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NAVIGATING DISPUTES BEYOND EARTH: A CRITICAL ANALYSIS OF THE PCA OUTER SPACE RULES

The rapid commercialization of outer space, including satellite deployment, space tourism, and asteroid mining, has created an urgent need for effective dispute settlement mechanisms. As private and international actors increasingly participate in space activities, disputes are likely to intensify. In response, the Permanent Court of Arbitration adopted the 2011 Optional Rules for Arbitration of Disputes Relating to Outer Space Activities, establishing a specialized framework for resolving space-related conflicts. This paper critically examines these Rules, highlighting features such as confidentiality

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protections, technical expertise, and party autonomy. It assesses their compatibility with existing international space law, including the 1967 Outer Space Treaty, while identifying challenges related to voluntary jurisdiction and enforcement of awards. Through illustrative dispute scenarios, the study evaluates the Rules' practical relevance and proposes reforms to enhance their accessibility, effectiveness, and alignment with contemporary international space governance.

Key words: *Outer space law. – PCA Outer Space Rules. – Dispute settlement. – Space activities. – Space debris.*

1. INTRODUCTION

Humankind's expansion into outer space has accelerated dramatically in recent decades, bringing new legal and governance challenges to the "final frontier". During the Cold War, space activities were dominated by a handful of state actors (primarily the United States and the Soviet Union), operating in a largely bilateral strategic context (Muszyński-Sulima 2023). Today, however, outer space activities have proliferated and include a wide range of participants, from private aerospace companies and startups to international organizations and emerging spacefaring nations, engaging in endeavors such as satellite mega-constellations, space tourism, asteroid mining, and deep-space exploration (Raitt *et al.* 2005). This democratization of access to space has yielded unprecedented opportunities for technological innovation and economic growth. At the same time, it has introduced complex and multifaceted disputes that transcend traditional legal boundaries. These disputes can span multiple jurisdictions, involve highly technical facts, and implicate overlapping legal regimes, making resolution via traditional courts or purely diplomatic channels increasingly inadequate.

The existing international legal regime for outer space is grounded in a set of foundational treaties and principles developed primarily in the 1960s and 1970s. Chief among these are the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space (Outer Space Treaty or OST), the 1968 Rescue Agreement, the 1972 Liability Convention, and the 1975 Registration Convention, along with subsequent United Nations resolutions (UNOOSA 2025a). In addition, the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement) forms part of the UN space treaty framework. Although it has a comparatively low number of ratifications and has not been adopted by major spacefaring nations, the Moon Agreement

is nonetheless considered one of the five core UN space treaties and is relevant for its provisions on the "common heritage of mankind" and the prospective international management of lunar resources (UNOOSA 2025b). These instruments establish fundamental norms – such as the peaceful use of space, the prohibition on national appropriation of celestial bodies, and the principle that states bear international responsibility for national space activities – and they generally envision that disputes will be settled through intergovernmental means. For example, the 1972 Liability Convention provides a state-to-state claims process (including a Claims Commission procedure) for damage caused by space objects. However, the Convention contains significant limitations, including the requirement that only states may bring claims, the nonbinding nature of Claims Commission awards unless the parties agree otherwise, and evidentiary challenges in proving "fault" for in-orbit incidents. These structural constraints reduce the Convention's practical effectiveness and contribute to the inadequacy of relying solely on it for contemporary space-related disputes. However, this mechanism is available only to states and its outcomes require the parties' consent to be binding, illustrating the limits of existing frameworks in addressing the full spectrum of potential disputes. Overall, current space treaties and institutions lack a comprehensive, specialized approach to adjudicating disputes that involve the newer landscape of actors (including private companies and public–private partnerships) and novel commercial activities (AALCO 2024). In the absence of a dedicated dispute-resolution forum with broad jurisdiction, unresolved conflicts in space law risk undermining the sustainability and orderly development of outer space activities.

Recognizing these gaps, in 2011 the Permanent Court of Arbitration (PCA) took a significant step by establishing the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities (PCA Outer Space Rules). The PCA, an intergovernmental organization based in The Hague, with extensive experience administering international arbitrations, developed these rules to tailor arbitration procedures to the distinctive characteristics of outer space disputes (Feng 2024). The PCA Outer Space Rules represent a milestone as the first arbitral framework explicitly designed for space-related conflicts. They offer a neutral forum accessible to states, international organizations, and private entities alike, and incorporate features intended to address the unique challenges of space disputes – for example, by allowing the use of technical experts and protecting sensitive information through confidentiality measures.

At the same time, the introduction of this specialized arbitral mechanism raises important questions. The PCA Outer Space Rules are voluntary in nature, meaning that they apply only by the agreement of the parties. Their

success thus depends on parties choosing to incorporate or invoke them, yet to date they remain largely untested in practice. Observers have noted concerns about the willingness of parties to submit to arbitration under these Rules, the consistency of such arbitration with existing treaty obligations, and the enforceability of any resulting awards in the international arena (Consoli, Chalkias 2024). As humankind's space activities push further – toward lunar bases, asteroid resource exploitation, and even Mars expeditions – it is timely to assess whether the PCA Outer Space Rules are adequate and adaptable to the rising complexities of multi-jurisdictional, high-stakes disputes in outer space.

This paper aims to critically evaluate the PCA Outer Space Rules in light of current and future needs of outer space dispute resolution. The research addresses several objectives: (1) to describe the development and key provisions of the PCA Outer Space Rules and how they differ from general international arbitration rules; (2) to determine how these Rules interact with existing international legal instruments (such as space treaties and general arbitration frameworks); (3) to examine hypothetical and emerging dispute scenarios – including conflicts over space resource utilization, liability for space debris damage, and satellite signal interference – as a means of testing the practical applicability of the Rules; and (4) to discuss the broader implications of adopting these Rules, including any shortcomings or gaps, and to give recommendations for improving their accessibility and effectiveness. By doing so, the study seeks to illuminate whether and how arbitration can serve as a fundamental mechanism for peacefully managing conflicts in the evolving domain of outer space, and what further developments may be necessary to integrate this mechanism into the international space governance regime.

2. METHODS

This study employs doctrinal and analytical methodology grounded in the examination of legal texts, scholarly commentary, and scenario analysis. First, we conducted a thorough review of primary legal instruments relevant to outer space disputes, including the United Nations space treaties (OST, Rescue Agreement, Liability Convention, etc.), as well as the 2011 PCA Optional Rules for Arbitration of Disputes Relating to Outer Space Activities. The text of the PCA Outer Space Rules and their drafting history are analyzed, with attention to how they incorporate or modify the well-established 2010 UNCITRAL Arbitration Rules, on which they are largely based. We also surveyed secondary sources, such as academic articles and

legal analyses, to contextualize the Rules within the broader framework of international dispute resolution. Key sources included works by specialists in space law and arbitration (e.g., Tronchetti 2013, 181–189; Hobe 2019, 3–4) that discuss the inception, content, and anticipated impact of the PCA Outer Space Rules.

Given that no publicly available arbitration cases under the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities have been reported, as confirmed by the PCA official case registry (PCA 2025a) and supported by recent legal commentary (Dreosti *et al.* 2023; Amerjee, Battisson, Hodgson 2025), the study adopts a hypothetical case approach in order to evaluate their practical significance. We constructed and examined representative dispute scenarios, drawn from current and anticipated space activities. These include collisions involving space objects (e.g., the 2009 Iridium–Cosmos satellite collision and potential future accidents caused by space debris or anti-satellite tests), contractual disputes in commercial space ventures (such as launch services agreements and satellite communication service failures), and conflicts over novel activities, such as asteroid mining and lunar resource extraction. For each scenario type, we analyzed how a dispute might be addressed under existing legal avenues versus how it could be handled under the PCA Outer Space Rules. This hypothetical analysis helps to illustrate the scope of the Rules, the procedural advantages they might offer, and any gaps or uncertainties in their application.

