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HUMAN RIGHTS IN THE ERA OF SPACE EXPLORATION: LEGAL FRAMEWORKS

DIREITOS HUMANOS NA ERA DA EXPLORAÇÃO ESPACIAL: ESTRUTURAS JURÍDICAS

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Abstract
As commercial space activities surge and plans for permanent extraterrestrial settlements advance, a critical gap has emerged in international law: the absence of enforceable human rights protections for individuals operating beyond Earth. This article examines whether existing international human rights treaties apply extraterritorially to outer space and what obligations exist for states and private actors under current space law. Through doctrinal legal analysis of international treaties, case law, and scholarly commentary, this research reveals that while foundational space law instruments—including the Outer Space Treaty (1967), the Rescue Agreement (1968), and the Moon Agreement (1979)—establish principles of peaceful cooperation and state responsibility, they lack explicit human rights protections essential for addressing contemporary challenges. These challenges include labor rights for space workers, equitable resource allocation, corporate accountability, and protection against exploitation in isolated extraterrestrial environments. Drawing on extraterritorial human rights jurisprudence, particularly from the European Court of Human Rights in Al-Skeini v United Kingdom and the International Court of Justice's advisory opinions, this article argues that human rights obligations follow states beyond terrestrial boundaries wherever they exercise effective control or authority. The article proposes concrete legal reforms, including amendments to existing space treaties, establishment of a UN Human Rights in Space Commission, and development of a Space Human Rights Convention to ensure that fundamental dignities,

Resumo
Com o aumento das atividades espaciais comerciais e o avanço dos planos para colonizações extraterrestres permanentes, surgiu uma lacuna crítica no direito internacional: a ausência de proteções de direitos humanos aplicáveis a indivíduos que operam fora da Terra. Este artigo examina se os tratados internacionais de direitos humanos existentes se aplicam extraterritorialmente ao espaço sideral e quais são as obrigações dos Estados e dos atores privados sob o direito espacial atual. Por meio da análise jurídica doutrinária de tratados internacionais, jurisprudência e comentários acadêmicos, esta pesquisa revela que, embora os instrumentos fundamentais do direito espacial — incluindo o Tratado do Espaço Exterior (1967), o Acordo de Resgate (1968) e o Acordo da Lua (1979) — estabeleçam princípios de cooperação pacífica e responsabilidade estatal, eles carecem de proteções explícitas dos direitos humanos essenciais para enfrentar os desafios contemporâneos. Esses desafios incluem direitos trabalhistas para os trabalhadores espaciais, alocação equitativa de recursos, responsabilidade corporativa e proteção contra a exploração em ambientes extraterrestres isolados. Com base na jurisprudência extraterritorial de direitos humanos, particularmente do Tribunal Europeu dos Direitos Humanos em Al-Skeini v United Kingdom e nas opiniões consultivas da Corte Internacional de Justiça, este artigo argumenta que as obrigações de direitos humanos seguem os Estados além das fronteiras terrestres, onde quer que eles exerçam controle ou autoridade efetivos. O artigo propõe reformas jurídicas

freedoms, and protections recognized on Earth extend equally to orbit, the Moon, and Mars.

Keywords: Human Rights in Space. Extraterritorial Application. International Space Law. Corporate Accountability. Outer Space Treaty.

concretas, incluindo alterações aos tratados espaciais existentes, a criação de uma Comissão de Direitos Humanos no Espaço da ONU e o desenvolvimento de uma Convenção de Direitos Humanos no Espaço para garantir que as dignidades, liberdades e proteções fundamentais reconhecidas na Terra se estendam igualmente à órbita, à Lua e a Marte.

Palavras-chave: *Direitos Humanos no Espaço. Aplicação Extraterritorial. Direito Espacial Internacional. Responsabilidade Corporativa. Tratado do Espaço Exterior.*

1 INTRODUCTION

The exploration and utilization of outer space have entered a transformative era. Since the Soviet Union launched Sputnik 1 in 1957, followed by Yuri Gagarin's historic orbital flight in 1961 and the Apollo 11 lunar landing in 1969, space activities were primarily the domain of state-sponsored programs driven by scientific discovery and geopolitical competition (McDougall,1984). However, the 21st century has witnessed a fundamental shift: the rapid commercialization of space, with private entities such as SpaceX, Blue Origin, and Virgin Galactic pioneering new frontiers in space tourism (Abbas, 2024) satellite deployment, and plans for permanent extraterrestrial settlements (Freeland & Ireland 2022).

