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Report of the International Institute of Space Law on the results of its Working Group on Light Pollution of the Night Sky from a space law perspective

Conference room paper by the International Institute of Space Law

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Report of the International Institute of Space Law (IISL) on the results of its Working Group on Light Pollution of the Night Sky from a Space Law Perspective

I. Introduction and Background

1. Founded in 1960, the International Institute of Space Law (IISL) is an independent non-governmental organisation dedicated to fostering the development of space law and the expansion of the rule of law in the exploration and use of outer space for peaceful purposes. The membership of the Institute is composed of individuals and institutions from more than fifty countries on all continents, comprising academic, governmental, industrial, and legal practice sectors. The IISL is a permanent observer of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS) since 2008, and it has regularly informed UNCOPUOS of all its activities at each session of the Legal Subcommittee. It regularly organises, together with the European Centre for Space Law (ECSL), the IISL/ECSL Symposia at the UNCOPUOS Legal Subcommittee.

2. Light pollution has considerably grown during the past decades but has reached a new intensity since 2019, when deployment started of the first large constellations of satellites which are intended to provide global broadband internet. The resulting launch of several thousand new satellites into Low Earth Orbit has caused a steady increase in the light pollution of the night sky.

3. In 2021, the Board of Directors of the IISL agreed to form a new 'Working Group on the Light Pollution of the Night Sky from a Space Law Perspective.' The goals of the Working Group were to collect as much information as possible about this issue, analyse it from a space law perspective, raise awareness on the topic among IISL members, and provide the IISL Board of Directors with a report describing the current state of the situation. The Group had ten members who acted in their individual capacities and was chaired by IISL member, Professor Rafael Moro Aguilar (Spain/USA).

4. The Working Group on the Light Pollution of the Night Sky from a Space Law Perspective completed its Report in March 2023. The Report was reviewed by the IISL Directorate of Studies and then it was adopted by the IISL Board of Directors in June 2023. The main findings of the Report were also presented during the IISL/ECSL Symposium held on the occasion of the 62nd Session of the UNCOPUOS Legal Subcommittee, on 28 March 2023.[1]

5. The Report of the IISL Working Group shows that light pollution of the night sky caused by space objects is a new global problem that is currently unregulated. However, a number of existing rules in international law and in the domestic laws of many countries were identified which support the protection of dark skies. The Working Group also explored the potential adoption of new international standards limiting the brightness of satellites, as well as the possibility of adopting in the future international agreements protecting dark skies. The present paper summarizes the contents of the Report.

II. REPORT OF THE IISL WORKING GROUP ON LIGHT POLLUTION OF THE NIGHT SKY

6. At present, several companies are building and are already launching constellations composed of hundreds or even thousands of satellites each. The main goal is to provide low-latency broadband internet access from space to virtually any place on the planet. Other companies and nations have plans for setting up

[1] The final report of the IISL Working Group can be found at: https://iisl.space/index.php/2023/07/05/iisl-publishes-report-of-iisl-light-pollution-wg/.

constellations in low Earth orbits (LEO) with the intention to provide global internet access as well, or other communications or remote sensing services. As a result, a number of new projects are being developed in LEO, taking advantage of the decreasing launch and satellite costs.

7. Providing worldwide internet connectivity and helping bridge the digital divide is certainly a beneficial application of space technology. However, the surge in the number of satellites placed in LEO since 2019 is posing significant technical and regulatory challenges, and it also has created an unintended environmental effect: a steady growth in the light pollution of the night sky.

8. The presence of thousands of new space objects in LEO is gradually changing the appearance of the night sky. Astronomers in particular are concerned with the negative impact that a night sky that is increasingly filled with shiny artificial objects will have on their scientific research. Other impacts of this luminic contamination can be expected as well: on the culture and ceremonies of Indigenous communities, which in some cases may suffer an alteration as a result of the changes produced in the dark night sky; on many animal wildlife species, which may see their daily life cycles and their orientation capacities altered as well; and on the ability of the public generally to view and enjoy a natural and pristine night sky.