Throughout the study, we evaluated the PCA Outer Space Rules against criteria of effectiveness and consistency with international law. This involved comparing their provisions on jurisdiction, procedure, and enforcement with parallel mechanisms (e.g., the claims commission process of the Liability Convention and the arbitration rules of other institutions). Where appropriate, we also draw analogies from actual space-related arbitrations that have occurred under other arbitral regimes (e.g., arbitrations under general rules such as ICC or UNCITRAL in satellite contract disputes) to infer how the PCA Outer Space Rules might operate. The analysis is qualitative in nature, focusing on legal interpretation and logical reasoning supported by expert commentary and historical evidence. This mixed doctrinal and scenario-based approach allows the paper to remain grounded in established law while exploring the forward-looking question of how outer space disputes could be navigated through arbitration.

3. THE HISTORICAL EVOLUTION OF INTERNATIONAL ARBITRATION AND SPACE DISPUTES

The concept of resolving disputes through peaceful means has deep roots in international law, long predating the space age. The Hague Peace Conferences of 1899 and 1907 laid the groundwork for modern arbitration by establishing the Permanent Court of Arbitration and endorsing arbitration, mediation, conciliation, and commissions of inquiry as preferred methods for interstate dispute settlement (Pellet 2013, 2–3). In the aftermath of World War I, the international community sought more structured adjudication: the Covenant of the League of Nations created the Permanent Court of International Justice (PCIJ) in 1920 as the first global judicial body, and the 1919 Treaty of Versailles, along with other post-World War I peace treaties such as those of Saint-Germain, Trianon, Neuilly, and Sèvres, established Mixed Arbitral Tribunals to adjudicate private claims between nationals of former adversary states and between individuals and states. These tribunals marked a significant innovation in international adjudication by enabling nonstate actors to bring legal claims under peace treaties (Erpelding, Ruiz Fabri 2023, 9–26). These developments signaled an enduring commitment to the peaceful settlement of international disputes in general.

The establishment of the United Nations, after World War II, further reinforced this commitment. The UN Charter not only prohibits the threat or use of force (Art. 2 para. 4) but also obliges member states to seek peaceful means of dispute resolution (Art. 2 para. 3), listing arbitration and judicial settlement among the options in Article 33 (UNGA 1945). Subsequent UN General Assembly declarations – such as the 1970 Declaration on Principles of International Law concerning Friendly Relations and the 1982 Manila Declaration on the Peaceful Settlement of International Disputes – reaffirmed and elaborated the duty of states to resolve conflicts without resorting to force, encouraging negotiation, inquiry, mediation, conciliation, arbitration, and judicial settlement as viable avenues (UNGA 1970; UNGA 1982). Over the 20th century, an expanded network of international courts and tribunals emerged (e.g., the International Court of Justice replacing the PCIJ, and specialized bodies for trade, law of the sea, human rights, etc.), reflecting the trend toward institutionalized third-party dispute resolution.

Despite these advances, the regime governing outer space remained relatively underdeveloped in terms of dispute settlement mechanisms. The core treaties of space law, notably the 1967 OST and its sister agreements, establish fundamental principles (e.g., requiring that space be used for peaceful purposes and declaring that no nation may claim sovereignty over outer space or celestial bodies) but they include no dedicated courts or

arbitration requirements to enforce these norms (UNOOSA 2025b). Disputes under these treaties were expected to be handled through diplomatic channels or, if necessary, through ad hoc procedures agreed by the parties. The OST provides for consultation between states if activities are thought to cause potentially harmful interference (Art. IX), but this is a political process rather than a legal adjudication. The 1972 Liability Convention offers a structured claims procedure for damage caused by space objects: states may present claims for compensation through diplomatic negotiations, and if that fails, the parties can convene a Claims Commission to make a determination. However, the decision of the Claims Commission is binding only if the parties agree beforehand to consider it final, which in practice makes its authority non-compulsory. Importantly, these treaties did not contemplate direct legal recourse by or against private companies (e.g., any claim for a satellite collision must be espoused by a state) and they did not set up a permanent venue to decide disputes involving technical space issues.

By the early 21st century, the absence of a specialized dispute resolution forum in space law became more glaring as the scale and complexity of space activities increased. Disputes arising from space activities began to surface in various contexts: for instance, contractual disagreements over satellite launches and services were sometimes submitted to arbitration under generic commercial rules, and investment arbitrations were initiated when state regulatory actions affected satellite ventures (Rosenberg, Dadwal 2021). These cases were handled in forums such as the International Chamber of Commerce (ICC) or under the ad hoc UNCITRAL Rules, indicating that arbitration as a method was indeed suitable for space-related disputes, but no tailored ruleset existed to address the particular needs of the space sector. Moreover, the proliferation of international judicial bodies in other fields raised concerns about forum fragmentation – multiple tribunals might have overlapped jurisdiction over aspects of a space dispute (e.g., an issue might engage the International Telecommunication Union processes for frequency allocation, as well as give rise to claims under treaties or contracts). This fragmentation could lead to inconsistent outcomes or procedural inefficiencies. These factors underscored that relying solely on traditional diplomatic negotiations or general-purpose courts could be inadequate for timely and technically informed resolution of space conflicts.

In response to these challenges, the PCA acknowledged the need for a dedicated arbitration framework for outer space. Building on its long-standing mandate to facilitate arbitration between states and others, the PCA convened an advisory group of experts in 2009 to explore the creation of specialized outer space arbitration rules (PCA 2011b, 4–5). The group included legal experts in space law, experienced arbitrators, scientific and

technical specialists, and representatives from both the government and private space sectors (Aceris Law 2024). They reviewed discussion papers on the nature of contemporary space activities – noting the rise of private actors and the high degree of international cooperation – and on the suitability of arbitration for space disputes. The consensus was that an effective dispute resolution mechanism for outer space needed to be accessible to all relevant parties (public and private) and capable of handling the complex technical evidence often involved (PCA 2011 b, 4–5). The Advisory Group proceeded to draft a set of arbitration rules tailored to space, taking the 2010 UNCITRAL Arbitration Rules as a procedural template and modifying them to reflect the "particular characteristics" of space disputes (Tronchetti 2013, 182). The PCA had prior experience in adapting arbitral rules to specialized contexts, notably, it had issued Outer Space Rules for arbitrating disputes in the domain of natural resources and the environment in 2001, which provided useful analogies because such disputes similarly involve scientific evidence and multiple stakeholders (PCA 2011a, 4). After two years of development, on 6 December 2011, the Administrative Council of the PCA formally adopted the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities (PCA 2011b, 4–5). This marked an important evolution in the peaceful settlement toolkit: for the first time, parties would have at their disposal a set of procedural rules crafted expressly for disputes beyond Earth. These Rules were designed to bridge the gap between classical international law principles and the practical realities of modern space commerce and exploration, effectively bringing arbitration "into orbit", as a mechanism for space governance.

4. DEVELOPMENT AND KEY FEATURES OF THE PCA OUTER SPACE RULES

The 2011 PCA Optional Rules for Arbitration of Disputes Relating to Outer Space Activities closely follow the structure of the 2010 UNCITRAL Arbitration Rules, while incorporating targeted modifications to address the distinctive technical, legal, and confidentiality concerns associated with space-related disputes.

The PCA Outer Space Rules comprise 43 articles, organized into four sections, reflecting the structural framework of the UNCITRAL Rules but adapting certain provisions to accommodate the particular characteristics of outer space activities. Section I (Arts. 1–6) covers introductory provisions such as scope of application and notice of arbitration; Section II (Arts. 7–16) deals with the composition of the arbitral tribunal; Section III (Arts. 17–32)

governs the arbitral proceedings (including procedures for submissions, evidence, hearings, and interim measures); and Section IV (Arts. 33–43) addresses the award, including its form, effect, and mechanisms for recognition and enforcement (PCA 2011b, 4–5). While maintaining this familiar framework, the drafters introduced several innovations and clarifications to reflect the needs of outer space disputes. The most salient features of the PCA Outer Space Rules are discussed below.

