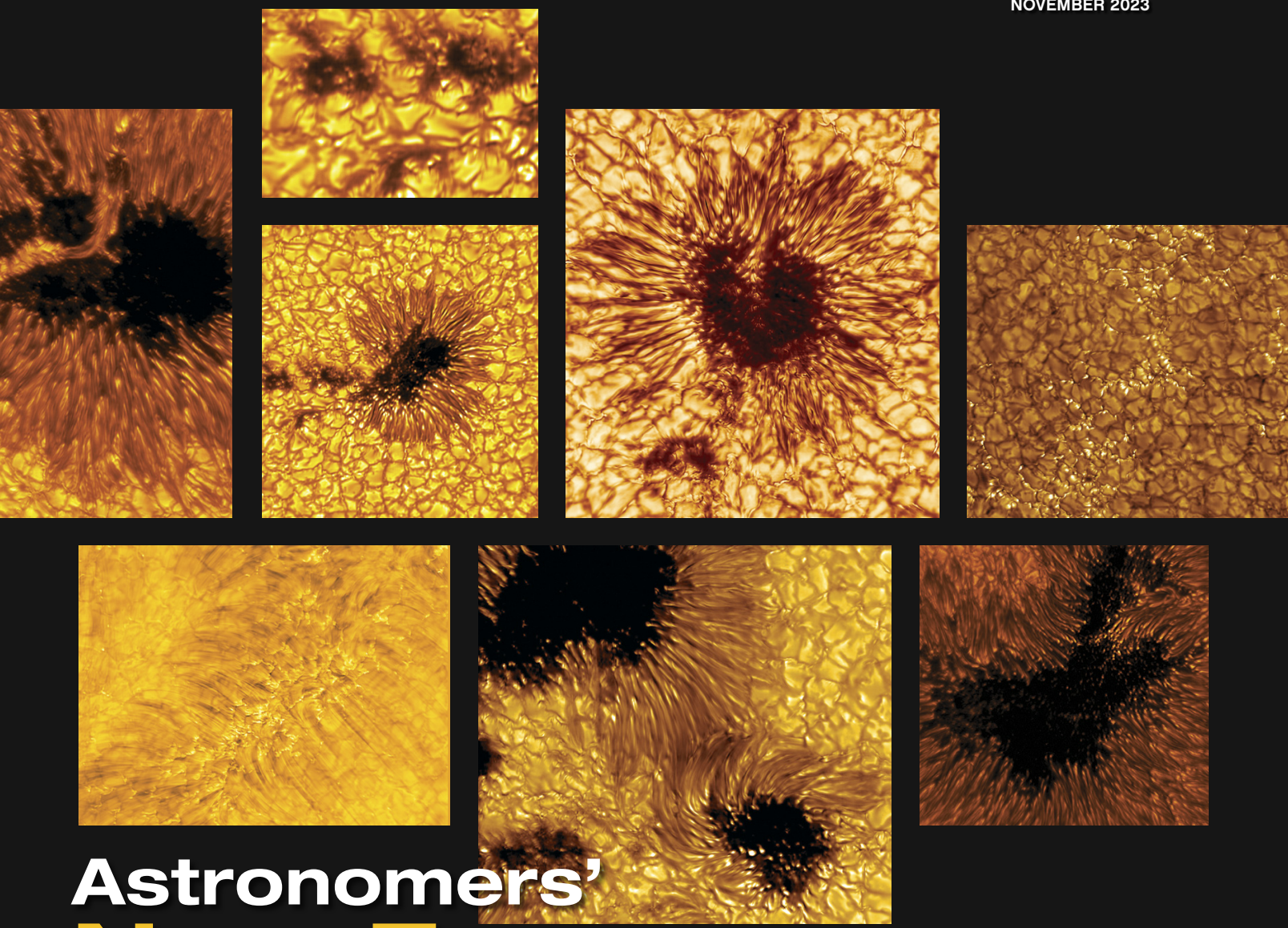
SKY & TELESCOPE

THE ESSENTIAL GUIDE TO ASTRONOMY

NOVEMBER 2023



Astronomers' New Eye on the Sun

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MEGACONSTELLATIONS

Satellites Leak Radio Emission

RADIATION LEAKING from Earth-orbiting satellites, now detected for the first time, may become a major problem for radio astronomy as the number of satellites continues to grow.

