Before the
Federal Communications Commission
Washington, D.C.

In the Matter of:	)	
Mitigation of Orbital Debris in the New Space Age	)	IB Docket No. 18-313
	)	

Comments of Academic Small Satellite Researchers

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[1] A previously submitted version of this comment inadvertently omitted several signatories. This is the corrected version.

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Summary

The above-listed academic researchers in the areas of aerospace engineering, space sciences, and other related fields respectfully comment on the Commission's Further Notice of Proposed Rulemaking concerning the mitigation of orbital debris. During this pandemic, we have had to face many other immediate challenges that make it difficult to engage with appropriate parties to adequately express the challenges this FNPRM presents. Furthermore, we are concerned that the rules proposed in the FNPRM will make it impossible to do our work, particularly in light of the considerable uncertainty and disruption caused by the ongoing coronavirus pandemic, and the Commission should not adopt them at this time.

Our research is necessary to observe and understand climate change, predict weather patterns, and track pollutant distribution, among other critical public interest research. Our institutions also serve as springboards for graduates to embark on careers in national defense and the critical satellite industry. The proposed rules would stifle our research to the detriment of the American public and close off a critical avenue for new entrants into the space industry.

While orbital debris is a concern, the risk to satellite operations and to human rated orbital system from missions like ours remains low. Most public university small-satellite research originates from platforms that operate under 600 km, which pose minimal risk. The proposed rules will substantially impair our continued involvement in satellite research to the detriment of our research communities, our partners at NASA, NSF and the DOD, and ultimately to the American people, to whom our research is intended to benefit. Propulsion requirements will dramatically increase costs to design, build, and operate small satellites. An indemnification requirement will unnecessarily increase costs to public universities and to the taxpayers and citizens that support them. Moreover, some public universities cannot submit to an indemnification requirement without express approval from their state governments.

Small satellites built and operated by universities have an enormous impact on space research. While the rules proposed in this FNPRM may marginally improve space safety, they will come at the tremendously high expense, and perhaps sacrifice, of the small satellite research community. We urge the Commission not to adopt these rules, especially the maneuverability and indemnification requirements.

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Discussion

The above-listed academic researchers in the areas of aerospace engineering, space sciences, and other related fields respectfully comment on the Commission's Further Notice of Proposed Rulemaking in the above-referenced docket.[2]

Universities and non-profit research institutes have been launching satellite missions for more than three decades and are vital contributors to innovation in the New Space Age. Small-satellite and CubeSat programs have enabled many public universities to produce graduates with invaluable experiences in space systems development, integration and testing and space mission operations. These graduates have already contributed significantly to the U.S. space and defense workforce. The Commission should not adopt rules that make it more difficult or impossible for us to participate in small-satellite launches and conduct space-based research for the benefit of the public.

First, current socio-economic conditions combined with indications of a substantial shift in national space policy has caused considerable uncertainty and consternation as to what rules the small-satellite community will ultimately be subjected to. Such uncertainty warrants delay in imposing new and potentially costly rules. Second, maneuverability requirements only marginally improve safety for small satellite operations while placing a hefty financial burden on operators like us who can hardly afford these changes. Imposing these requirements will drive many of us from space-based research altogether. Finally, compliance with proposed indemnification requirements may be impossible for public universities who are affiliates of their respective state governments and subject to their laws. Indemnification and maneuverability requirements for academic researchers should not be adopted.

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[2] *Mitigation of Orbital Debris in the New Space Age*, Report and Order and Further Notice of Proposed Rulemaking, IB Docket No. 18-313, FCC 20-54, 35 FCC Rcd. 4156 (2020) ("FNPRM"), https://www.fcc.gov/document/fcc-updates-orbital-debris-mitigation-rules-new-space-age-0.

I. The Commission should not adopt the proposed rules given the high level of uncertainty surrounding space research and policy.

The Commission should not enact rules under consideration in the FNPRM because of the considerable uncertainty facing the American space industry. Present conditions—political, economic, and social—do not support enacting rules that could effectively bar the public university small-satellite research community from participating in future launches or conducting critical space-based research. The Commission should not adopt these rules now for three reasons:

1) Uncertainty and turmoil caused by the coronavirus pandemic has imposed unforeseen challenges on the small-satellite research community to the point that future launches may be impossible under the proposed rules;
2) Recent shifts in national space policy have made it difficult to anticipate what requirements will ultimately apply to the small-satellite research community; and
3) The proposed rules themselves are confusing and conflict with past rulemakings.