4.1. Scope of Application and Jurisdiction

As an "optional" regime, the PCA Outer Space Rules apply only when all parties to a dispute agree to use them, either by a prior arbitration clause or by a submission agreement after a dispute has arisen. The jurisdictional breadth of the Rules is noteworthy. Article 1 para. 1 specifies that they govern arbitrations arising out of "disputes relating to outer space activities" where parties have agreed to arbitrate under these Rules (PCA 2011b, 4–5). Importantly, the Rules do not attempt to narrowly define what constitutes a "dispute relating to outer space" – in fact, the official commentary and the introduction to the Rules emphasize that no particular characterization of a dispute as an "outer space" dispute is required for jurisdiction, as long as the parties consent to use the Rules (Aceris Law 2024; Tronchetti 2013, 182). This flexibility was a deliberate solution, to avoid debates over justiciability: even if the precipitating events of a dispute occur on Earth (e.g., a breach of contract for a satellite launch service), the parties can still bring the matter under the Outer Space Rules by mutual agreement. In other words, the applicability of the Rules hinges entirely on party consent, not on a rigid geographic or technical threshold – a recognition that many "space" disputes are hybrid in nature, involving terrestrial contracts or downstream services related to space operations.

The Rules also allow a wide range of entities to participate in arbitration. Consistent with the PCA mission, eligible parties include not only states, but also state agencies, intergovernmental organizations, private corporations, and even individuals or other nonstate actors with legal personality (Tronchetti 2013, 182). This inclusiveness is critical given the privatization and commercialization of space; it ensures that, for example, a dispute between two companies from different countries, or between a company and a state, can find a neutral forum under the PCA auspices. All parties are placed on procedurally equal footing, helping to mitigate sovereignty-related asymmetries that might deter states from arbitrating private entities. Indeed, the voluntary nature of the Rules was designed in part to respect

state sovereignty; unlike a compulsory international court, arbitration under these Rules occurs only by the state's own agreement, which historically has made states more amenable to accept third-party resolution (Hobe 2019, 3). As Tronchetti (2013) notes, the optional character of the Outer Space Rules was seen as a "welcome step", to accommodate the reluctance of states to be bound by mandatory jurisdiction, thus encouraging their participation without formally ceding sovereign prerogatives (p. 182).

One significant legal hurdle in arbitration involving sovereign states or intergovernmental organizations is the doctrine of immunity from jurisdiction. The PCA Outer Space Rules directly address this by requiring an express waiver of immunity when a party agrees to arbitrate under the Rules. Article I para. 2 of the Rules provides that such an arbitration agreement "constitutes a waiver of any right of immunity from jurisdiction" with respect to the dispute, and the Rules include a model waiver clause in an annex for this purpose (PCA 2011b, 4–5). In practice, this means that if a state or an international agency submits to arbitration under these Rules, it cannot later claim sovereign immunity to avoid the proceedings or to frustrate the tribunal's jurisdiction. This is a crucial provision because it closes a loophole that might otherwise allow a respondent to derail the arbitration; it gives private parties confidence that a consenting state or international organization cannot subsequently invoke jurisdictional immunity to avoid or derail the proceedings once arbitration under the Rules has been accepted. Similarly, immunity from execution of an award – i.e., protection of state assets – is typically addressed by requiring a separate explicit waiver if parties want to ensure an award can be enforced against sovereign assets, though such issues are often handled at the enforcement stage under national laws.

Another adaptation in the Outer Space Rules pertains to the applicable law. Space-related disputes may engage a patchwork of legal sources: international treaties (e.g., the OST or ITU regulations), national space laws and licensing regulations, contractual agreements, and general principles of law. The Rules acknowledge this by giving parties the autonomy to choose the substantive law or rules of law that the arbitral tribunal should apply (Art. 35, mirroring UNCITRAL Rules). If the parties cannot agree, the tribunal will select the law it deems appropriate. Notably, the appendices to the PCA Outer Space Rules list various instruments potentially relevant to outer space disputes, including treaties, national laws, and even the constitutive instruments of international agencies, thereby signaling to arbitrators that an amalgam of public and private law might govern a case (Tronchetti 2013, 182). This broad approach to applicable law is intended to ensure that tribunals have the flexibility to apply sources of law most pertinent to the dispute's subject matter, bridging the gap between international space law

obligations and commercial contractual frameworks. It also highlights the expectation that arbitrators may need to interpret space treaties or principles when resolving certain disputes (e.g., issues of liability or allowable activities under the OST), underscoring the importance of selecting arbitrators with expertise in public international law as well as commercial law.

4.2. Tribunal Composition and Specialized Expertise

A hallmark of the PCA Outer Space Rules is the integration of scientific and technical expertise into the arbitral process. Recognizing that many outer space disputes involve complex aerospace technology and scientific data (such as satellite technical failures, orbital mechanics, frequency spectrum interference, etc.), the Rules make special provisions for expert arbitrators and expert advisors. Under Article 10 para. 4, the PCA Secretary-General is tasked with maintaining a panel of arbitrators experienced in space-related disputes (Rosenberg, Dadwal 2021). The Permanent Court of Arbitration maintains a specialized Panel of Arbitrators and Experts for Space-Related Disputes, which comprises individuals with expertise in space law and space-industry matters. This official list of panel members is public, available on the PCA website and provides detailed profiles of the arbitrators and experts (PCA 2025). When constituting a tribunal for an outer space dispute, the parties are free to appoint arbitrators outside of this list, but the existence of the list is a resource to assist them in identifying qualified candidates. Moreover, the Rules depart from the UNCITRAL Rules by stipulating that the *appointing authority* for arbitrators is the PCA Secretary-General by default (Art. 6) (Rosenberg, Dadwal 2021). In UNCITRAL ad hoc arbitrations, parties often choose an external appointing authority or request one to be designated, but here the PCA Secretary-General centrally handles appointments if the parties cannot agree. This streamlines the process and ensures that the person selecting arbitrators (when needed) is intimately familiar with the space arbitrator panel and the technical requirements of the case.

The PCA maintains a dedicated Panel of Scientific and Technical Experts for Space-Related Disputes, as provided under Article 29 of the Outer Space Rules, comprising individuals with expertise in areas such as satellite technology, orbital dynamics, and space engineering. These experts may be appointed by arbitral tribunals to assist with complex technical matters relevant to the dispute. A public list of these experts is maintained

and accessible through the PCA website.[1] For example, in a dispute over interference between two satellite systems, the tribunal might appoint a spectrum engineer as an independent expert to provide an unbiased analysis of the signal data. The Rules also allow the tribunal to request the parties to provide nontechnical summaries of complex scientific information (Art. 27 para. 4), helping arbitrators to understand the context before delving into technical evidence, especially if they are legal experts without deep technical training. These innovations aim to ensure that arbitral decisions are well-informed by appropriate expertise, thereby increasing the credibility and accuracy of outcomes in the eyes of the space industry. They also reduce the risk of "dueling experts" paralyzing a case – the tribunal's own appointed expert or confidentiality adviser (discussed below) can cut through partisan claims when needed.

The appointment procedure under the Outer Space Rules follows the UNCITRAL model: typically, a three-member tribunal with each side appointing one arbitrator and the two arbitrators selecting the presiding arbitrator, unless the parties agree to a sole arbitrator or another number. Given the potential for multiparty disputes (e.g., a collision involving several operators or a constellation affecting many actors), the Rules include provisions for consolidating arbitrations or appointing arbitrators in multi-party settings, similar to the UNCITRAL Rules (PCA 2011b, 4–5). The PCA's experience with multi-party cases can be particularly valuable here, and the Secretary-General can help coordinate these appointments fairly. Importantly, once constituted, the tribunal – even if not all members are technical experts – can always draw on the aforementioned expert lists to inform specific questions. This structural flexibility addresses a key critique often leveled at traditional courts dealing with space issues (such as the ICJ or domestic courts): judges in those forums may lack technical knowledge, whereas the PCA arbitration system is built to incorporate such knowledge directly into the decision-making process.