This commercialization trend presents unprecedented legal and ethical challenges. SpaceX's Starship program, designed to carry up to 100 passengers to the Moon and Mars, achieved significant milestones in 2024 with successful test flights and orbital operations. The Polaris Dawn mission in September 2024 saw the first private spacewalk, reaching an altitude of 870 miles—the highest crewed mission since Apollo (Greshko, M. 2024). Blue Origin's New Shepard and Virgin Galactic's SpaceShipTwo have already conducted commercial suborbital tourism flights (De Chiara, G., & Sivolella, D. 2025). These developments are not merely technological achievements; they fundamentally challenge the adequacy of existing international legal frameworks designed in an era when only states operated in space.

The central problematic of this research is that while space activities accelerate toward permanent human presence beyond Earth, current international law provides insufficient protection for the human rights of individuals who will live and work in these extraterrestrial environments. The Outer Space Treaty of 1967 (OST), which remains the cornerstone of space law, establishes that outer space shall be used "for the benefit and in the interests of all countries" and requires that space activities be conducted "in accordance with international law, including the Charter of the United Nations". (OST. 1967) However, the OST and subsequent space treaties—the Rescue Agreement (1968), the Liability Convention (1972), the Registration Convention (1975), and the Moon Agreement (1979)—were negotiated during the Cold War in a state-centric context and lack explicit provisions addressing individual human rights, labor protections, or mechanisms for corporate accountability (Tronchetti, 2009).

This gap becomes critical as humans spend extended periods in space. Astronauts and future space workers face unique hazards: exposure to cosmic radiation, prolonged microgravity affecting musculoskeletal and cardiovascular systems, psychological isolation, and dependence on life-support systems controlled by governmental or private entities (Tomsia, M., Cieśla, J., Śmieszek, J., Florek, S., Macionga, A., Michalczyk, K., & Stygar, D. 2024). The resource-constrained environment of space raises fundamental questions about equitable access to oxygen, water, and energy—resources that on Earth are increasingly recognized as connected to fundamental human rights (UN Committee on Economic, Social and Cultural Rights, 2002). Moreover, the increasing role of private corporations in space activities creates potential for exploitation, particularly as commercial entities prioritize profit over the welfare of workers operating in isolated, dangerous conditions without traditional labor protections or access to legal remedies (Macchi, 2024).

The development of international human rights law occurred contemporaneously with the creation of space law in the post-World War II period, yet these two bodies of law evolved largely in isolation from each other (Ireland-Piper & Freeland, (2021). The Universal Declaration of Human Rights (1948) and the International Covenant on Civil and Political Rights (ICCPR, 1966) were being negotiated at the same time as foundational space law principles were taking shape, but the primarily state-focused geopolitical context of outer space prevented meaningful integration of human rights

considerations into space treaties. This historical disconnect has created a legal vacuum that must now be addressed as space becomes a domain for sustained human activity.

This article makes three primary contributions to the scholarly discourse on space law and human rights. First, it provides a comprehensive analysis of the applicability of existing human rights frameworks to space activities, examining whether treaties such as the ICCPR and the European Convention on Human Rights (ECHR) impose extraterritorial obligations on states for acts committed in outer space. Second, it critically evaluates the adequacy of current space law instruments in protecting human rights, identifying specific gaps in labor rights, resource allocation, safety standards, and accountability mechanisms. Third, it proposes concrete legal reforms, including treaty amendments, institutional mechanisms, and a dedicated Space Human Rights Convention, grounded in contemporary jurisprudence on extraterritorial human rights application.

The significance of this research extends beyond academic inquiry. As emphasized by Professor Steven Freeland, one of the leading authorities in space law, "Why has there been so little work done so far as regards the human rights aspects of the exploration and use of outer space?" (Kim, 2021). Addressing this question is urgent because the legal frameworks established today will shape human existence beyond Earth for generations. Without proactive legal safeguards, there is a significant risk that exploitative colonial models, authoritarian governance structures, and human rights violations could be replicated in space settlements, creating what scholars have termed "legal black holes" where individuals have no effective recourse against violations (Ferreira-Snyman & Ferreira, (2019).

2 RESEARCH OBJECTIVES

This research pursues four specific objectives:

1. To examine the applicability of current international human rights frameworks to space activities, analyzing whether existing treaties such as the ICCPR and ECHR impose extraterritorial obligations on states operating in outer space.

2. To identify gaps in current space law regarding human rights protections, with particular focus on labor rights, resource allocation, safety standards, and corporate accountability.
3. To analyze extraterritorial jurisdiction precedents from human rights tribunals and their relevance to space activities, examining key cases including *Al-Skeini v United Kingdom* and the International Court of Justice's advisory opinions.
4. To develop evidence-based recommendations for policymakers, international organizations, and private space actors to strengthen human rights protections in future space activities through legal reforms and institutional mechanisms.

