

# Mega-Constellations of Satellites and their Impact on Astronomy: Exploring the Role of Article IX of the Outer Space Treaty

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## Abstract

The activity of designing and launching into low earth orbits (LEO) large constellations of satellites (sometimes known as mega-constellations) is posing a number of challenges to the sustainability of outer space. One significant challenge has turned out to be the visual impact that huge numbers of satellites placed in LEO is having on the Earth's night sky. The present paper analyzes this problem from the point of view of Space Law, and more specifically, by exploring the potential role of Article IX of the 1967 Outer Space Treaty. The main question is whether this provision and its corresponding obligations of due regard, preventing harmful interference, and engaging in consultations can be applicable also vis-à-vis activities that are not space activities proper (such as ground-based astronomy) yet nonetheless are directly related to and affected by activities carried out in outer space. In order to answer that question, the origin of Article IX is reviewed, particularly considering its direct predecessor, Principle 6 of the Declaration of Principles adopted by the United Nations General Assembly in 1963. Since the origin of Principle 6 (and therefore, of Article IX) can be traced back to the effects on both space and earth of West Ford and other large-scale experiments carried out in LEO in the early 1960s, the conclusion is that Article IX does apply and protects terrestrial activities such as ground-based astronomy that are affected by activities conducted in outer space.

## 1. Introduction

### 1.1 The Impact of Light Pollution of the Night Sky on Astronomy

The activity of designing and launching into low earth orbits (LEO) large constellations of satellites (sometimes known as mega-constellations) is posing a number of challenges to the sustainability of outer space. One significant challenge has turned out to be the visual impact that huge numbers of satellites placed in LEO is having on the Earth's night sky.

Light pollution of the night sky due to orbital objects is certainly not a new problem. The scale of the problem is what has changed. As early as 1961, the

International Astronomical Union (IAU) showed its concern about the effect that certain space projects could have on its members' activities, and "appealed to all Governments to refrain from launching [such projects] until it is established beyond doubt that no danger will be done to astronomical research".<sup>1</sup>

In the 1990s, Russia considered orbiting large reflectors in LEO to illuminate portions of the northern hemisphere in winter; eventually, this plan was not implemented. But any future development of solar power array systems in orbit would necessarily affect visual astronomy, and perhaps radio astronomy as well. Since any catcher of solar radiation in space will necessarily be very large, interference with astronomical observations is unavoidable.<sup>2</sup>

In addition, an IAU background paper submitted to the Committee on the Peaceful Uses of Outer Space (COPUOS) in 2001 noted proposals to put objects in orbit for advertising or celebratory purposes. The paper noted that some space activities necessarily affect the work of astronomers, but their social benefit may be perceived to outweigh their adverse effects; however, in the case of obtrusive space advertising (the one that is visible with naked eyes from the surface of the Earth), it was better to ban it altogether.<sup>3</sup>

At least one country, the United States of America, did adopt a prohibition of obtrusive space advertising.<sup>4</sup> But other than that isolated initiative, no national or international regulation can be found related to the brightness of space objects as seen from the surface of the Earth and causing an impact on astronomical observation.<sup>5</sup>

## 1.2 OST Article IX: Description and Scope of Application

The lack of applicable rules is not complete, however. Article IX of the Outer Space Treaty (OST, 1967)<sup>6</sup> is the provision of existing International Space Law that most readily applies to the problem that we are discussing here. In its relevant parts, Article IX states the following:

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- 1 «Obtrusive space advertising and astronomical research - Background paper by the International Astronomical Union», United Nations Document A/AC.105/777, 18 December 2001, at par. 30. Available at: [https://www.unoosa.org/pdf/reports/ac105/AC105\\_777E.pdf](https://www.unoosa.org/pdf/reports/ac105/AC105_777E.pdf).
  - 2 *Ibidem*, para. 17.
  - 3 *Ibidem*, para. 20 et seq., 34.
  - 4 51 U.S. Code § 50911. See at: <https://www.law.cornell.edu/uscode/text/51/50911>.
  - 5 On the current legal void and the eventual need for regulation to address the problem posed by light pollution from space objects, see Rafael Moro-Aguilar, "Megaconstellations of Satellites and their Impact on Astronomy: A Potential Need for International Regulation", (2021) 63 Proceedings IISL.
  - 6 '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 UNTS 205 (the Outer Space Treaty).