[1] Permanent Court of Arbitration. Case No. 2013–09, CC/Devas (Mauritius) Ltd., Devas Employees Mauritius Private Limited, and Telcom Devas Mauritius Limited v. Republic of India (PCA), Case information. *https://www.italaw.com/cases/1962*, last visited February 18, 2026.

4.3. Confidentiality and Procedural Safeguards

Confidentiality is a significant concern in many outer space disputes. Space activities often implicate national security information, proprietary technology, and commercially sensitive data. Parties may be hesitant to engage in any dispute resolution process that could expose launch codes, satellite design secrets, or strategic vulnerabilities to public view or even to their adversaries (Blessing 1996, 191–222). The PCA Outer Space Rules tackle this issue with more robust confidentiality options than standard arbitration rules. By default, PCA arbitrations are not public, and the Rules explicitly allow parties to designate information as confidential and to request special protective measures (Art. 17 para. 6) (Rosenberg, Dadwal 2021). If a party asserts that certain information (e.g., technical schematics or operational data) is highly sensitive, the tribunal must determine whether disclosure of that information would likely cause serious harm to the party. If so, the tribunal can order appropriate measures; this might include limited disclosure only to counsel, holding portions of hearings in camera, or sealing parts of the award.

One of the most distinctive tools provided is the option for the tribunal to appoint a confidentiality adviser (PCA 2011b, Article 17 paras. 7–8). A confidentiality adviser is an independent expert (appointed under Article 29) who is given access to the confidential information and is tasked with reviewing it and reporting to the tribunal in a generalized or redacted form. In this way, the core issues can be addressed without the full details ever being revealed to the opposing party or the arbitrators. For instance, imagine a scenario where a private company claims damages because a rival's satellite allegedly took high-resolution images of its proprietary technology on the ISS. The evidentiary details might be classified or export-controlled. A confidentiality adviser (perhaps a technical expert with security clearance) could examine the classified data and then testify to the tribunal in general terms about whether the images show what the claimant alleges, without divulging the sensitive specifics. This mechanism attempts to balance the need to protect secrets with the need to resolve the dispute on the merits. It is a relatively novel solution in arbitration, reflecting practices seen in national security litigation (like courts using special masters or cleared counsel). The tradeoff is that it adds complexity and potentially cost, but for high-stakes space disputes, it may be essential to give parties the confidence to arbitrate rather than avoid legal recourse entirely.

The PCA Outer Space Rules also incorporate safeguards to prevent undue delay and obstruction – issues that can be acute given the time-sensitive nature of some space disputes (e.g., a dispute over orbital slot interference

might need quick resolution to avoid service outages). The Rules empower tribunals to issue interim measures (Art. 26) to preserve the status quo or prevent harm, which could be vital in a space context (e.g., ordering a satellite operator to refrain from transmitting on certain frequencies while the case is pending, if interference is claimed). Furthermore, the Rules encourage expeditious proceedings: Article 25 calls for the proceedings to be conducted so as to avoid unnecessary delay and expense. If an arbitrator becomes unable or unwilling to act, the Secretary-General can step in to appoint a replacement promptly (PCA 2011b, 4–5). Unlike some domestic courts that might get bogged down, an arbitration under PCA Outer Space Rules can be more readily tailored for speed – parties can even agree to expedited schedules. In practice, parties often set timetables for submissions and hearings; the Rules nod to this by allowing the mandate of the arbitrator to terminate if an award is not made within any agreed time limit (Art. 33 para. 1). While complex space cases may require substantial time to gather technical evidence, these provisions pressure all participants to proceed efficiently.

Finally, regarding awards, the Outer Space Rules state that the arbitral award must be in writing, final and binding on the parties (Art. 34). Parties are required to undertake to carry out the award without delay. This finality is a cornerstone of arbitration and is particularly valuable in space commerce – it provides certainty and closure, enabling parties to move forward with missions or business plans rather than being stuck in protracted litigation or diplomatic standoffs. The enforceability of an arbitral award from a PCA Outer Space Rules arbitration would typically be governed by the 1958 New York Convention on Recognition and Enforcement of Foreign Arbitral Awards, to which over 160 states are party, if the award is considered a commercial arbitration award. In scenarios involving only states or state entities, enforcement might rely on diplomatic compliance (since states are not subject to national courts in the same way), but even then, the award's binding nature carries moral and political weight. The PCA provides mechanisms for recognition of awards in national legal systems and the Rules allow that copies of the award may be deposited with the PCA for safekeeping and potential disclosure to national courts if needed for enforcement (PCA 2011b, 4–5). The award can only be challenged or set aside on limited procedural grounds (possibly under the law of the arbitral seat, if one is designated, similar to other arbitral regimes), meaning parties cannot easily relitigate the matter once it is decided. This aspect is crucial for maintaining order and predictability in space affairs; if, for example, a company wins an award for damages caused by another entity's satellite,

that company can invoke the New York Convention to enforce the award in domestic courts where the losing party has assets, rather than having to lobby its government to pursue diplomatic claims.

In summary, the PCA Outer Space Rules furnish a comprehensive procedural framework that marries the flexibility and party autonomy of international arbitration with special features tailored to the outer space context. They broaden who can access arbitration (beyond states, to private actors), ensure expert knowledge is available to the decision-makers, protect sensitive information, and strive for efficient, conclusive outcomes. These features collectively aim to overcome many of the perceived deficiencies in existing dispute resolution avenues for space – namely, the lack of a neutral forum for mixed disputes, the risk of politicization in diplomatic negotiations, the slow pace and technical ignorance of some courts, and the inability to handle multi-party technical evidence. The true test of these Rules, however, lies in their application to real-world disputes, which we explore through hypothetical scenarios in the next section.

5. ILLUSTRATIVE DISPUTE SCENARIOS IN THE SPACE DOMAIN

In the absence of publicly reported cases under the PCA Outer Space Rules so far, hypothetical and emerging scenarios provide insight into how the Rules might function and why they are needed. This section examines several types of outer space disputes, drawing on actual incidents and plausible future conflicts, and considers how arbitration under the PCA Outer Space Rules could address them.

5.1. Satellite Collisions and Space Debris Liability

One prominent category of disputes involves physical collisions or damage caused by space objects – a risk that is growing as orbital congestion increases. A real-world example was the February 2009 collision between an active U.S. Iridium communications satellite and the defunct Russian Cosmos-2251 satellite. This incident created a cloud of debris and highlighted the question: who is responsible for the losses? Under existing law, the Liability Convention attributes liability to the launching states of space objects for damage caused in outer space on a fault-based standard, as provided in Article III of the 1972 Convention on International Liability for Damage Caused by Space Objects (UNGA 1972). However, any claim would need to be pursued diplomatically by one state against the other, and private

operators, like Iridium, themselves have no standing under the treaty except through their national government. Ultimately, no claim under the Liability Convention was filed in the Iridium–Cosmos case, despite the incident being widely cited as a textbook example of potential treaty application. Scholars have noted that evidentiary complexity – especially in attributing fault for in-orbit collisions – and the diplomatic sensitivity of state-to-state claims likely discouraged formal proceedings (von der Dunk 1992, 363). This underscores how the current liability regime, while theoretically robust, remains underutilized in practice.