9. In terms of numbers of people affected, potential economic damage, and scientific repercussions, the disruption of astronomical research is particularly worrisome. Several studies suggest that a number of astronomical observations will be particularly affected by the presence of large constellations in LEO, such as the detection of objects (including near-earth objects) and other observations conducted during twilight hours; general surveys of the night sky; and radio astronomical observations.

10. Historically, astronomy has made to humanity many long-term scientific and cultural contributions. However, should all the planned satellite constellations become a reality, the situation may become unsustainable for ground-based astronomy, even if all currently proposed mitigation measures were to be adopted. It may become unsustainable for much space-based astronomy as well, as telescopes orbiting in LEO such as the Hubble Space Telescope are starting to be affected by the visual impact of other satellites, and in such cases, mitigations are more challenging to implement.

11. This emerging problem has already been the object of several international conferences. It has prompted statements from the International Astronomical Union (IAU) and from other institutions, such as the European Southern Observatory (ESO). It has also attracted the attention of the public at large, both inside and outside the space community. And it has also reached UNCOPUOS, where a number of national delegations and observer organizations have brought the issue to the attention of the Committee.

12. During its 65th session, the plenary of UNCOPUOS recognized that "astronomical observations for both optical and radio astronomy [a]re an essential aspect of space activities and should be protected from interference".[2]

13. The subject matter of the IISL Report is the light pollution caused by space objects in the night sky, and in particular the optical impact caused by large satellite constellations. This is a real problem that is already affecting the work of astronomers over the world. In principle, this problem has a technical nature, and it requires technical solutions.

14. However, this can also be seen as a legal problem, as there are two human activities that are conflicting with each other: Large constellations of satellites on the one hand, and astronomical observations (together with general stargazing and other affected groups) on the other hand.

[2] UN Doc. A/77/20, at paragraph 182.

15. Indeed, satellite constellations providing global telecommunication services are a lawful activity that potentially offers great practical benefits for mankind. Ground-based astronomical observation is also a lawful activity that provides great (if more intangible) benefits for mankind. It is desirable to achieve a coordination of both activities, so that they can both be developed in a fully sustainable manner.

16. There is currently a lack of regulation of the light pollution and optical interference caused by satellites, but a number of international space rules, general international law rules, and many pieces of national legislation that are in force around the world either can apply or at least be relevant to the current situation, and they can help achieve the necessary coordination.

17. First of all, the IISL Working Group aimed to examine the potential application to this issue of international rules in force for outer space activities, particularly the 1967 Outer Space Treaty (OST).[3] This Treaty is generally considered the cornerstone of contemporary international space law.

18. Rules contained in the Outer Space Treaty that may apply to this situation are Article I (which establishes freedom of exploration and use of outer space), Article III (which affirms the application of international law to outer space activities), Article VI (which brings the duty for states to authorize and supervise private operators of space objects), and Article IX (which introduces the duties to act with due regard, prevent harmful interference, and engage in consultations when necessary).

19. Article I establishes freedom for all states to explore and conduct scientific investigations in outer space. Article I equally establishes the free utilization of outer space, including by way of satellite constellations. Therefore, both astronomy and constellations constitute legitimate activities according to the Outer Space Treaty, and both can be considered to be on equal footing.

20. Article III establishes that all human activities in space must be conducted in accordance with international law. This opens the way to the application of other branches of international law in outer space, such as international environmental law. Important principles of international environmental law that might serve as an inspiration to solve the current problem include the prevention of transboundary harm, the precautionary principle, and the principles of equitable use and sustainable development. A responsible and sustainable use of outer space by states should include limiting the light pollution caused by space objects.

21. Article VI means that states are internationally responsible to ensure that all space activities are conducted in conformity with the Outer Space Treaty and with general international law. As a relevant part of the compliance with applicable international law by private operators, including operators of constellations, states must guarantee a responsible and sustainable use of the Earth's orbital space environment, including the issue of light pollution of the night sky.