In the exploration and use of outer space... States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space... with due regard to the corresponding interests of all other States Parties to the Treaty. (...) If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space... would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space... it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space... would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.<sup>7</sup>

Article IX has been described by legal scholars as ‘vague,’ as it seems to open more questions than it gives clear answers, due to its programmatic formulation.<sup>8</sup> However, it has also been noted that most of the Outer Space Treaty contains general principles rather than detailed rules.<sup>9</sup>

From this provision, it seems that States Parties to the Outer Space Treaty must 1) conduct all of their activities in outer space with due regard to the corresponding interests of other States Parties to the Treaty; 2) conduct all their activities in outer space avoiding harmful interference with the activities of others; and 3) engage in international consultations whenever necessary. In this sense, Article IX amounts to a limitation to the freedom of exploration and use of outer space provided for in OST Article I paragraph 2. Article IX was an attempt to resolve the problem of reconciling the freedom of exploration and use of outer space with the need to ensure that no adverse

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7 OST Art. IX.

8 See e.g. Ivan A. Vlasic, “The Space Treaty: A Preliminary Evaluation”, *California Law Review*, vol. 55, No. 2 (May 1967), declaring that “the provisions of the OST relating to control over potentially harmful space activities are too general and rudimentary to offer adequate protection to the world community against the hazards brought about by recent advances in technology” (at p. 518); Stephen Gorove, “Contamination and the Outer Space Treaty”, 14 *Proceedings IISL* (1971), pointing out that none of the terms used in Article IX is defined, and attributing the lack of clarity to the fact that, at least in part, this Article resulted from a compromise between the Soviet Union and the United States (at p. 64); Nicholas M. Poulantzas, “Legal Problems Arising Out of Environmental Protection of the Earth”, 14 *Proceedings IISL* (1971), noting that “Article 9 is drafted in general terms” (at p. 76).

9 Sergio Marchisio, “Article IX”, in Hobe, Stephan/Schmidt-Tedd, Bernhard/Schrogl, Kai-Uwe (eds.), *«Cologne Commentary on Space Law»* (CoCoSL), Volume I, Carl Heymanns, Cologne 2009, p. 170.

effects and no harmful interference with other activities will take place as a result of such exploration and use.<sup>10</sup>

It is worth to recall that for all purposes of the Outer Space Treaty, “activities in outer space” means all space activities, whether carried out by governmental agencies or by non-governmental entities (i.e. private companies and organizations).<sup>11</sup>

Similarly, it is worth recalling that for all purposes of the Outer Space Treaty, “activities in outer space” include also any activities that may be carried out in space by international organizations. Both the international organization involved and the Member States are responsible for the lawfulness of the activities carried out by the organization.<sup>12</sup>

## 2. OST Article IX – Key Terms

The key terms used in OST Article IX that are relevant for our discussion are “space activity”, “due regard”, “harmful interference”, and “appropriate consultations.” The notion of “due regard” has been identified as coming from International Air Law, while the term “harmful interference” is also used in International Telecommunications Law.

### 2.1 Space Activity

Neither the Outer Space Treaty nor any other international instrument defines the term “space activity,” which therefore is open to interpretation. Several provisions of the OST mention ‘exploration and use of outer space’, ‘studies in and exploration of outer space’ and ‘launching of space objects’, all of which can be understood to be space activities; but space activities are certainly not limited to those few that are expressly mentioned in the Treaty.<sup>13</sup>

The lack of a definition in the Outer Space Treaty means the term “space activity” or its functional equivalents must be interpreted from the treaty’s plain language, according to the Vienna Convention on the Law of Treaties (VCLT). Based on the plain language of the OST, including Article IX itself, it is certain that an act or experiment performed physically in outer space is a space activity. The Treaty’s plain language does not, however, necessarily exclude a terrestrial act as a space activity. This lack of clarity on whether “space activity” can encompass terrestrial acts has resulted in some commentators noting that “space activity” is a “generic term and not

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10 Stephen Gorove, *ibidem*, p. 63.