If a similar incident were to occur today, for example, involving a collision between a commercial satellite and a piece of space debris or another operator's satellite, the PCA Outer Space Rules could provide a neutral forum for resolving liability and damages. For instance, suppose Company A's active satellite is destroyed by debris resulting from Company B's satellite break-up. Absent arbitration, Company A might lobby its government to espouse a claim against the government of Company B (if B's state is responsible under treaty law), or sue B in domestic court (raising jurisdiction and enforcement issues across borders). By contrast, if both companies (or their states) agreed to arbitrate, the dispute could be heard by a technically knowledgeable arbitral tribunal applying the Liability Convention standards and any relevant contracts between the parties. The Rules are well-suited for this: technical experts from the PCA panel could be engaged to analyze orbital data and debris trajectories to determine fault (Iannotta 2009). Moreover, the confidentiality provisions would allow sharing of sensitive satellite telemetry and military tracking data under protective measures, enabling a factually informed decision. An arbitral award could apportion damages and determine compensation more expeditiously than a diplomatic process, and it would be enforceable against the liable party's assets under international arbitration enforcement norms. This scenario underscores how the PCA Outer Space Rules can supplement the Liability Convention; rather than replacing the state-to-state mechanism, they offer a parallel path where the actual operators and insurers can directly resolve the issue. It is worth noting that arbitrating such disputes also avoids some of the political overtones of blaming a state for a collision; it reframes it as a juridical matter of fault and damage, decided by experts. As space activities extend to crewed stations and possibly lunar bases, the ability to arbitrate liability (e.g., damage caused by a falling rocket stage or an explosion in orbit) could prove vital to providing remedies and accountability in a depoliticized manner.

5.2. Contractual Disputes in Commercial Space Projects

Another common source of conflict is breach of contract in the space industry. This can range from launch services agreements and satellite manufacturing contracts to commercial agreements for telecommunications or Earth observation services. A notable example is the 2011 dispute between the UK-based company Avanti Communications and U.S.-based SpaceX. Avanti had contracted SpaceX to launch a satellite, but after delays and issues, Avanti initiated arbitration and ultimately won an award for damages (SpaceNews 2011). In that case, arbitration was conducted (reportedly under an ICC or other clause) and Avanti obtained a remedy. Many such contracts today include arbitration clauses, but they often reference general rules (ICC, LCIA, UNCITRAL) without special provisions for space. If the PCA Outer Space Rules were incorporated (e.g., via the model clause provided in the Rules' Annex), such disputes could benefit from the tailored features.

Consider a hypothetical scenario: a satellite operator contracts a launch from a launch provider, but the launch is repeatedly delayed, causing the operator to lose a critical telecom contract. The parties have a clause to arbitrate under PCA Outer Space Rules. When the dispute arises (operator claims lost profits, launcher claims force majeure due to technical rocket issues), they initiate PCA arbitration. The case might hinge on highly technical evidence about the rocket failure or delay causes. Under the Outer Space Rules, the tribunal can quickly bring in a rocket engineering expert from the PCA list to evaluate whether the delays were due to negligence or unforeseeable technical challenges. If some documents about the rocket are export-controlled or proprietary, the confidentiality adviser mechanism can be used so that the expert and tribunal see them but not the opposing party's personnel. The tribunal, possibly seated in a neutral country, applies the governing contract law to decide liability. This process could be faster and more specialized than litigating in national courts (which might struggle with jurisdiction if the contract spans countries, and with technical evidence). It also avoids disparate results: without such an arbitration agreement, the operator might only have political recourse (pressuring the launch provider's national agency) or might sue in the launch provider's home courts, where procedural disadvantages, unfamiliar legal standards, or national bias could reduce the claimant's chances of success. The arbitration award, once given, would be binding and if not paid voluntarily, the operator could seek enforcement in any country where the launch provider's assets exist, pursuant to the New York Convention. In essence, the PCA Outer Space Rules here facilitate a level playing field for transnational commercial disputes and ensure that technical facts are properly understood in adjudicating contract breaches. To date, many satellite contract disputes have been resolved

quietly via arbitration; the adoption of the PCA framework could make such resolutions more straightforward by offering off-the-shelf rules geared to space matters.

Another area of growing importance are intellectual property (IP) disputes related to space technology. As companies develop proprietary processes for things such as in-orbit satellite servicing, 3D printing in space, and asteroid mining tech, IP conflicts are likely. For example, two companies might dispute the rights to a patented component used on a spacecraft, or an international collaboration on a space telescope might break down amid disagreements over data sharing and IP ownership. These disputes often have a contractual backbone (e.g., nondisclosure agreements, licensing contracts). The PCA Outer Space Rules could be employed to arbitrate such disputes in a neutral forum, perhaps crucially because one party might be a state-owned enterprise and the other a private firm – a situation where a national court system is now viewed as impartial. Consoli (2024) points out that space-related IP issues are emerging as significant, given the dual-use nature of much space technology and the lack of a specialized international IP regime for space. Under the PCA Outer Space Rules, an arbitral tribunal could apply patent law or licensing law as needed (drawing experts in space technology IP if necessary) and do so confidentially (important if the details of the technology are not yet public). This provides a way to resolve IP claims without public litigation that could inadvertently disclose the very secrets in dispute.

5.3. Interference and Regulatory Disputes

The use of outer space is also subject to regulatory coordination, especially in the radiofrequency spectrum and orbital slots, via the International Telecommunication Union (ITU). With the advent of satellite mega-constellations, tensions have emerged between operators regarding interference and priority – for instance, if one network's satellites interfere with another's signals, or if there are conflicting filings for the same orbital shells. While the ITU procedure handles allocation and technical coordination, it does not issue binding resolutions of disputes between companies. If Company X believes Company Y's satellite network is causing harmful interference, in violation of ITU rules or their operator-to-operator coordination agreement, X could seek relief. A real example is the dispute that arose in the late 2010s when a satellite operator accused another of causing interference and not following the coordination agreement (this has happened occasionally between telecom satellite companies). The PCA

Outer Space Rules could serve to arbitrate such a dispute: the tribunal could interpret any memorandum of understanding that the operators had, or even apply the general principles of the ITU Radio Regulations as contractual context. Technical experts in satellite communications would be key to determining whether harmful interference occurred and whether it was due to negligent operation or spectrum misuse. An award could potentially order the offending operator to take mitigative actions (like modify transmissions or pay damages for losses incurred due to outages). While enforcement of an order to cease interference could be challenging, as it would constitute a form of specific performance or injunctive relief rather than a monetary award, arbitral tribunals under the PCA Outer Space Rules are empowered to issue such remedies, though actual compliance may depend on the cooperation of the parties. Having an arbitral decision would carry weight; it could be communicated to regulators or used as evidence to pressure compliance. At minimum, damages could be enforced monetarily if the interference caused quantifiable harm.

5.4. Future Resource Utilization Conflicts

Looking ahead, disputes may arise from activities such as mining of lunar or asteroid resources, the operation of private space stations, or the establishment of infrastructures on celestial bodies. Currently, international law on resource extraction in space remains underdeveloped. The Outer Space Treaty prohibits national appropriation but is silent on private mining. Although Article 11 of the 1979 Moon Agreement declares the Moon and its resources to be the "common heritage of mankind" and prohibits private ownership over extracted resources, its practical impact is limited, as major spacefaring nations have not ratified the treaty. Meanwhile, several countries have enacted national laws recognizing private rights to extracted resources. several countries have passed national laws granting companies rights to extracted space resources, a practice that has raised debate over whether such legislation constitutes a form of national appropriation, potentially in tension with Article II of the Outer Space Treaty. Suppose, in a future scenario, Company A from Country A and Company B from Country B, each land on the same platinum-rich asteroid. Both claim the right to mine a particular region; confrontations ensue over access, perhaps with equipment interference or sabotage allegations. There is no international court with compulsory jurisdiction over two companies in such a matter, and it is unclear whether states would get involved directly (they might, but that raises political tension). If there were a prior agreement (e.g., both companies signed the same international industry code of conduct

committing to dispute resolution) or even ad hoc consent, they could take the conflict to PCA arbitration. The tribunal might have to apply a mix of legal principles: the Outer Space Treaty (which says space is the province of all mankind and no sovereignty can be claimed) would form the backdrop, national laws on space resource exploitation might supply some rules, and the specific agreements or principles accepted by the parties (maybe an industry standard or a clause in their mission documentation) would fill in details. The arbitrators – likely needing both a legal and a technical background – could determine whether either party has a legitimate prior right, whether any actions violated international norms (e.g., causing harmful contamination, which is barred by the OST Article IX due regard principle), and how to allocate the resources or compensation. While this is highly speculative, it demonstrates the potential role of arbitration in the absence of clear treaty regimes: it can provide an equitable solution based on general legal principles (such as unjust enrichment, or liability for damage) and the facts, until formal laws catch up. The legitimacy of the award would derive from the parties' consent and the arbitrators' impartial application of law, and it could prevent a resource conflict from escalating into a diplomatic or even physical confrontation. Essentially, arbitration could act as a "stopgap" legal system for new space activities in cases where international law is still evolving.