3 METHODOLOGY

This research employs a doctrinal legal research methodology, analyzing primary sources of international law including treaties, customary international law, United Nations General Assembly resolutions, and judicial decisions. Doctrinal research focuses on analyzing legal rules, principles, and doctrines to comprehend their meaning, interrelationships, and application. This method is particularly appropriate for examining how existing legal frameworks apply to emerging challenges in space activities (Majeed, Hilal, A & Khan, 2023).

3.1 Sources analyzed

Primary Sources:

- International space law treaties: Outer Space Treaty (1967), Rescue Agreement (1968), Liability Convention (1972), Registration Convention (1975), and Moon Agreement (1979)
- Human rights treaties: Universal Declaration of Human Rights (1948), International Covenant on Civil and Political Rights (1966), European Convention on Human Rights (1950)
- Case law from the European Court of Human Rights, International Court of Justice, and UN Human Rights Committee
- UN General Assembly resolutions and declarations on space activities

Secondary Sources:

- Peer-reviewed journal articles in space law and human rights law
- Monographs by leading scholars including Fabio Tronchetti, Steven Freeland, Irmgard Marboe, Frans von der Dunk, and Shirley Freeland
- Policy documents from space agencies (NASA, ESA) and international organizations
- Reports from human rights organizations on extraterritorial obligations

3.2 Analytical framework

The research employs comparative legal analysis to examine how extraterritorial human rights obligations have been interpreted in analogous contexts, particularly military operations abroad and occupied territories. This jurisprudence provides critical insights into how human rights treaties might apply to space activities where states or corporations exercise effective control over individuals in extraterrestrial environments.

3.3 Inclusion and exclusion criteria

Inclusion criteria:

- Peer-reviewed scholarly articles published in English, Arabic, or French
- Primary legal sources (treaties, cases, resolutions) related to space law and human rights law
- Publications from 2000-2025, with seminal earlier works included for historical context
- Materials addressing extraterritorial application of human rights, corporate accountability, and emerging space governance issues

Exclusion criteria:

- Non-peer-reviewed sources, except for official legal documents and reports from authoritative international organizations
- Materials focusing solely on technical or scientific aspects without legal analysis
- Publications predating the commercialization of space activities unless addressing foundational principles

3.4 Limitations

This research acknowledges several limitations. First, the rapid pace of technological change in space activities means that legal analysis must account for emerging developments that may not yet be fully documented in scholarly literature. Second, the limited number of binding judicial decisions specifically addressing human rights in space means that much analysis relies on analogical reasoning from terrestrial precedents. Third, the state-centric nature of international law creates challenges when analyzing the obligations of private corporate actors operating in space. These limitations are inherent to research in an emerging field and underscore the need for continued scholarly attention and legal development.

4 INTERNATIONAL SPACE LAW AND ITS HUMAN RIGHTS DEFICIT

4.1 The outer space treaty and foundational principles

On October 10, 1967, 116 states ratified the Outer Space Treaty (OST), also known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST 1967). The OST establishes fundamental principles that still govern space activities, such as the freedom of all states to explore and use space (Article I), the prohibition of national appropriation of celestial bodies (Article II), the requirement that space activities be carried out for peaceful purposes and in compliance with international law, including the UN Charter (Articles III and IV), and state responsibility for national space activities, including those carried out by non-governmental entities (Article VI).

Article III of the OST is particularly relevant to human rights considerations, as it mandates that states parties "shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations" (OST 1967). Since international human rights law constitutes a core component of the broader framework of international law, this provision creates an indirect linkage between space activities and human rights obligations. However, as Fabio Tronchetti observes in his analysis of the OST, "while the

treaty references international law generally, it provides no specific enforcement mechanisms for human rights violations and was not conceived with individual protections in mind" (Tronchetti, 2009).

Article VI of OST establishes that states bear international responsibility for national activities in outer space "whether such activities are carried on by governmental agencies or by non-governmental entities". This provision creates a foundation for state responsibility even when private companies conduct space activities, but scholars note that the practical implementation of this responsibility remains ambiguous, particularly regarding how liability is allocated between states and private actors when violations occur (Freeland, S., & Ireland-Piper, D. 2022).

4.2 Complementary space treaties and their limitations

The Rescue Agreement (1968) represents the most direct engagement with individual welfare in space law. It obligates states parties to provide all possible assistance to astronauts in distress and to safely return them to the launching state (RRAA 1968). However, the Agreement's protections are limited in several respects. First, it applies primarily to government astronauts rather than private space tourists or workers. Second, it addresses only emergency rescue situations rather than ongoing welfare during missions. Third, it contains no provisions regarding working conditions, labor rights, or protection against exploitation (Froehlich, A. 2018).