11 OST Art. VI. Article VI of the Treaty expressly states that each State shall be responsible for its national activities whether “carried on by governmental agencies or by non-governmental entities.”

12 OST Art. VI and Art. XIII.

13 Stefan A. Kaiser, “When Cyber Activities are Space Activities”, (2020) 62 Proceedings IISL, p. 298.

necessarily restricted geographically (...) to only what occurs in outer space (...).”<sup>14</sup>

## 2.2 Due Regard

“Due regard” refers to the performance of an act with a certain standard of care, attention or observance. This notion is taken from the 1944 Chicago Convention,<sup>15</sup> which empowered the International Civil Aviation Organisation (ICAO) to develop principles and procedures for the safety of air navigation. Article 3 of the Convention exempts all State aircraft from ICAO procedures, but it requires such aircraft to fly with “due regard for the safety of civil aviation”. This sentence is understood as giving rise to a duty of due diligence upon State and military aircraft to ensure the safety of the navigation of civil aircraft. In fact, the “due regard” rule remains the principal treaty obligation imposed upon States for the regulation of the flight of military aircraft applicable during times of peace and armed conflict.<sup>16</sup>

The due regard principle has also been included in the 1982 United Nations Convention on the Law Of the Sea (UNCLOS).<sup>17</sup> It is particularly relevant, in this sense, Article 87 of UNCLOS, establishing that freedoms in the high seas – which shares the same legal nature as outer space – shall be exercised by all States with due regard for the interests of other States.<sup>18</sup>

From the perspective of the Outer Space Treaty, due regard should be understood as an obligation to take into account, both prior to and during space activities and experiments, the legal rights of other States Parties in the peaceful use and exploration of outer space. Outer space is a shared common in which all States have the right to access and use. The failure of a State to give due regard to the rights and interests of other States has the potential to result in harmful interference with other States' space activities.<sup>19</sup>

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14 Bin Cheng, “Article VI of the 1967 Space Treaty Revisited: “International Responsibility”, “National Activities”, and “The Appropriate State””, 26 *Journal of Space Law* 7 (1998), p. 19. Cited at: George Anthony Long, “Terrestrial Cyber Activity of Non-Governmental Actors and State Responsibility Under the Outer Space Treaty”, (2020) 62 *Proceedings IISL*, p. 353.

15 Convention on International Civil Aviation (done 07 December 1944, entered into force 04 April 1947) 15 UNTS 295 (Chicago Convention).

16 Sergio Marchisio, *ibidem*, p. 175.

17 United Nations Convention on the Law of the Sea (done 10 December 1982, entered into force 16 November 1994) 1833 UNTS 396 (UNCLOS).

18 UNCLOS Article 87, paragraph 2.

19 Michael Mineiro, “Principles of Peaceful Purposes and the Obligation to Undertake Appropriate International Consultations in Accordance with Article IX of the Outer Space Treaty”, paper presented at the 5th Galloway Symposium, Washington, D.C., December 2nd, 2010.

The requirement of due regard is indeed a qualification of the rights of States in exercising the freedoms contemplated in the OST. Outer space is to be explored and used with due diligence, not only in accordance with one's own interests, but also taking into account the interests and rights of the remaining States Parties to the Treaty. The State must prove beyond a reasonable doubt that everything possible was undertaken to prevent a harmful act from occurring. This obligation is of a continuing character.<sup>20</sup>

### **2.3 Harmful Interference**

As already noted, the term "harmful interference" is related to international telecommunication law. Article 45 of the ITU Constitution provides a definition, which is valid only in the context of radio frequency interferences. The concept of harmful interference as used in Article IX is much broader, covering all possible kinds, forms or instances of severe interference with the peaceful space activities conducted by other States. A useful definition of harmful interference could be this one: "Harmful interference occurs when the interference is deep and/or long enough to deteriorate the services of the affected systems."<sup>21</sup>

### **2.4 Consultations**

Finally, according to Article IX, space activities that would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space are intended to be subject to international consultations.<sup>22</sup> Consultation is engaged in either voluntarily by the States carrying out the activity that has the potential to cause interference (States Parties assume the obligation to initiate such a consultation prior to causing harmful interference with the activities of another) or at the request of the State that fears such interference with its own activities.