Through these scenarios, a common thread emerges: the PCA Outer Space Rules offer a flexible, party-driven mechanism to resolve disputes that might otherwise fall into a legal void or provoke interstate friction. They can handle mixed public–private disputes, bring in needed expertise, and yield enforceable outcomes, thereby injecting rule of law into situations that might otherwise be governed by power dynamics or uncertainty. However, the effectiveness of this mechanism in practice will depend on parties actually choosing to use it. As of 2025, many space-related disputes have been resolved in arbitration, but under other rules – for example, the well-known cases of investors versus states over satellite licenses in *Devas v. India*[2] and *Deutsche Telekom AG v. India*[3]. were administered by the PCA but used generic UNCITRAL Rules, not the space-specific ones (Rosenberg, Dadwal 2021). This suggests that awareness and acceptance of the PCA Outer Space Rules is still limited. The next section will discuss why this might be and what challenges and improvements are pertinent, drawing on the findings above.

[2] PCA, Case No. 2013–09. *CC/Devas (Mauritius) Ltd., Devas Employees Mauritius Private Limited, and Telcom Devas Mauritius Limited v. Republic of India*.

[3] PCA, Case No. 2014–10. *Deutsche Telekom AG v. Republic of India*.

6. DISCUSSION

6.1. Implications and Challenges of the PCA Outer Space Rules

The analysis of the PCA Outer Space Rules reveals them to be a thoughtfully crafted instrument that fills an important gap in international dispute resolution. In theory, these Rules align well with the principles of peaceful dispute settlement, championed by the UN, and offer a forum compatible with existing space law obligations. By allowing both states and nonstate entities to resolve disputes on neutral ground, the Rules operationalize the OST's broad mandate of cooperation and due regard among space actors, in a judicial form. The incorporation of scientific expertise and confidentiality measures shows an acute awareness of the practical needs in this high-technology field. Moreover, the flexibility regarding applicable law means that arbitrators can (and indeed must) take into account the relevant space treaties (such as the OST and Liability Convention) when making decisions, ensuring consistency with the fundamental legal principles of space activities. In essence, the PCA Outer Space Rules can be seen as a procedural bridge between the established corpus of space law (which is mostly substantive and state-centric) and the fast-evolving landscape of space commerce (which demands dispute mechanisms that include private stakeholders).

However, the success of any legal framework lies in its use and acceptance. A critical observation is that since their inception in 2011, the PCA Outer Space Rules have had minimal traction in actual disputes (Rosenberg, Dadwal 2021). As of 2025, there are still no publicly known cases in which the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities have been invoked to resolve a space dispute, although the PCA has administered space-related arbitrations under other rules. This limited uptake points to several challenges:

1. **Awareness and Preference of Parties:** The international space industry may simply be insufficiently aware of the PCA Outer Space Rules or unconvinced of their added value. Many commercial contracts continue to use familiar arbitral venues (ICC, LCIA, AAA/ICDR) or standard clauses, possibly because lawyers stick to what is known or because major space companies have established relationships with certain institutions. Additionally, private entities might not distinguish between general UNCITRAL-based PCA rules and the specialized Outer Space Rules; from their perspective, any arbitration under PCA auspices might seem equally capable. As Rosenberg and Dadwal (2021) suggest, a survey indicated low awareness of the PCA's offerings among industry respondents. This is a practical barrier: one cannot expect parties to opt into a regime they

do not fully understand or even know exists. Overcoming it will require outreach and education – by the PCA, by space law practitioners, and perhaps endorsement by bodies such as the International Institute of Space Law (IISL) and the UN Committee on Peaceful Uses of Outer Space (UNCOPUOS). If industry players see successful precedents or receive guidance that the PCA Outer Space Rules are advantageous, they may be more inclined to incorporate them into contracts.

2. **Voluntary/Optional Nature – A Double-Edged Sword:** The optional character of the PCA Outer Space Rules, while respecting sovereignty and party autonomy, inherently limits their reach. No matter how well-designed the Rules may be, they cannot compel parties to use them. In disputes where one side prefers not to arbitrate (perhaps hoping to avoid any binding outcome), there is no way to force arbitration unless a prior agreement exists. For example, if a state is accused of violating the OST, it cannot be hauled before a PCA tribunal unless it consents – something states may be loath to do post-dispute. This is a classic problem in international law: *compulsory jurisdiction* is rare, and the Outer Space Rules did not change that reality. The Rules might have benefited from a broader international endorsement – for instance, if the UN General Assembly had recommended states to consider them for certain disputes, or if they were annexed to a multilateral agreement where states commit in advance to arbitrate categories of disputes. Lacking that, they remain an option that must be contractually agreed. In the realm of state-versus-state disputes, this is particularly limiting. States generally prefer diplomatic solutions or, if going legal, might opt for the ICJ or an ad hoc tribunal under their own terms. The PCA Outer Space Rules could offer a tailored forum for state disputes (e.g., one state alleging another failed to control its space object causing damage), but so far, no such arbitration has occurred. The hesitation of states to commit in advance to binding outcomes remains a core challenge. While the Outer Space Rules reflect the foundational arbitration principle of party consent, this very consensual structure can lead to inertia: when parties do not agree to use the Rules, disputes may remain unresolved altogether. In other words, the optional model avoids infringing on sovereignty, yet at the cost of potentially fewer referrals. This challenge is intrinsic to arbitration and not easily remedied without states taking a more forward-looking stance on space governance.
3. **Enforcement and Compliance Concerns:** Even if parties arbitrate and obtain an award, enforcing it can be problematic, especially against sovereign or quasi-sovereign entities. A winning party might face a scenario where the loser, if a state, refuses to comply and hides behind

sovereign immunity from execution (unless a waiver was clearly given). While the Outer Space Rules include an implicit waiver of jurisdictional immunity once a state consents to arbitration, they do not extend to enforcement immunity. Waiving immunity from execution against state property typically requires an explicit and separate declaration, which is not automatically triggered by consent to arbitration. This means that if a state lost an arbitration and did not voluntarily pay damages, the winning party could have difficulty seizing assets without a further waiver. On the commercial side, enforcement against companies is generally straightforward under the New York Convention, but if the company is a state-owned enterprise or in a jurisdiction with weak rule of law, collection is not assured. These realities might make parties question the utility of arbitrating: will they be able to enforce the award? This is not a flaw of the PCA Outer Space Rules per se – it is a general arbitration challenge, but it is heightened in space disputes because many key players are government-controlled or have political importance. One possible mitigation is that simply having a neutral decision might carry weight even if not enforceable through the courts; in the space community, reputational factors and the need for ongoing cooperation can pressure compliance. Nonetheless, the lack of an overarching enforcement regime in outer space (no "space sheriff") means arbitration awards ultimately rely on terrestrial legal systems for execution. As space activities globalize, cross-border enforcement will remain a concern and an area where international cooperation (For example, developing norms for honoring space-related awards) could be beneficial.