Only once the present uncertainty can be alleviated should the Commission consider these rules.

A. The coronavirus pandemic has created significant uncertainty for academic small-satellite research.

First, deep uncertainty caused by the coronavirus pandemic, economic turbulence from state-mandated shutdown orders, and political turmoil inherent in an election year has made forecasting and planning for further research and scientific missions incredibly challenging, if not impossible. The coronavirus pandemic has injected a degree of uncertainty in the political, economic, and social trajectory of this nation unlike anything seen since the 1918 Flu Pandemic.[3] The academic community is not immune from these conditions.

[3] *See* Thomas A. Garrett, Economic Effects of the 1918 Influenza Pandemic: Implications for a Modern-day Pandemic 8-15 (2007) (describing the economic and human costs for

Between political decisions mandating closures, tuition refunds to students forced to stay home, and paltry support from state governments, public universities' budgets are likely to face deep cuts in the aftermath of the pandemic.[4] Budget reductions in combination with new Commission rules mandating satellite maneuverability will likely eliminate public university involvement in small-satellite launches or space research simply because of costs.

If university administrators, already under substantial stress in response to the pandemic, are forced to decide between allocating limited funds to activities that allow universities to survive these turbulent times or to adding a propulsion element to a small satellite, which has not been previously required nor budgeted for, the choice is stark. Many small-satellite research efforts will, as a consequence, be starved for additional funds to comply with new satellite design requirements. We are confident that the Commission does not intend to shut down this vital area of public research, but this outcome is likely given current conditions.

B. Responsibility for space policy is in a significant state of flux.

Second, incongruity between national space policy and recovery from current economic conditions has increased uncertainty at a time when consistency and certainty are needed. The possibility that a new agency may be formed to regulate space activities

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the influenza outbreak in the United States in 1918); Robert J. Barro et al, *The Coronavirus and the Great Influenza Pandemic: Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity* 2-5 (Nat'l Bureau of Econ. Res., Working Paper No. 26866, 2020), https://www.nber.org/papers/w26866.

[4] *See* Victoria Yuen, *Mounting Peril for Public Higher Education During the Coronavirus Pandemic*, Ctr. for Am. Progress (June 11, 2020, 4:00 AM), https://www.americanprogress.org/issues/education-postsecondary/reports/2020/06/11/485963/mounting-peril-public-higher-education-coronavirus-pandemic/.

has caused substantial uncertainty in the public university small-satellite research community.

The current regulatory regime for space activity is spread among several agencies operating under various laws.[5] Under this regime, the Commission has a vital role regulating communications in space.[6] However, with the signing of Space Policy Directive-3, President Trump signaled that a new or existing agency under the Department of Commerce (DOC) may be empowered to regulate activity in space in the near future.[7]

Although the DOC has not yet taken substantial steps to assume this mission outside of requesting budget increases,[8] this situation is likely to change. Once Congress can overcome challenges presented by the pandemic and economic recovery, it may act on President Trump's directive and empower the DOC with additional funds to regulate space traffic.[9] With the proposed rules in this FNPRM, the Commission intends to considerably expand its authority in regulating space activity at a time when the

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[5] *See generally Space Law*, Space Policy Online, https://spacepolicyonline.com/topics/space-law/#:~:text=98%2D575)%20that%20designated%20the,its%201988%20amendments%20(P.L (last visited Oct. 8, 2020).

[6] *See generally Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, Report and Order, L13 Docket No. 96-111, CC Docket No. 93-23, FCC 97-399, 12 FCC Rcd. 24094 (1997), https://www.fcc.gov/document/communications-and-satellite-services.

[7] *See* Space Policy Directive-3, *National Space Traffic Management Policy*, 83 Fed. Reg. 28,969, 28,970, § 5 (2018).

[8] Jeff Foust, *Commerce Department Seeks Big Funding Boost for Office of Space Commerce*, Space News (Feb. 16, 2020), https://spacenews.com/commerce-department-seeks-big-funding-boost-for-office-of-space-commerce/.

[9] *See* Jacqueline Feldscher & Bryan Bender, *Congress' Growing Space Divide*, Politico (Aug. 3, 2018, 7:00 AM), https://www.politico.com/newsletters/politico-space/2018/08/03/congress-growing-space-divide-294138.

executive and legislative branches are seeking to place more authority in other agencies. The Commission should not venture ahead to forge new rules that may end up conflicting with or being replaced by rules enacted by other agencies.