Satellites' communication signals are strong but are by regulation limited to certain wavelengths, and they can be filtered out. However, satellites may also leak artificial signals at unintended wavelengths, and this radiation isn't regulated to the same degree. A team led by Federico Di Vruno (Square Kilometre Array Observatory) has announced the first detection of this electromagnetic interference from satellites in large constellations.

Di Vruno and colleagues used the core antennas of the Low-Frequency Array (LOFAR) in the Netherlands to look for signals from satellites in SpaceX's Starlink constellation, which at the time numbered 2,100 (currently, there are more than 4,000). Out of 68 observed satellites, 47 were detected at frequencies between 110 and 188 MHz, well below the 10.7 to 12.7 GHz radio frequencies reserved for downlink communications. The report will appear in *Astronomy & Astrophysics*.

◀ Artist's impression of a satellite constellation in orbit above the LOFAR telescope

"Every electric device generates leakage radiation," explains team member Gyula Józsa (Max Planck Institute for Radio Astronomy, Germany). But as the number of satellites increases, so will the radiation they leak.

"Usually, we just eliminate data that has been contaminated by a satellite from further processing," Józsa says. "The more this happens, the more observation time we lose." Even more troubling, weak artificial signals may hide in the noise, which could lead to erroneous results when typical methods for noise reduction are employed.

So far, the researchers have only obtained one-hour "snapshot" observations. They plan to follow up to better understand how much radiation leaks from Starlink and other satellites.

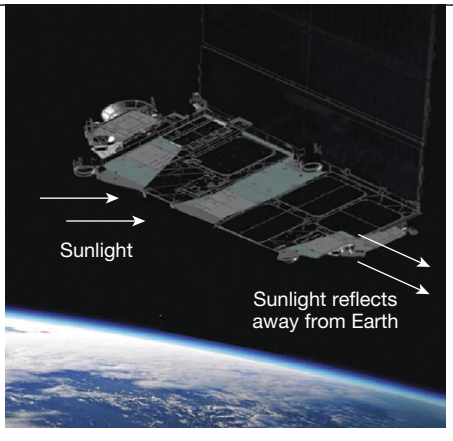
■ JAN HATTENBACH

MEGACONSTELLATIONS

New, Larger Starlink Satellites Are Faint

SPACEX LAUNCHED the first batch of second-generation Starlink satellites dubbed "Minis" on February 27th. They are only small in comparison to the full-size version that will come later: With 116 square meters of surface area, Minis are more than four times the size of the satellites in the previous generation. SpaceX has since launched several additional batches.

While the Minis' large dimensions were an immediate concern to astronomers, SpaceX also changed the physical design and concept of operations in order to mitigate their brightness. The company applied a highly reflective dielectric mirror film to several parts of the spacecraft body, in order to reflect sunlight into space rather than scatter it toward observers on the ground.



▲ Dielectric mirror surfaces on the spacecraft body reflect sunlight (coming from the left), directing it into space rather than down to the ground. Special black paint is put on some areas where the dielectric film can't be applied.

On some areas that couldn't take the dielectric layer, the company used low-reflectivity black paint. In addition, the solar panels can be oriented so that observers do not see their sunlit sides.

To check the brightness mitigation plan, a group of seven satellite observers (including the author) began recording magnitudes both visually and with a camera, prioritizing measurements for spacecraft that SpaceX confirmed were operational. Our group found that these had an average magnitude of 7.1. These satellites are thus slightly fainter than astronomers' guidelines and are invisible to the unaided eye.

Next, we adjusted the observed magnitudes to a uniform distance of 1,000 km from the observer, in order to compare the intrinsic magnitudes of mitigated and unmitigated spacecraft: 7.9 and 5.1, respectively. The new satellites are on average dimmer by a factor of 12, as reported in a paper posted on the arXiv astronomy preprint server. But our work isn't done yet: We need more Starlink magnitudes to characterize and monitor the brightness of the new and upcoming satellites.

■ ANTHONY MALLAMA

ARTIST'S CONCEPT OF SATELLITES ABOVE A RADIO ARRAY: DANIËLLE FUTSELAAR; ILLUSTRATION OF DIELECTRIC MIRRORS ON STARLINK SATELLITE BODY: SPACEX