## **3. Origin of OST Article IX**

The genesis of Article IX can be found in a specific dispute between the Union of Soviet Socialist Republics (USSR) and the United States of America (US) from 1961 to 1963.

In the early years of the space race, both the US and the USSR deliberately detonated nuclear devices in orbit. Three US "Operation Argus" explosions were conducted over the South Atlantic between August and September 1958, while "Operation Starfish" occurred in 1962 over the Pacific.

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<sup>20</sup> Sergio Marchisio, *ibidem*, pp. 175-6.

<sup>21</sup> Rajat Acharya, «Satellite Signal Propagation, Impairments and Mitigation» (2017), available at: <https://www.sciencedirect.com/science/article/pii/B9780128097328000089>.

<sup>22</sup> OST Art. IX.

Radiation from Starfish destroyed three satellites. Similarly, three USSR tests over Siberia took place in October-November 1962.<sup>23</sup>

In addition, the United States was conducting the so-called “Project West Ford” (1961 to 1963). This was an experiment in space communications carried out by the US military and NASA. It involved the launch and release of millions of small dipoles (2-cm long copper needles) into LEO for the purpose of creating an artificial belt around the Earth which could reflect long-range radio waves from ground stations. This plan generated grave concern and a great deal of criticism. The USSR and other countries complained that this project had been conducted without prior consultation with the global scientific community. Also, radio astronomers worldwide complained that the experiment had the potential to cause interferences that would ruin their radio observations of the sky. Many years later, some clusters of West Ford needles are still in orbit.<sup>24</sup>

On 28 May 1963, this crisis led to a statement presented to the United Nations by the USSR entitled “Dangerous United States Activities in Outer Space” in which the USSR complained that certain activities in space, in particular Project West Ford, had been carried out by the US without consultation with the global scientific community prior to its conduct.<sup>25</sup> The USSR proposed instead a system of having a prior discussion and agreement between the countries concerned before conducting experiments in outer space. The 1963 Soviet note also alluded to the Argus high altitude nuclear tests conducted by the US in 1962. In its reply, the US objected that scientific information relating to these experiments had been made available to the international community prior to the conduct of the experiment. The US Government added that high altitude nuclear tests had also been conducted by the USSR.<sup>26</sup>

As a result of this criticism, an agreement was reached on 29 May 1963 on a recommendation that directed the attention of COPUOS “to the urgency and

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23 For more information on the Argus Project, see the report “Operation ARGUS, 1958” prepared by the Defense Nuclear Agency as executive agency for the Department of Defense: <https://babel.hathitrust.org/cgi/pt?id=uiug.30112075683737&view=1up&seq=10&skin=2021>.

24 F. Lyall & P. Larsen, «Space Law - A Treatise», 2009, pp. 297-8; S. Marchisio, *ibidem*, p. 172; Bin Cheng, “The 1967 Space Treaty”, *Journal du Droit International*, 95 (1968) No. 3, p. 626. For more information see The Harvard Crimson, “Project West Ford”, May 24, 1963: <https://www.thecrimson.com/article/1963/5/24/project-west-ford-pfour-hundred-million/>.

25 In this letter, the Soviet Union sharply criticized another launching of copper needles which, in the opinion of a number of scientists, would make it more difficult to maintain contact with space ships bound for the Moon and the planets. See the “Letter dated 24 May 1963 from the Permanent Representative of the Union of Soviet Socialist Republics addressed to the Secretary-General”, UN Doc. A/AC.105/13, 28 May 1963.

