

March 23, 2026

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	ICFS File No.:
Space Bureau Accepts for Filing SpaceX's)	SAT-LOA-20260108-00016
Application for Orbital Data Centers)	
)	

REPLY COMMENTS OF THE AMERICAN ASTRONOMICAL SOCIETY

The American Astronomical Society¹ (AAS), the major organization of professional astronomers in the United States, respectfully submits this reply in response to the consolidated opposition to petitions and response to comments (the “Opposition”) filed by Space Exploration Holdings, LLC (SpaceX)² regarding its application to launch and operate one million orbital data centers (the “Application”).

The Petition to Deny by AAS establishes that the operations proposed by SpaceX in the Application would cause significant harm to federally funded and operated astronomical facilities, resulting in wasted taxpayer dollars. Nothing in SpaceX’s Opposition resolves these concerns. Indeed, the Opposition’s statement (not contained in its original Application) that SpaceX “plans a phased deployment approach for this system” is an implicit acknowledgement that the threats identified by AAS are very real.

It is clear that the proposed satellite system would result in tens of thousands of sunlit satellites being visible at any given location and at any given time. SpaceX does not provide even a concept for how the aggregate effect of the brightness of these satellites could be mitigated to protect professional and amateur astronomical observations. We further note that even if the satellites are not visible to the naked eye, i.e., fainter than visual magnitude 7, they will cause unavoidable interference with astronomical observations. The visual magnitude 7 target is the level at which a modest number of objects is unlikely to cause irreparable harm to the scientific operation of federally funded telescope facilities. It should not be misconstrued as a threshold below which tens to hundreds of thousands of satellites (and certainly not one million) will have no impact whatsoever on astronomy or the sky. Furthermore, most of SpaceX’s present satellites do not meet the visual magnitude 7 target³, and we find it disingenuous that SpaceX suggests it

¹ The American Astronomical Society webpage: <https://aas.org/>

² Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC (filed March 16, 2026) (“Opposition”)

³ A. Mallama & R. E. Cole 2025, “Satellite constellations exceed the limits of acceptable brightness established by the IAU,” MNRAS 544, 1, L15-L17, <https://academic.oup.com/mnras/article/544/1/L15/8251664>. To explore the latest data, crowdsourced brightness measurements are also available at <https://score.cps.iau.org/visualization/graphs>.

can trivially develop novel technologies that will reliably meet this target for innumerable physically larger objects.

SpaceX's Opposition also does not address a multitude of other issues:

- The infrared radiation from these satellites would make observations in this wavelength regime nearly impossible, and SpaceX does not provide concrete steps that they will take to address this issue in their Opposition.
- SpaceX's Opposition also does not adequately address our concerns about radio frequency interference, as it fails to provide details to show that the aggregate interference would be negligible, and does not address the concern regarding interference from harmonics and unintended electromagnetic radiation.
- Further, SpaceX does not address the latest literature on atmospheric impacts of satellite reentry cited in our Petition.
- Finally, SpaceX does not address the need for interoperability of its collision avoidance systems, nor does the Opposition address the risks to terrestrial and, in the future, lunar safety caused by the use of heliocentric disposal orbits.

In short, the record reflects that there are substantial and material questions with respect to SpaceX's proposed operations and their impact on federal astronomical facilities and investments that SpaceX has not adequately addressed. As such, the Commission should not grant SpaceX's application.

I. Optical Interference

SpaceX's Opposition does not resolve the concern raised by AAS with regard to optical interference that will be experienced by astronomical facilities, including those funded and operated by the United States government. The simulations presented in our Petition show that with the granting of this license, tens of thousands of sunlit satellites will be above the horizon for every location on Earth for much of the night for most of the year. This scenario is concerning for both casual observation of the night sky and for astronomical research.

Astronomers measure the brightness of sky objects seen from Earth at night in terms of magnitudes. The human eye can detect down to a faint limit of around a visual magnitude of 7. The International Astronomical Union (IAU) recommends that satellites below an altitude of approximately 550 km be fainter than visual magnitude 7 in brightness⁴, such that they are not visible to casual observers. For satellites at higher altitudes, including those proposed in SpaceX's Application, the IAU recommends that they be even fainter, e.g., approximately visual magnitude 7.6⁵ at an altitude of 1000 km.⁶ This limit helps ensure, for example, that the multiple

⁴ Boley et al. (2025) "[IAU CPS Satellite Optical Brightness Recommendation: Rationale](#)", *Research Notes of the American Astronomical Society*

⁵ Note that visual magnitude 7.6 is fainter than visual magnitude 7, because higher numbers on this scale correspond to fainter apparent brightness.