At the beginning of the coronavirus pandemic, the Trump administration released another executive order directing agencies to remove regulatory barriers to economic recovery.[10] The order commands agencies to "address this economic emergency by rescinding, modifying, waiving, or providing exemptions from regulations and other requirements that may inhibit economic recovery."[11] Although the true economic impact of these rules is unknown, promulgating a rule that even has the potential to impact economic recovery may be unwise in the current environment. Establishing rules for the safe operations of spacecraft is an important objective and one that current regulations largely address. New rules that effectively bar small-satellite research, especially from the university research community, will indubitably impact economic recovery and should not be decided at this juncture.

C. The proposed rules have caused confusion and uncertainty for the small-satellite research community.

Finally, the proposed new rules imposing maneuverability and operational requirements for small satellites represent a significant departure from the Commission's decision in 2019 to streamline licensing procedures and add to the current level of

[10] *See* Exec. Order No. 13924, *Regulatory Relief to Support Economic Recovery*, 85 Fed. Reg. 31,353, 31,353-54, § 1 (May 22, 2020).

[11] *Id.*

uncertainty.[12] That order, little more than a year old, specifically allows small satellites to operate up to 600 km without requiring propulsion.[13]

Now, new rules mandating maneuverability below this altitude directly contradict this recent order. Some of these proposed rules, including those for maneuverability include terms that are as yet undefined.[14] Further, information requirements for proposed disclosures remain unclear.[15]

We expressed our support for the streamlining rules and appreciated the Commission's intent to provide a licensing framework beneficial to the public interest and especially for entities like us who strive to further that public interest through our research.[16] The Commission's new stance has caused deep uncertainty in our community as to whether we will be able to operate under these new rules. Further clarity is

[12] *See* Ex Parte of Planet Labs, Docket No. 18-313, 8 (July 29, 2020), https://www.fcc.gov/ecfs/filing/107291938406586 (noting that the Commission already decided in the Streamlining Procedures that maneuverability would not be a requirement for small satellites below 600 km).

[13] *Streamlining Licensing Procedures for Small Satellites*, Report and Order, IB Docket No. 18-86, FCC 19-81, 34 FCC Rcd. 13,077, 13,093, ¶ 44 (2019) ("600 km as an upper altitude limit is a useful benchmark for now, which will in many instances be consistent with a six-year in-orbit satellite lifetime.") ("*Streamlining Order 2019*"), https://www.fcc.gov/ecfs/filing/08020582709488.

[14] *See* Petition for Reconsideration of the Boeing Company, Echostar Satellite Services, LLC, Hughes Network Services, LLC, Planet Labs Inc., Spire Global, Inc., and Telesat Canada at iv (Sept. 24, 2020) ("As the Further Notice acknowledges, the term 'effective maneuverability' remains undefined and therefore the rules cannot be implemented in an objective, transparent or predictable manner.") ("*Boeing Petition*"), https://www.fcc.gov/ecfs/filing/1092466277139.

[15] *Id.* at 2-5.

[16] Ex Parte of Dr. Scott Palo, et al., Docket No. 18-86, 1-3 (Sept. 13, 2018), https://www.fcc.gov/ecfs/filing/10913682308989.

necessary before these rules are adopted.[17] For these reasons, the Commission should not enact rules proposed in the FNPRM at this time.

II. The Commission should not adopt the proposed propulsion requirements. (¶ 53)

The Commission proposes requiring all small satellites operating above a certain altitude have propulsion capability for station keeping and collision avoidance, regardless if propulsion is necessary for de-orbit within 25 years.[18] In addition, the Commission seeks further comment on a proposed 400 km altitude limit above which propulsion or maneuvering ability should be required, based on the operational altitude of the ISS.[19]

As discussed in our previous filings, the requirements proposed by the Commission effectively make any educational or scientific research missions all but impossible.[20] Small satellite missions operated by educational and scientific research groups typically have limited budgets[21] and strict timelines that cannot be met while also complying with the proposed new standards. Because most university missions can be—and, due to *in-situ* remote sensing requirements, often must be—accomplished at altitudes below 600 km, the proposed new standards will effectively apply to all university small-satellite missions.

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[17] *Boeing Petition* at 13.

[18] FNPRM, 35 FCC Rcd. at 4180, ¶ 53.