26 S. Marchisio, *ibidem*, p. 172.

the importance of the problem of preventing potentially harmful interference with peaceful uses of outer space.” The USSR interpreted it as confirming the need for prior agreement on space experiments, a principle proposed by their delegation in a 1962 presentation in COPUOS of a Draft Declaration of Basic Principles.<sup>27</sup>

While this crisis was unfolding, on 11 September 1963, the *Institut de Droit International* (IDI) unanimously adopted a proposal of a ‘Resolution concerning the Legal Regime of Outer Space.’ Concerning experiments conducted in outer space, principle no. 12 of that Resolution stated:

Scientific or technological experiments or tests in space which may involve a risk of modifying the natural environment of the earth, of any of the celestial bodies or in space in a manner liable to be prejudicial to the future of scientific investigation and experiment, the well-being of human life, or the interests of another State, necessarily affect directly the interests of the whole international community.<sup>28</sup>

On the basis of the work of COPUOS, a set of basic principles applicable to space activities was finally agreed upon by means of the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, which was adopted unanimously by the UN General Assembly Resolution 1962 (XVIII) in December 1963.<sup>29</sup> Principle 6 of the Declaration established that:

In the exploration and use of outer space, States shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space with due regard for the corresponding interests of other States. If a State has reason to believe that an outer space activity or experiment planned by it or its nationals would cause potentially harmful interference with activities of other States in the peaceful exploration and use of outer space, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State which has reason to believe that an outer space activity or experiment planned by another State would cause potentially harmful interference with activities in the peaceful exploration

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27 S. Marchisio, *ibidem*, p. 172. For more information on the documents reflecting the negotiations that led to OST Article IX, see Joanne Irene Gabrynowicz & Sara Langston, “Chronological Survey of Art. IX Development”, A Supplement to the Journal of Space Law, Univ. of Mississippi, 2010.

28 See the English text of the Resolution in *The American Journal of International Law*, vol. 58 (1964), pp. 118-120.

29 Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, UNGA Res 1962 (XVIII), 13 December 1963.



and use of outer space may request consultation concerning the activity or experiment.

It is widely acknowledged that the fundamental principles of the 1963 Declaration now form part of customary International Law.<sup>30</sup>

After 1963, both the West Ford project and the high-altitude nuclear tests were halted, due to the concerns of the scientific community, the criticism from several States such as the USSR and the UK (which had lost its first satellite, *Ariel-1*, due to Starfish<sup>31</sup>), and the ratification by the major atomic powers of the Nuclear Test Ban Treaty in 1963 forbidding any further nuclear explosions in outer space.

On 20 May 1964, the Committee on Space Research (COSPAR) adopted a Resolution on “No harmful interference from Westford Experiment” calling on its members to give advance information on experiments of this sort in the future. On the basis of that Resolution, COPUOS adopted a new recommendation urging all Member States planning to carry out experiments in space to give full consideration to the problem of possible interference with other peaceful uses of outer space. Member States were also to consider possible harmful changes in the natural environment caused by space activities, and seek a scientific analysis of the qualitative and quantitative aspects of those experiments from the Consultative Group on Potentially Harmful Effects of Space Experiments of COSPAR. These recommendations were to be read without prejudice to the recourse to international consultations as provided for in UNGA Resolution 1962 (XVIII).<sup>32</sup>

Thus, on 15 December 1966, when the draft text of the Outer Space Treaty was submitted to the First Committee of the UN General Assembly for its adoption, the provision which was to become Article IX was present with all its final elements, as summarized by the report of the fifth session of the Legal Sub-Committee of COPUOS:

(9) *Observance of corresponding interests of other States in outer space*; the conduct of exploration of outer space, including the moon and other celestial bodies, so as to avoid their harmful contamination and adverse changes in the environment of the earth; *conduct of international consultations if an activity or experiment planned by a State or its nationals in outer space would cause potentially harmful interference with activities of other States*.<sup>33</sup>

30 See e.g. Lyall & Larsen, *ibidem*, p. 276.

31 <https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=1962-015A>.