22. In this context, mention should also be made of the Statement issued by the Board of Directors of IISL in July 2021, "Consideration of the Interests of the Public and other Stakeholders in the Authorization and Continuing Supervision of Commercial Space Activities." This Statement highlights the importance for national licensing authorities to consider the interests of the global public while granting licenses to private sector applicants. It also declares that "space activities should be developed in accordance with the rule of law, for peaceful purposes, and in a manner that is sustainable for the present and future generations."[4]

[3] 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies' (adopted by UNGA Resolution 2222 (XXI) of 19 December 1966, opened for signature on 27 January 1967, entered into force 10 October 1967) 610 United Nations Treaty Series 205.

[4] https://iisl.space/index.php/2021/07/19/iisl-board-of-directors-issues-statement-addressing-commercial-space-activities/.

23. Article IX constitutes another limitation on the freedom of exploration and use of outer space established in Article I. From this provision, states parties to the Outer Space Treaty must conduct all of their activities in outer space: 1) paying due regard to the corresponding interests of all other states parties to the treaty; 2) avoiding any harmful interference with the activities of others; 3) avoiding the harmful contamination of outer space and celestial bodies, as well as adverse changes in the Earth's environment; and 4) engaging in international consultations with affected states parties in case of an ongoing or potential harmful interference.

24. Article IX OST seems particularly suitable to apply to our problem, provided that 1) the term "harmful interference" includes visual interference on astronomical activities, and that 2) ground-based astronomy may be considered as an activity contained within its scope of application. The latter is not clear from the text, but there are strong arguments in favour of considering astronomy, whether ground-based or space-based, as an activity of "exploration of outer space" and therefore placed under the remit of the Outer Space Treaty.

25. In addition, historical interpretation of Article IX of the Outer Space Treaty also favours the view that essential activities conducted by states on the ground must be protected under that Article's provisions. A close analysis of the events which led to formation of Principle 6 of the United Nations General Assembly Resolution 1962 (XVIII),[5] a provision that is a direct predecessor of Article IX, strongly suggests that the intention of the drafters of both provisions was to protect the interests and activities of states on Earth as well as in outer space.

26. Apart from the preceding provisions of the Outer Space Treaty, and the potential application of international environmental law to space activities via Article III, at present there are no international rules that apply to the problem of light pollution of the night sky caused by space objects. Given that current regulation is clearly insufficient, the potential elaboration of new legal rules addressing this problem was also considered by the IISL Working Group.

27. Having some international rules, standards or guidelines on light pollution caused by space objects that are applied uniformly to all operators has arguably become a necessity. Should the international community decide to create such global standards, a place to do so would be UNCOPUOS, which offers an excellent forum in which to propose a uniform approach to the matter.

28. Accordingly, as a first step towards the adoption of a common framework aimed to limit light pollution due to space activities around the Earth, the IISL Working Group considered the path of adopting a series of non-binding guidelines in UNCOPUOS. They could take as a model the Space Debris Mitigation Guidelines and the Long-Term Sustainability Guidelines that were adopted in UNCOPUOS in 2007 and in 2019, respectively.

29. The aim would be to reflect in those potential new UNCOPUOS guidelines a reasonable compromise between the satellite operators and the needs of astronomers. The new guidelines limiting the optical impact of space objects could then be picked up by national governments as licensing regulations and be gradually applied through their national space laws.

30. The IISL Working Group also explored the possibility of adopting other types of legal protection of the night sky at the international level. For instance, the international community might decide to conclude agreements protecting the global night sky as a world heritage. Attempts have been made in the past in that respect, and as a result, some soft law documents already exist, most notably the Starlight Declaration adopted in La Palma, Spain, in 2007.[6] We also have the precedents of the United Nations Education, Science and Culture Organization (UNESCO) protecting

[5] United Nations General Assembly, Resolution 1962 (XVIII), 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space' (adopted on December 13, 1963).