[19] *Id.*

[20] Comments of Dr. Scott Palo, et al., Docket No. 18-86 (April 5, 2019) ("*Researchers 2019 Comments*"), https://www.fcc.gov/ecfs/filing/1040566700182; Comments of Dr. Scott Palo, et al., Docket No. 18-86 (June 22, 2018) ("*Researchers FY 2018 Comments*"), https://www.fcc.gov/ecfs/filing/1062172793709.

[21] *Researchers 2019 Comments* at 4.

A. Propulsion is cost-prohibitive for university missions.

For small-satellite missions, educational and scientific research projects typically have access to budgets averaging approximately $300,000 or less.[22] As this is an all-inclusive budget that that must fund all aspects of the mission from design to deorbit, academic missions must be very mindful of every expenditure.

The Commission's proposed propulsion requirements can effectively price out university missions from being able to conduct research using their own equipment. More specifically, workable propulsion systems that require 1U or more of volume would cost from $50,000 up to $200,000 or more, an unworkably large fraction of a design-to-disposal academic budget of $300,000.[23]

Moreover, small form factors such as those used by CubeSats lack the necessary power generation and storage for operating sophisticated propulsion systems.[24] This further increases the cost of designing, manufacturing, and launching well beyond what a university or research non-profit is capable of affording. The proposed requirement will make small satellites in the CubeSat-size range effectively impossible outside of large commercial ventures.

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[22] *Id.* at 8.

[23] *Id.* at 10.

[24] The NASA-built INSPIRE CubeSat, launched in 2012, was created as a technology demonstration to show that CubeSats were capable of operation far from Earth, for use in interplanetary research missions. The INSPIRE CubeSat as designed is capable of generating 20 watts of electricity under 3-axis stabilization (positioned with the greatest possible number of solar panels facing the sun), roughly enough power to operate a single incandescent light bulb. While tumbling, INSPIRE is capable of generating only 13 watts. Although efficiency has somewhat improved since then, the ability of small satellites to generate power is limited by the available surface area and their ability to dissipate heat created by solar emissions and onboard electronics, including any required propulsion systems.

In the Commission's Streamlining Order of 2019, the primary goals of the new policy were to create an easier application process, reduce fees, and shorten timelines for small satellite operators.[25] Although the streamlining process largely did not apply to university and academic missions, the Commission showed a strong concern for all U.S. interests in the deployment of small satellites. The realization of each of these goals would have a significant, positive effect on the ability of applicants to participate in satellite and space-based research by eliminating prohibitive temporal and financial barriers.

The Commission must extend these goals to university and academic small satellite operators in these Orbital Debris proposals. They are necessary for ensuring that the United States and its academic institutions are able to meaningfully participate in space-based research. However, the Commission's proposed maneuverability regulation puts an unreachable cost on small satellite missions for universities that stands to put the United States at a great disadvantage relative to those of other countries. The Commission should continue to follow its previous goals of reducing barriers to entry by eliminating unnecessary regulation on small satellites, especially for universities and research groups.

B. Propulsion draws time and resources from research and mission capability.

Adding propulsion to university small-satellite missions also will significantly increase the design-to-launch timelines and divert resources away from mission capabilities. Universities carry out important scientific research that commercial entities cannot, including climate change, physics, and meteorology endeavors that U.S.

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[25] *Streamlining Order 2019*, 34 FCC Rcd. at 13,078, ¶ 2 ("This will enable small satellite applicants to choose a streamlined licensing procedure and thereby take advantage of an easier application process, a lower application fee, and a shorter timeline for review than currently exists for applicants . . . . This action will support and encourage the increasing innovation in the small satellite sector and will help preserve U.S. leadership in space-based services and operations.").

universities are uniquely positioned to carry out. Each of these missions require specific design features to accomplish their goals and have unique requirements that cannot be easily reconciled with the additional burden of propulsion.

In addition to having smaller budgets, academic missions often operate on more difficult timelines because of the inherently smaller number of experts on their respective teams. Academic teams also maintain a parallel goal to educate students and move them into industry. Typical academic missions take two to three years from conception to deployment; this is done to ensure that university students are able to engage in all aspects of a satellite mission and gain valuable real-world experience in an important yet difficult-to-access aspect of space-based research.[26]

University satellite missions also have comparatively small teams who work on every aspect of the project. As a result, even incremental changes to regulatory requirements require significantly more time and expertise, extending the timelines for preparing and launching missions and making it more difficult for students to gain valuable educational experience with the different aspects of conducting the mission. Because academic missions are just as focused on the education of students involved as they are on scientific data gathered, it is important for students to be able to take full advantage of the shorter operational lifespans of academic small satellites to receive a comprehensive education and experience.