⁶ Boley et al. (2025) "[IAU CPS Satellite Optical Brightness Recommendation: Rationale](#)", *Research Notes of the American Astronomical Society*

“ghost” images from a single satellite streak (due to electronic crosstalk in the detectors) from the newly built NSF-DOE Vera C. Rubin Observatory do not invalidate large swaths of images over 10x the area of the streak itself. Moreover, astronomers study objects that are many orders of magnitude fainter than this threshold, so reflected sunlight from satellites will always appear as bright foreground noise in our data. In other words, even if all satellites in a small fraction of “initial operations” of this stunningly large constellation meet the above brightness recommendation, astronomers will still experience numerous contaminations in each astronomical observation, in a manner that will significantly compromise research from a large number of taxpayer- and government-funded ground-based and low-Earth-orbit based facilities.

More concerningly, we note that in their Opposition, SpaceX has claimed to have reached the visual magnitude 7 (VM7) limit with Starlink - it has not⁷ - even though this was a stated goal. Currently, on any given night, most satellites visible to casual observers are Starlink satellites. The new direct-to-cell Starlinks recently authorized by the FCC are likely to be many times brighter than the current generation of satellites because of their larger size, despite SpaceX having chosen lower orbits that somewhat offset these effects for large ground-based observatories at low latitudes. The satellites that would be required for AI data centers are likely to be even larger, although their size is not specified in the Application or the Opposition. As a result, in the full deployment of the proposed constellation, casual observers would see tens of thousands of moving objects across the sky for much of the night, fundamentally altering the human experience with the night sky. For a significant fraction of the night, the sky would be inaccessible to professional astronomical observation, regardless of whether the satellites could be made to meet any desired single-object brightness limit. This outcome will result in the waste of countless billions of dollars of taxpayer investment in federally funded astronomy research.

SpaceX notes in its Opposition that it is refining advanced Bidirectional Reflectance Distribution Function (BRDF) models that accurately predict satellite brightness as seen from Earth. SpaceX has not provided the results of these models, or a plan to do so, so no demonstration of the satellite brightness mitigation exists.

II. Infrared Interference

SpaceX’s Opposition does not resolve the concerns raised by AAS regarding interference with astronomical observations at infrared wavelengths. The Opposition offers no substantive pathway forward other than a vague commitment to “establish appropriate infrared guidelines.” It is physically impossible to make hot objects like satellites faint in thermal infrared wavelengths. An orbiting data center would generate substantial amounts of waste heat which would need to be radiated, so it would appear much brighter in the thermal infrared than a communications satellite. And again, aggregate effects are completely ignored in SpaceX’s Opposition. With tens of thousands of these satellites above the horizon as seen from any point on Earth, bright infrared streaks from satellites would be continuously traversing every telescope’s field of view. Nearly every federally funded optical observatory also observes in

⁷ Mallama & Cole (2025) “[Satellite constellations exceed the limits of acceptable brightness established by the IAU](#)”, *Monthly Notices of the Royal Astronomical Society*

infrared wavelengths, so the proposed system would have far-reaching negative impacts on many US astronomical facilities.

III. Radio Interference

SpaceX's Opposition does not resolve the concerns raised by AAS regarding radio frequency interference. SpaceX asserts that Ka-band downlink will only be used on a "limited basis" for backup communications and TT&C, and therefore that aggregate out-of-band emissions will not scale with the size of the constellation. But neither the Application nor the Opposition appears to quantify that claim. The record does not identify the expected duty cycle of Ka-band operations, the fraction of satellites expected to use Ka-band simultaneously, the duration of such operations per satellite, or any upper bound under nominal, degraded, or failure conditions. In the absence of those parameters, there is no basis for the Commission or commenters to evaluate whether aggregate emissions are in fact negligible.

Moreover, SpaceX's statement that "no allocation exists for radio astronomy services adjacent to the Ka-bands" misses the point. AAS did not limit its concern to adjacent-band interference into nearby RAS allocations. The concern is that harmonic emissions and other unintended emissions associated with the proposed Ka-band downlinks can fall into higher-frequency radio astronomy bands, and those effects are not addressed merely by noting the absence of adjacent RAS allocations. The petition also raised concerns regarding unintended electromagnetic radiation more generally, and existing studies indicate that such emissions can be broadband rather than confined to frequencies immediately surrounding the intended downlink band. SpaceX's response does not address that issue with any quantitative analysis.