32 ‘Report of the Scientific and Technical Sub-Committee on the Work of its Third Session (22 May–05 June 1964),’ UN Doc A/AC.105/20, pp. 16ff. See S. Marchisio, *ibidem*, p. 173; Bin Cheng, “The 1967 Space Treaty”, p. 628.

33 Yearbook of the United Nations 1966, pp. 35-36, 38. (Emphasis added).

At the time of adoption of the Outer Space Treaty, Ambassador Arthur Goldberg, the US representative to the United Nations General Assembly, stated that:

The treaty also laid down some basic ground rules for peaceful co-operation among nations in the exploration and use of outer space, which it declared to be the province of all mankind. Article I stated that the exploration and use of outer space was the right of all States without discrimination of any kind and on a basis of equality. That provision, like the provision prohibiting national appropriation by claim of sovereignty, was a strong safeguard for those States which at present had no space programme of their own. The interests of such States were also protected by *articles VII, IX and XI, which guaranteed them not only protection against damage, contamination and disturbances but also full participation in the progress of scientific research.*<sup>34</sup>

The latter's reference to States that have no space programme and the general tone of his speech argues in favor of inclusion of all nations (whether spacefaring or not) and all of their activities, wherever they are located, within the general protection from "disturbances" provided by Article IX.

#### **4. OST Article IX – Application**

##### **4.1 Application of Article IX to Astronomy and to Satellite Constellations**

Satellite constellations are certainly raising critical questions about space debris, space traffic management, and other issues that are relevant to the provisions of Article IX of the Treaty. More in particular, the unexpected challenge posed to astronomers by large constellations has illustrated an important yet rarely asked question about the extent of the protection granted to astronomy by International Space Law.<sup>35</sup>

A pertinent question here is whether ground-based astronomical observation could be considered a space activity and thus be directly subject to these obligations of due regard, prevention of harmful interference, and engagement in international consultations contained in OST Article IX. The lack of judicial decisions and the scarcity of State practice based on Article IX makes it difficult to find any customary rule or to provide a definitive assessment. Only the views of some authors can be considered in this regard.

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34 UNGA 21st Session, 1st Committee, 1492nd Meeting (17 December 1966), para. 8. (Emphasis added).

35 Giuliana Rotola & Andrew Williams, "Regulatory Context of Conflicting Uses of Outer Space: Astronomy and Satellite Constellations", *Air & Space Law* 46, No. 4&5 (2021), pp. 545-568, at p. 546.

As already noted, there is no internationally agreed definition of space activities. However, the literature and national legislation suggest that space activities encompass the launching, operation and return of space objects (including the related command, control and guidance actions from Earth), as well as experiments conducted in space, satellite broadcasting, earth observation from satellites, and other activities that happen in outer space generally.<sup>36</sup>

Ground-based astronomy is obviously not conducted in outer space, but instead on the Earth's surface, so in principle it would not qualify as a space activity proper. Under this restrictive view, the due regard principle and the rest of Article IX obligations would not apply to our case.

On the other hand, there are a number of reasons in favor of admitting ground-based astronomy as a space activity in a broader sense. First, it is an activity that is clearly oriented towards outer space and has the nature of exploration and scientific investigation of outer space, so it could be covered under the expression "peaceful use and exploration of outer space" that is prevalent throughout the Treaty.

It can also be noted that astronomy provides an important support to many space activities that are engaged in both exploration and utilization of outer space, including the crucial task of planetary defence of the Earth against the threat posed by near-earth objects. In addition, astronomy is conducted generally following a policy of open sharing of data and open access to all astronomical facilities, without discrimination of any kind, and for the benefit of all humanity, all in keeping with the spirit of international cooperation promoted by the OST.<sup>37</sup>

Even if we conclude that ground-based astronomy is not a space activity proper, it is still worthy of protection under the OST. Under the current International Space Law regime, lives and property located on the surface of the Earth are thoroughly protected by OST Article VII and by the 1972 Liability Convention, which impose absolute liability on the launching state in case any injuries or damages are caused by a space object to third parties. Similarly, by virtue of OST Article IX, ground-based astronomy should also be protected from any space activities conducted without due regard and which may be causing a harmful visual interference in the night sky.