4. **Ensuring Consistency with International Space Law:** A theoretical concern that may make some states wary is whether arbitrators applying the PCA Outer Space Rules will faithfully adhere to the states' treaty obligations and not issue awards that contradict or undermine international law precedents. For example, consider a resource mining dispute: an arbitrator might have to opine whether extracting resources is lawful under the OST. States might worry that a tribunal's interpretation could set an informal precedent or affect their interests if they are not party to the case. There is an inherent tension between party autonomy in arbitration and the erga omnes character of certain space law obligations, particularly those grounded in the "common heritage of mankind" principle, which frames outer space and celestial bodies as belonging to all humankind. If arbitrations were to proliferate, there is a risk that inconsistent interpretations of the Outer Space Treaty could emerge. To help mitigate this, the PCA has established panels of arbitrators and scientific experts with backgrounds in space law and related disciplines. While these panels are currently modest in size, they

are publicly listed on the PCA website and are intended to support legally coherent and expert-informed adjudication (PCA 2025b). Additionally, awards could be kept confidential (so not all would become precedents). But the concern remains as a psychological factor: states might simply be more comfortable with intergovernmental resolution (like diplomatic negotiation or UN forums) for issues they see as touching core space treaty principles, rather than entrusting those to arbitrators. Over time, if a body of arbitral jurisprudence in space is built up and proves to be balanced, this fear may subside. For now, it is an impediment to state buy-in. The best way to address it is likely transparency (when possible) and quality – ensuring that any early cases under the Rules are handled by arbitrators of impeccable authority and yield decisions seen as legitimate under international law. This would build confidence that arbitration complements rather than clashes with the treaty system.

5. **Multiplicity of Forums and Lack of Exclusivity:** As identified in the results, the Outer Space Rules do not contain an explicit clause preventing parallel proceedings or subsequent relitigation of the same dispute in other forums. This contrasts with the ICSID Convention, where Article 26 provides that once both parties have consented to arbitration, that consent becomes exclusive and precludes the pursuit of other dispute-resolution remedies for the same dispute (ICSID 2006). In theory, a party could start arbitration under the PCA Outer Space Rules and simultaneously lobby its government to bring a case to the ICJ or raise it in diplomatic channels. This could undermine the effectiveness of arbitration. While in practice arbitrators might pause proceedings if a very similar case is before the ICJ (to avoid conflicting rulings), there is no legal bar to two tracks. This lack of forum exclusivity might dissuade parties who fear the opponent is not fully committed to arbitration. To improve this, parties can contractually agree not to pursue other forums once arbitration is invoked – but that requires foresight. The formal addition of an exclusivity provision to the Rules (or guidance encouraging it) could strengthen the regime by ensuring arbitration is the one-shot process for that dispute. In the absence of it, we must rely on good faith. Most arbitration agreements implicitly rule out court litigation (via the doctrine of arbitration agreement primacy), but they cannot preclude diplomatic efforts. A related point is third-party rights: if a dispute affects others (e.g., a debris collision impacting multiple operators), bilateral arbitration cannot bind third parties. While ICJ judgments may appear broader in scope, the Court is also subject to the "necessary third party" doctrine, which bars adjudication if the legal interests of a non-consenting state are essential to the outcome. In practice, multilateral negotiations may be more effective for fully inclusive dispute resolution.

The PCA Outer Space Rules currently have no mechanism for joinder of third parties without their consent – understandably, as arbitration is consensual. Yet space disputes often have a collective dimension (e.g., debris mitigation or spectrum use). The inability to bring in all interested parties can be a limitation. One possible improvement could be developing amicus curiae practices in these arbitrations – allowing, for example, an international organization or another state to submit a brief if a matter of general interest (Tronchetti 2013, 188–189, hints at wider participation issues). This would not give them a say in the outcome but would help arbitrators consider broader impacts. At present, the Rules do not mention amicus briefs, but arbitral tribunals typically have discretion to accept them. Encouraging such openness (while balancing confidentiality) could mitigate concerns that a small arbitration might inadvertently decide issues of wide import without broader input.

6.2. Recommendations and Future Directions

In light of the challenges identified, several steps are recommended to enhance the efficacy and acceptance of the PCA Outer Space Rules:

- **Increasing Outreach and Integration into Space Governance:** International institutions and national space agencies should actively promote awareness of the PCA Outer Space Rules. For instance, the UNCOPUOS or the UNOOSA could include references to the availability of PCA arbitration in their capacity-building workshops and consensus documents. The inclusion of an arbitration clause referencing the PCA Outer Space Rules in multinational projects (e.g., the Artemis Accords agreements and the ESA contracts) would familiarize stakeholders with the process. Additionally, states could agree, even informally or in a UN resolution, that they view the PCA Outer Space Rules as an acceptable means for settling appropriate space disputes. Such political endorsement would lend legitimacy and encourage parties to consider arbitration before conflicts escalate. Another avenue is industry associations (satellite operators, launch providers) developing model contracts that include PCA Outer Space Rules arbitration clauses – this bottom-up approach can normalize the practice in commercial dealings.
- **Enhancing Accessibility and Reducing Costs:** One practical reform would be to ensure that arbitration under these Rules remains affordable and user-friendly, especially for smaller commercial actors or agencies of developing countries. The PCA already has flexible fee structures, but further measures could be instituted, such as capped fees for certain

categories of disputes and expedited "light" procedures for low-value cases. This addresses the criticism that international arbitration can be expensive and favors wealthier players. If a NewSpace start-up, understood as a privately financed and innovation-driven entrant to the space industry characterized by cost efficiency and responsiveness to market demand (Lisk & de Zwart 2019, 446), or a developing nation's space agency sees that it can reasonably afford to arbitrate a dispute (compared to litigating in foreign courts), it will be more inclined to choose the PCA forum. The PCA should also consider offering administrative support funds or cost-sharing for space arbitrations that raise important precedents (some professional organizations or governments might sponsor this as part of fostering space law development). Improving accessibility also means providing clear, publicly available guidance on how to invoke the Rules, sample clauses, and perhaps a roster of available arbitrators with their credentials, so parties have confidence in the quality of adjudicators.

- **Encouraging Early Use Cases (Pilot Arbitrations):** The first few cases often set the tone. It could be beneficial for the PCA, in cooperation with willing parties, to push several non-sensitive disputes through the process to demonstrate its value. For example, states could refer a relatively contained issue (e.g., a disagreement over interpreting a provision of a bilateral space agreement) to a PCA Outer Space Rules arbitration as a test case. If those awards (or even the smooth conduct of proceedings) become known in the community, it will serve as a proof of concept. Such cases might even be conducted publicly (if parties consent) to maximize learning and transparency. The arbitration community could also publish redacted summaries of any awards (with party permission) to build a corpus of *lex arbitri* for outer space. Seeing concrete outcomes would alleviate abstract concerns and provide precedents to guide future arbitrators and parties. In the same vein, training programs or moot courts focused on the PCA Outer Space Rules (similar to the Manfred Lachs Space Law Moot Court which currently simulates ICJ cases) could be introduced to build familiarity among the next generation of space lawyers.
- **Strengthening Provisions for Broad Participation and Enforcement:** At the rules level, PCA and stakeholders might consider modest updates or protocols to address some of the identified gaps. For third-party participation, an amicus curiae guideline could be issued by the PCA (even without formal rule amendment) encouraging tribunals to accept submissions from entities such as the UN Office for Outer Space Affairs or industry groups when a case touches on general interest (subject to party agreement). This would help bring in wider perspectives and increase

the legitimacy of decisions without compromising the parties' control. Regarding exclusivity, while one cannot unilaterally impose it, the PCA could recommend a model commitment that once arbitration is invoked, parties will not seek parallel resolutions (except interim measures, if urgent). If such language were to become standard in arbitration clauses, it would reduce the risk of multiple forums and signal that arbitration is the parties' chosen path. As for enforcement, states could be encouraged to explicitly waive execution immunity for awards in their arbitration clauses with private parties – this could even be included in the model clause annex (currently the annex has a simple model clause; it could add "The Parties agree that any award rendered shall be enforceable, hereby waiving any objection to enforcement on grounds of sovereign immunity, to the extent applicable"). Gaining agreement with that is problematic, but if a state is genuinely willing to arbitrate, it should logically be willing to stand by the result. Highlighting this issue during contract negotiations can prevent headaches later.