The additional time and resources needed to meet the added complexity of the proposed propulsion requirements burden both the academic and scientific aspects of the university small-satellite mission. This is not a concern shared by the major commercial small-satellite operators or operators of large constellations, as they often have many more resources that can be dedicated to ensuring regulatory compliance. Smaller commercial entities, such as start-ups, universities and other academic institutions do not

[26] *Researchers 2019 Comments* at 16.

have such resources. As a result, they must carefully consider every aspect of the mission, while realistically balancing what can be accomplished with smaller teams.[27]

C. Requiring propulsion poses more threat to the environment, not less.

The Commission made several decisions in the Orbital Debris FNPRM that recognize the increased potential threat presented by small satellites with propulsion. We commend the Commission for accurately concluding that at orbital velocities, small satellites lack the sophistication to become threats even when compromised by malevolent actors.[28] We also commend the Commission's decision not to adopt additional encryption rules for small satellites that lack propulsion, which would have made academic and scientific small-satellite missions prohibitively expensive.[29]

The Commission should extend this same reasoning to the proposed addition of propulsion requirements to small satellites. It is effectively impossible for a small satellite of short duration and no propulsion capability to pose a threat. Below 600 km, atmospheric drag is a significant limiting factor on the lifespan and orbit duration of university satellite missions, which typically range from 1 kg to 10 kg in mass. While a conjunction event is likely to be catastrophic to the individual mission, the overall environment remains unchanged. The sheer volume of orbital debris already present in low-earth orbit renders the impact of a 1U small satellite insignificant.[30]

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[27] *Id.* at 17.

[28] *See* FNPRM, 35 FCC Rcd. at 4214, ¶ 125 ("At orbital velocities, the capabilities necessary to present a credible threat require advanced systems at a level of technical sophistication well beyond what is commonly deployed, particularly in typical low-cost small satellite missions. For this reason, we are not adopting the proposed [encryption and security] rule focusing on those satellites with propulsion systems.").

[29] *Id.*

[30] *See* Planet Ex Parte at 3 (noting that with approximately 1 million objects greater than 1 cm currently in low-earth orbit, the impact of small satellites is extremely low in such a cluttered environment).

In addition, other agencies also already have effective policies in place that address the protection of the ISS. For example, the FAA already requires launching authorities to conduct collision avoidance analysis for their payloads.[31] The limited size and maneuverability inherent in academic small satellite missions ensures that unintended deviation from approved orbits remains minute.

While the NPRM and the FNPRM claim that the purpose of considering maneuverability requirements is to protect the ISS from collisions and taking avoidance maneuvers,[32] the Commission's concerns are not shared by NASA. NASA has long-established guidelines for assessing the risk of orbital debris to space vehicles, including the ISS.[33] If the threat is high, spacecraft can take avoidance maneuvers to avert collisions.[34] Even the presence of some debris may not require the ISS to maneuver at all.[35]

NASA fully supports research conducted by small-satellite operators and views such research as a critical component to continued space operations.[36] Enacting rules that

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[31] 14 C.F.R. § 417.107(e).

[32] *See* FNPRM, 35 FCC Rcd. at 4178, ¶ 49 (claiming that concern over object transit near the ISS and the necessity of avoidance maneuvers are the principle reasons for requiring disclosure of operational constraints).

[33] *See* Mark Garcia, *Space Debris and Human Spacecraft*, NASA (updated Aug. 7, 2017), https://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

[34] *See id.*

[35] *See Frequently Asked Questions: Orbital Debris*, NASA, https://www.nasa.gov/news/debris_faq.html (last visited Oct. 8, 2020) (stating that the ISS "is the most heavily shielded spacecraft ever flown.").

[36] *See* Jerry Colen, *NASA Selects Universities for Collaborative Development of Small Spacecraft Technologies*, NASA, https://www.nasa.gov/feature/ames/nasa-selects-universities-for-collaborative-development (last updated March 12, 2020) ("Managed by NASA's Ames Research Center in California's Silicon Valley, the Small Spacecraft Technology program expands U.S. capability to execute unique and more affordable missions through rapid development and in-space demonstration of capabilities for small spacecraft that are applicable to exploration, science, and the commercial space sector.

essentially block or make continued small satellite operations cost prohibitive, such as requiring maneuverability, will substantially impact NASA's collaborative activity with the research community.