Astronomy is a valid use of space, which should always be borne in mind. One portion of it, radio astronomy, is already protected by the Radio Regulations of the International Telecommunication Union. Even so, radio astronomy continues to suffer interferences from terrestrial and orbital stations. The

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36 Stephan Hobe, "Article I" in CoCoSL Vol. I, p. 34.

37 These and other interesting arguments in favor of considering astronomy, whether ground or space-based, as a space activity falling under the scope of the OST are provided by G. Rotola & A. Williams, *ibidem*, at pp. 556-561.

allocation of specific bands of frequencies and the institution of nationally and internationally protected “radio-quiet zones” aims to alleviate this problem.

In contrast to this – albeit limited – protection of the radio spectrum for purposes of fundamental scientific exploration conducted from the Earth, there is no international or national regulation protecting the visual appearance of the Earth’s night sky, or in more technical terms, there is a lack of regulation concerning the optical spectrum and the impact of the brightness of space objects.<sup>38</sup>

However, historical interpretation of OST Article IX fully supports the idea of including ground-based astronomical observations in the activities to be taken into account when carrying out activities in outer space, as illustrated by the precedent of the West Ford Experiment.

Indeed, according to the reasoning that was developed under 3 above, a significant part of OST Article IX derives from West Ford. The main negative consequences of that Experiment were to be felt on the ground, and not on other activities conducted in outer space. The impact caused by West Ford on radio astronomical observations was one of the reasons to discontinue the experiment and add the provisions contained in Principle 6 to the 1963 Declaration, and subsequently in OST Article IX.<sup>39</sup>

#### **4.2 Application of the “Due Regard” Rule**

When applied to the case at hand, the “due regard” principle mandates that States Parties to the OST implement activities in space with due regard to (i.e. duly taking into account) the interests of other States that will be affected by the light pollution created by “megaconstellations.” States are bound to ensure that the exercise of their rights and freedoms in outer space does not interfere with the space activities of others.

In brief, States Parties to the OST have an obligation to consider the corresponding interests of other States in respect of all the potential problems created by large satellite constellations, and that includes the issue of light pollution of the night sky. The way to achieve this goal would be for the different States involved to adopt specifications that take into account the impact of satellite constellations on ground-based astronomy and reduce that impact as much as possible.

When it comes to non-governmental activities in outer space, the way to comply with this continuing international obligation is for the different States

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38 G. Rotola & A. Williams, *ibidem*, at p. 547.

39 F. Lyall & P. Larsen, *ibidem*, pp. 297-8; S. Marchisio, *ibidem*, p. 172; Bin Cheng, “The 1967 Space Treaty”, p. 626. See also Howard J. Taubenfeld, “International Environmental Law: Air and Outer Space”, *Natural Resources Journal* Vol. 13, No. 2 (April 1973), pp. 315-326, available at <https://www.jstor.org/stable/24880673>, making a reference to West Ford as well at p. 315.

involved in the authorization and supervision of satellite constellations to adopt licensing conditions that are imposed on the operators.

In this context, it is worth remembering that the US Federal Communications Commission (FCC) has been tasked with the reduction of the creation of new space debris and the pollution of Earth's orbit by satellite constellations, and it is accordingly updating its orbital debris mitigation rules. It would be perfectly possible for the FCC to incorporate into the list of requirements imposed on the operators a set of rules aimed to prevent the light pollution of the night sky caused by satellite constellations.

It should also be noted that several pieces of national legislation such as the United Kingdom's Outer Space Act include, among the conditions imposed on private operators in order to obtain a license for space activities, the requirement that their operations be conducted in such a way as to prevent contamination of outer space or adverse changes to the environment of the Earth.<sup>40</sup>

### 4.3 Application of the International Consultations Provision

The last part of Article IX deals with a mechanism of consultation designed to avoid potentially harmful interference in outer space, including the Moon and other celestial bodies. In principle, any State that plans an activity or experiment has the obligation, before proceeding, to undertake appropriate international consultation with other States Parties if it has reason to believe that such activity or experiment would cause potentially harmful interference to the activities of such other States Parties in the peaceful exploration and use of outer space. This obligation must be fulfilled also when the activity or experiment is planned by the State's nationals. Alternatively, a State potentially affected by an activity or experiment planned by another State has the capacity to request that the latter enter into consultations concerning the activity or the experiment that would cause potentially harmful interference.