- **Alignment with Evolving International Initiatives:** The coming years may see new international instruments for space traffic management, space resource utilization, and debris mitigation. It would be prudent to integrate dispute resolution mechanisms into those instruments, and the PCA Outer Space Rules could be an obvious choice. For example, if a future "Moon Agreement 2.0" or a multinational accord on asteroid mining is negotiated, states could insert a clause that disputes arising under the agreement *may* (or *shall*) be submitted to binding arbitration under the PCA Outer Space Rules. Similarly, any global framework on space traffic coordination (to avoid collisions and interference) could use arbitration as the backstop if coordination breaks down. By dovetailing the PCA mechanism with new regulatory regimes, the arbitration Rules gain relevance and legitimacy as part of the broader governance toolkit. This also addresses the concern of being an isolated, unused option – instead, arbitration becomes a built-in part of the rule-making for new space activities.
- **Continued Review and Improvement:** Finally, as actual cases are handled, it will be important to conduct after-action reviews. The PCA and the space law community should remain open to refining the Rules based on lessons learned. For instance, if a particular technical challenge in evidence arises frequently (e.g., handling classified military data), perhaps a standardized procedure or memorandum of understanding with governments (for sharing data with PCA under safeguards) could be developed. Or if certain terms in the Rules prove ambiguous in practice, an explanatory note or revision might be warranted. The PCA Outer

Space Rules are not a static legal instrument; they can be amended by the PCA Administrative Council relatively easily, if needed. Such flexibility is an advantage – the Rules can evolve alongside the fast-changing space environment, unlike treaties which are difficult to amend. Stakeholder feedback from arbitrators, parties, and experts involved in cases should feed into periodic updates, ensuring the Rules remain *fit for purpose* as space activities reach new frontiers (such as commercial human spaceflight liability, planetary defense efforts, etc.).

6.3. Theoretical and Broader Implications

From a theoretical standpoint, the move toward arbitrating outer space disputes underlines the increasing privatization and decentralization of international law in certain domains. Traditionally, space was seen as a realm of state-centric activity managed by diplomacy and international organizations. The embrace of arbitration – a private law mechanism – for space indicates a blending of public and private international law. This has both positive and cautionary implications. On the positive side, it suggests that even in areas traditionally dominated by states, flexible legal processes can emerge to handle new realities (much as commerce forced adaptation in other fields). This empowers nonstate actors to have their grievances heard and resolved, contributing to what one might call the "democratization" of space governance: not all issues need to be escalated to nation-state negotiations – they can be settled by rule of law between the actual stakeholders. This can reduce politicization and perhaps lead to more technically sound outcomes, as arbitrators are chosen for expertise rather than political influence.

On the other hand, heavy reliance on arbitration could lead to a body of semi-private jurisprudence that is not easily accessible or transparent to the broader international community. Important interpretations of the Outer Space Treaty or determinations of fault might be locked in confidential awards. This raises questions about the development of *lex spaceria* (space law jurisprudence) – will it bifurcate into public ICJ opinions (rare as they may be) and private arbitral awards? Could differing approaches create uncertainty? The challenge for scholars and practitioners will be to ensure cross-fertilization, i.e., that insights from arbitration inform public law discourse and vice versa. Efforts such as publishing key findings from awards (with party consent) and arbitrators writing academic commentary (without breaching confidentiality) can promote transparency and coherence in space law. These measures also respond to concerns familiar from the investment

arbitration context, such as opaque decision-making, far-reaching awards that may affect public policy, and the limited ability of third parties or states to influence outcomes.

Furthermore, the use of arbitration must be complemented by robust international cooperation. Arbitration addresses the symptoms (disputes) but not the root causes of issues such as space debris proliferation or resource competition; it is a dispute resolution tool, not a regulatory regime. The presence of the PCA Outer Space Rules does not diminish the need for global norms and preventative measures – in fact, it accentuates it, as arbitrators ultimately apply whatever rules exist. If the substantive law is lacking (e.g., no clear rule on mining rights), arbitrators can only do so much; their decisions may rely on general principles or equity, which could vary from case to case. Thus, one implication is that the international community should not view arbitration as a panacea that replaces treaty-making – rather, it is a safety valve that buys time and manages conflicts while harder multilateral agreements are negotiated. In an ideal scenario, as new treaties or agreements emerge, they will specify how arbitration fits in (as discussed, possibly by mandating or recommending it).

Finally, the PCA Outer Space Rules experiment could serve as a model for other emerging global commons and high-technology domains. For example, discussions are already occurring about dispute resolution for cyberspace incidents and polar regions activities, where traditional mechanisms are weak. The outer space arbitration framework might inspire similar specialized rules for those domains, indicating a broader trend of adapting arbitration to areas of international commons and complex multi-actor engagement. This cross-domain influence would reinforce the role of arbitration in global governance but also require careful tailoring to the particularities of each domain.

7. CONCLUSION

The 2011 PCA Outer Space Rules represent a forward-looking innovation at the intersection of international law and the new space economy. The critical analysis in this study shows that the Rules are both necessary and nuanced: they respond to a clear gap in the peaceful settlement of outer space disputes by providing a forum that all space actors can access, and they thoughtfully integrate features to handle the technical and sensitive nature of those disputes. The Rules bring to the table advantages of neutrality, expertise, and enforceability that, if utilized, can greatly strengthen the rule of law in outer space affairs. They ensure that as human endeavors in space

continue to expand, there is a conflict resolution mechanism that is more formal than diplomatic negotiation yet more flexible and inclusive than existing courts.

However, the journey of these Rules from paper to practice is still in its early days. The fact that they remain underused after more than a decade of existence highlights that legal innovation must be coupled with community acceptance. Overcoming hesitations – whether due to lack of awareness, sovereignty concerns, or strategic calculus – is crucial. With appropriate reforms and proactive engagement from both the international community and industry stakeholders, the PCA Outer Space Rules can be made more accessible and attractive. The recommendations provided, such as promoting the Rules in new international agreements, encouraging model clauses, and possibly tweaking certain provisions, aim to catalyze their adoption.

It must be acknowledged that the PCA Outer Space Rules are not a panacea or a final solution for all outer space disputes. Some issues will still fall to diplomacy or require political consensus that arbitration cannot impose. Moreover, as space activities evolve (e.g., mega-constellation crowding or potential conflicts over lunar zones), the nature of disputes may change in ways that test the limits of the current Rules. In that sense, the Rules are an evolving legal instrument – a "bridge" as described earlier, connecting well-trodden arbitration practice with the novel realities of space. They will likely undergo refinement as they encounter real cases, and perhaps one day they will pave the way for a more permanent judicial mechanism, if the community deems it necessary.

In conclusion, the PCA Outer Space Rules offer a fundamental piece of the governance puzzle for an increasingly crowded and commercialized outer space. By providing a means to peacefully navigate disputes beyond Earth, they contribute to the stability and predictability necessary for sustainable space development. To fully realize their potential, concerted efforts must be made to integrate them into the fabric of international space activities and to address the practical challenges that hinder their use. If those efforts are undertaken, one can envision a future where arbitration under the PCA Outer Space Rules becomes a common and trusted way to settle differences in space – thus ensuring that as humankind's reach for the stars continues, our capacity to resolve conflicts keeps pace with our ambitions.

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