If SpaceX intends to rely on the argument that aggregate emissions will remain small because Ka-band is only a backup mode, then it should provide, at a minimum, quantitative assumptions regarding:

- the expected duration of Ka-band operation during normal mission phases;
- the expected use during early mission, orbit-raising, station-keeping, contingency, and de-orbit phases;
- the maximum number of satellites that could simultaneously employ Ka-band links under nominal and degraded network conditions; and
- the resulting aggregate harmonic and unintended-emission environment.

Without those disclosures, the Commission cannot meaningfully assess the impact of the proposed system on radio astronomy.

IV. Other consequences for the night sky and terrestrial environment

We note that several peer-reviewed studies on the atmospheric impacts of satellite reentry⁸, cited in our Petition, have been published in leading academic journals *after* the two European Space

⁸ As cited in our Petition: "For known and suspected effects on the Earth's atmosphere resulting from re-entering spacecraft, see, e.g., Sharma, S.P. (2024), "Impact of Spaceflight on Earth's Atmosphere: Climate, Ozone, and the

Agency (ESA) studies cited in the Opposition. These studies all point to potentially hazardous changes to atmospheric chemistry resulting from the anthropogenic deposition of metals into the upper atmosphere.

V. Concerns regarding the orbital environment

SpaceX's Opposition does not resolve the concerns raised by AAS regarding the orbital environment. SpaceX states that their million satellites would only inhabit a tiny fraction of orbital space, which is true at any moment, much as it is also true that the number of pixels blocked by a single streak in one image from a large facility like NSF-DOE Vera C. Rubin Observatory is also small. But satellite engineers and astronomers alike ought to understand first, that satellites move very quickly, and second, that small individual impacts do not equal small aggregate impacts. Every single one of these satellites is travelling at LEO orbital speeds, about 7 km per second, and they will sweep out their orbits in about 90 minutes. Due to the criss-crossing orbits and constant orbital adjustments, close encounters (and, ideally, collision avoidance maneuvers) will occur frequently. The Opposition's argument against worrying about orbital crowding is akin to saying that Indianapolis 500 drivers don't need to worry about crashing, because the few cars that are racing take up very little of the total track area. SpaceX does not address concerns regarding the interoperability of their collision avoidance systems, which will be critical to ensuring that low Earth orbit remains accessible to all, per US treaty obligations.

SpaceX's Opposition also fails to address serious concerns regarding its proposed use of heliocentric disposal orbits. As stated in our Petition, current research on heliocentric disposal suggests these objects do not simply disappear but instead remain as hazards that may eventually intersect with the orbits of Earth and the Moon⁹, posing a threat to future US lunar operations and to terrestrial safety. We believe that such risks would mean that granting a license for the proposed megaconstellation is not in the public interest.

VI. Summary

SpaceX's Opposition does not resolve any of the concerns raised by the Petition from AAS. Moreover, SpaceX's opposition fundamentally misunderstands our Petition. We have not asked that the Commission conduct an environmental review under NEPA when considering this application. As stated in our Petition, we urge that the Commission require SpaceX to carry out or fund a rigorous assessment, prior to the deployment of the proposed system, of the impact of this proposal on U.S. funded astronomical facilities, including the cost of any impacts in terms of

Upper Atmosphere". NASA/TM-20240013276; Maloney, C. M., et al. (2025). "Investigating the Potential Atmospheric Accumulation and Radiative Impact of the Coming Increase in Satellite Reentry Frequency." *Journal of Geophysical Research: Atmospheres*, 130(6). <https://doi.org/10.1029/2024jd042442>; and Murphy D.M., et al. (2023). "Metals from spacecraft reentry in stratospheric aerosol particles." *Proceedings of the National Academy of Sciences*, 120 (43) e2313374120. <https://doi.org/10.1073/pnas.2313374120>"

⁹ Rein, H., Tamayo, D., & Vokrouhlický, D. (2018). The Random Walk of Cars and Their Collision Probabilities with Planets. *Aerospace*, 5(2), 57. <https://doi.org/10.3390/aerospace5020057>



U.S. taxpayer dollars. This exercise is fundamentally different from an environmental review. In its original Application and Opposition, SpaceX has failed to demonstrate that its proposed megaconstellation would not compromise investments of billions of taxpayer dollars. We therefore urge the Commission to deny the Application, given that it is not in the public interest.

Thank you for your consideration.

On behalf of the American Astronomical Society,

A handwritten signature in black ink, appearing to read 'Joel Parriott', followed by a long horizontal line.

Joel Parriott, PhD
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CERTIFICATE OF SERVICE

I, Roohi Dalal, hereby certify that on this 23rd day of March, 2026, I have caused a copy of the foregoing Petition to Deny to be served as specified upon the parties below:

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