Following the previous reasoning that traces the origin of many of the provisions of Article IX to the West Ford Experiment, then we should conclude that activities conducted in outer space that cause a harmful interference to other activities, *including the exploration of outer space conducted from the ground*, are subject to this obligation to engage in international consultations, either by the State causing the interferences or by the State that is suffering them. When applied to our case, those States Parties to the OST that have licensed large networks of satellites would have an obligation to enter into consultations with other States due to any potential interference created by those constellations.

A significant obstacle however is that Article IX allows for a wide margin of interpretation of the consultation obligation. At the very least, affected States should be provided with information sufficient to take appropriate action to

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40 UK Outer Space Act 1986, Sec. 5.

prevent potentially harmful interference with their peaceful activities in outer space. However, an analysis of State practice of Article IX in the field of military activities, in particular ASAT and weapons testing, indicates that consultation with other States prior to those high-risk experiments is seldom if ever practiced.<sup>41</sup>

Also, when the OST was adopted, some authors already pointed out that the duty of prior consultation would be hard to apply in practice, since it rests on the somewhat subjective premise that the Party undertaking the experiment or activity “had reason to believe” that it would cause potentially harmful interference.<sup>42</sup> When applied to the present case, the highly discretionary nature of this expression means that, if a government in charge of licensing a satellite constellation is the one to determine whether this activity may cause harmful interference or not, then that government could easily argue that there was no reason to believe that any interference would occur, and therefore there was no need for prior consultation with other States Parties.

Other potentially affected states may still, of course, raise the issue and request consultations. However, there have been no cases so far of States formally demanding international consultations because of activities conducted in outer space that are perceived as “risky” or as causing interference. The only case that came close to this was the Note verbale dated 3 December 2021 from the Permanent Mission of China to the United Nations Office in Vienna addressed to the Secretary-General, whereby China complained of the danger posed to the life or health of astronauts aboard the China Space Station by close encounters with Starlink satellites in LEO. The note however was not based on OST Article IX; it invoked instead Article V of the Treaty.<sup>43</sup>

## 5. Conclusions

Despite its shortcomings, it is fair to conclude that OST Article IX, and more specifically its due regard and harmful interference provisions, must protect ground-based astronomy from space activities that are “prejudicial to the future of scientific investigation and experiment, the well-being of human life, or the interests of another State,” to put it in the words used by the 1963 IDI Resolution; or that are causing “damage, contamination and disturbances,” to put it in the words used by US Ambassador Goldberg during the adoption of the Outer Space Treaty back in 1966.

The impact of space objects on the outer space environment is a matter clearly within the responsibility and competence of States that license space

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41 M. Mineiro, *ibidem* (see note 19 above).

42 Bin Cheng, “The 1967 Space Treaty”, pp. 628-630.

43 [https://www.unoosa.org/res/oosadoc/data/documents/2021/aac\\_105/aac\\_1051262\\_0\\_html/AAC105\\_1262E.pdf](https://www.unoosa.org/res/oosadoc/data/documents/2021/aac_105/aac_1051262_0_html/AAC105_1262E.pdf).

activities, in accordance with OST Article VI. In the consideration of whether to license a space activity such as a satellite constellation, due regard to the corresponding interests of others, as well as the prevention of any harmful interference with other space activities, should be an important requirement to be imposed on private operators by all nations.

Similarly, any potential harmful interference to the interests of other States should trigger consultations with the potentially affected States, although in this case the obligation is vague – the Treaty does not prescribe any procedure or any outcome for these consultations – and the margin for opting out of the obligation is wider, particularly with regard to the duty of prior consultation. We also suffer here from the lack of any previous State practice in initiating international consultations under Article IX.