[6] https://www.starlight2007.net/index_option_com_content_view_article_id_185_itemid_80_lang_en.html.

astronomical heritage sites, or the International Dark-Sky Association (IDA) conferring dark-sky status to certain areas or countries around the world.

31. Alternatively, the creation or the emergence of a new fundamental human right of a cultural nature that would protect stargazing and the enjoyment of dark skies was also discussed by the Working Group. Certain international texts already in force acknowledge the importance of the participation of individuals in cultural life and science, as well as the right of Indigenous peoples to perform ceremonies and maintain their traditions, some of which are related to the night sky and the stars. The 1966 International Covenant on Economic, Social and Cultural Rights[7] and the 2007 United Nations Declaration on the Rights of Indigenous Peoples[8] contain provisions that could be interpreted in the sense that astronomy (stargazing generally) is a fundamental cultural right that has to be protected.

32. All of this suggests that astronomy and the right to a pristine night sky are increasingly viewed as a fundamental human right and a world heritage under international law.

33. The IISL Working Group also looked for any already existing national regulations limiting the optical brightness of space objects, but none could be found. The only related national rule is a United States federal law enacted in 2001 prohibiting obtrusive space advertising,[9] which was enacted following a suggestion made by the IAU in 2000 to UNCOPUOS member states.[10] This law does not apply exactly to our case, but it provides an interesting precedent of states protecting dark skies on a global scale.

34. On the other hand, the IISL Working Group identified a large number of national and regional laws and regulations in force around the world preserving the quality of the night sky at the local level. The IISL Report provides a brief overview of these laws and regulations that are already protecting dark skies, albeit from ground-emitted light pollution only. Although not directly applicable to our current problem, these laws and regulations are evidence of an *opinio iuris* of states in terms of acknowledging the immense value of dark skies, and they constitute a significant precedent for establishing a worldwide protection of the night sky. These laws and regulations may also provide elements to be taken into account when addressing the visual impact of satellite constellations.

35. It is important to emphasize that if no limits are set to the brightness of space objects, particularly at the international level, the progressive deterioration of the quality of the global night sky will defeat the purpose of all these national laws and regulations and render them useless in practice.

36. The final Section of the IISL Report contains an analysis of what has been done so far in order to address the problem of light pollution of the night sky caused by satellite constellations.

37. Collaboration between the satellite industry and the astronomical community has led to a set of best practices to reduce the amount of visual interference. These include implementing certain changes to satellite designs to make them less reflective; modifying the orientation of satellites in orbit-raising and orbit-lowering phases in order to minimize the sunlight reflected by satellites; and providing positional data of the satellites to the astronomical facilities so that they can plan their observations accordingly.

38. The IISL Working Group examined to what extent these voluntary measures are working. It is acknowledged that this channel of communication between astronomers

[7] 'International Covenant on Economic, Social and Cultural Rights' (adopted on December 16, 1966 by UNGA Resolution 2200A (XXI), in force since January 3, 1976), Article 15.

[8] 'United Nations Declaration on the Rights of Indigenous Peoples' (adopted on September 13, 2007 by UNGA Resolution 61/295), Articles 11.1, 12.1 and 13.1.

[9] 51 U.S. Code § 50911.

[10] IAU, 'Obtrusive space advertising and astronomical research - Background paper by the International Astronomical Union' (UN Document A/AC.105/777, 18 December 2001).

and operators is essential and it must be preserved. However, there is a general perception that the voluntary adoption of mitigation measures by the space industry so far has not been sufficient to solve the problem. In any case, this path of voluntary mitigation should not replace the institutions that oversee and regulate problematic matters. Voluntary mitigation measures can better be conceived as a complementary tool in the joint efforts to preserve the dark skies.

39. The IISL Working Group also considered recent initiatives related to space sustainability rating (SSR), as an additional measure adopted by governments and companies to promote a responsible use of outer space. In the future, the rating of companies based on their respect for sustainability of the orbital environment should also take into account any measures taken with the intention to reduce the visual impact caused by their space objects.