If the Commission chooses to enact propulsion requirements, it should not require propulsion for altitudes lower than 600 km, consistent with the Commission's decision to streamline certification for small satellites with short lifespans and low collision risk.[37] The 400-600 km altitude range is of critical importance to university research missions; mandating propulsion requirements below 600 km thus renders inaccessible the ideal altitudes for scientific research.[38]

For these reasons, the Commission should not enact propulsion requirements below 600 km. Alternatively, the Commission should provide exemptions to these requirements for academic missions with short lifespans. Doing so is not only in the public interest because it would allow academic missions to operate, but because it focuses the Commission's requirements on higher-risk deployments by entities with much greater resources and ability to comply with propulsion requirements.

The Commission should closely consider only imposing propulsion requirements on satellite constellations which operate in greater numbers and pose a larger collective debris risk. Academic missions are typically of short duration and with only small numbers of satellites. Even the combined metric of total academic missions is dwarfed by

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The program enables new mission architectures through the use of small spacecraft while seeking to expand the reach of small spacecraft to new destinations and challenging new environments.").

[37] *Streamlining Order 2019*, 34 FCC Rcd. at 13,094, ¶ 45 ("[W]e emphasize that, as adopted, the streamlined small satellite process will only apply to qualifying applicants that have certified that, among other things, the authorized satellite(s) will deorbit within six years. Applicants will also certify that the risk of in-orbit collision with other large objects is 0.001 or less . . . and so we find that adopting a 600-kilometer certification is appropriate at this time.").

[38] *Researchers 2019 Comments* at 10.

those of constellation operators seeking persistent coverage over the populated surface of the Earth. Such constellations can number in the hundreds or more, and thus carry risks inherently greater than those presented by university missions, both due to the number of satellites needed for persistent coverage and the limited number of available orbits to accomplish the goal.

III. The Commission should not adopt the proposed indemnification requirements at least for entities affiliated with, or operating under, state governments. (¶¶ 135, 176)

The Commission again proposes to require space station licensees to "indemnify the United States against any costs associated with a claim brought against [it] related to the authorized facilities under international law."[39] The Commission's apparent goal is to guarantee that operators of small satellites consider liability issues associated with operating them and in turn help mitigate orbital debris concerns.

As the Commission concedes, the record overwhelmingly disapproves of the proposed indemnification requirements.[40] We agree with the majority of other commenters that the indemnification requirements would impose substantial costs and unwarranted burdens. Moreover, the record is unclear that these requirements will achieve the Commission's end goal of mitigating orbital debris, or even encouraging "good behavior."[41] Additionally, as Boeing observes, the "U.S. government has never incurred civil liability for damages resulting from an accident involving an FCC-licensed

[39] FNPRM, 35 FCC Rcd. at 4218, ¶ 135.

[40] Id. at n.475.

[41] Reply Comments of Sirius XM Radio Inc., Docket No. 18-313, 4 (May 6, 2019), https://www.fcc.gov/ecfs/filing/1050683638846.

satellite"—likely because international agreements have limitations on such claims, limiting them to one sovereign State against another.[42]

An indemnification requirement would not only be bad policy as a general matter, but would uniquely harm academic small-satellite programs that cannot legally indemnify the federal government.[43] This is because some universities are part of state entities that have sovereign immunity and cannot enter into indemnity agreements as a result. For example, the University of Colorado interprets Colorado's Constitution and statutes to mean that University is "prohibited from providing indemnity on awards that are accepted under [the Office of Contracts and Grants'] authority."[44]

If the Commission chooses to adopt indemnification requirements in the face of a majority negative opinion, it should exempt universities and public research teams from such a requirement. An exception to this requirement would be essential to avoid effectively barring small satellite missions operated by public universities that cannot enter into indemnification requirements.

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[42] *See* Reply Comments of The Boeing Company, Docket No. 18-313, 43 (May 6, 2019), https://www.fcc.gov/ecfs/filing/1050656163821.

[43] *E.g.*, Colo. Rev. Stat. §§ 13-21-111.5, 3-50.5-102.

[44] Office of Contracts and Grants, *Indemnification*, University of Colorado Boulder, https://www.colorado.edu/ocg/indemnification (last visited Oct. 8, 2020).