The Liability Convention (1972) establishes a framework for compensating damage caused by space objects, but its focus is on property damage and state-to-state claims rather than individual rights or remedies. The Convention's limitation to damage occurring on Earth or to aircraft in flight means it does not address harm suffered by individuals in space itself (LC 1972).

The Moon Agreement (1979) represents the most progressive attempt to address equitable resource distribution and common heritage principles, including provisions for benefit-sharing and environmental protection (MA 1979). However, the Agreement has been ratified by only 17 states, and critically, none of the major spacefaring nations (United States, Russia, China) are parties to it, rendering it largely ineffective as a governance instrument. As Tronchetti notes, the Moon Agreement's failure demonstrates

"the tension between the principle of outer space as the common heritage of mankind and the practical interests of spacefaring states in commercial exploitation" (Tronchetti, 2009).

4.3 The human rights gap in space law

The absence of explicit human rights provisions in space treaties creates several critical gaps:

Labor Rights: Current space law contains no provisions addressing working conditions, maximum working hours, rest periods, occupational safety standards, or protection against forced labor for individuals working in space. The International Labour Organization's conventions, which establish fundamental labor rights on Earth, have no clear application to extraterrestrial employment (Maxamataminovich, M. M. 2025).

Resource Access: While the OST prohibits national appropriation of celestial bodies, it provides no framework for ensuring individual access to essential resources such as oxygen, water, and energy in space settlements. The potential for monopolistic control of life-sustaining resources by states or corporations poses severe human rights risks (Macchi, 2024).

Privacy and Autonomy: The isolated, confined environments of spacecraft and space stations create conditions where privacy rights and personal autonomy are highly vulnerable. Current space law does not address surveillance, personal communications, or protection against arbitrary interference with privacy (Hassan & Sheer, 2024).

Access to Justice: Individuals in space currently have limited or no access to effective remedies for rights violations. The jurisdictional complexities of space activities, combined with the lack of dedicated dispute resolution mechanisms, create significant barriers to justice.

Medical Care and Bodily Autonomy: Space workers may face medical decisions made by mission commanders or corporate officials without adequate informed consent procedures or respect for medical autonomy. The OST and subsequent treaties provide no framework for protecting these rights.

In their thorough examination, Steven Freeland and Danielle Ireland-Piper contend that "the international legal regulation of outer space was founded on an

assumption that space was a new frontier that would enable a far broader range of activities on Earth and in space itself." The relationship and junction between the particular international legal regime of space and the international legal regulation of human rights, however, have not received much thorough examination to date" (Ireland-Piper and Freeland 2021).

5 EXTRATERRITORIAL APPLICATIONS OF HUMAN RIGHTS TREATIES

5.1 The legal framework for extraterritoriality

The question of whether human rights treaties apply extraterritorially—that is, to state actions occurring outside a state's territorial boundaries—is central to determining whether these instruments protect individuals in outer space. This issue has been extensively litigated before international human rights bodies, generating a substantial body of jurisprudence relevant to space activities.

Article 2(1) of the International Covenant on Civil and Political Rights (ICCPR) requires each state party "to respect and to ensure to all individuals within its territory and subject to its jurisdiction" the rights outlined in the agreement (International Covenant on Civil and Political Rights 1999). Whether "within its territory" and "subject to its jurisdiction" are disjunctive alternatives (requiring satisfaction of either condition) or cumulative requirements (requiring both to be achieved simultaneously) is the crucial interpretative question.

The United States has historically advocated for a restrictive, cumulative interpretation, arguing that the ICCPR applies only to individuals both within US territory and subject to US jurisdiction (Hathaway, Levitz,Nielsen, Nowlan, 2011). However, reputable Covenant interpreters have repeatedly rejected this reading. "A state party must respect and ensure the rights laid down in the Covenant to anyone within the power or effective control of that State Party, even if not situated within the territory of the State Party," the UN Human Rights Committee explained in General Comment No. 31 (2004). Regardless of geographic location, this functional approach focusses on whether a state effectively controls or has authority over persons.

In several advisory opinions, the International Court of Justice has supported this approach. The International Court of Justice (ICJ) ruled in the Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory (2004) that "the International Covenant on Civil and Political Rights is applicable in respect of acts done by a State in the exercise of its jurisdiction outside its own territory" and that "while the jurisdiction of States is primarily territorial, it may sometimes be exercised outside the national territory" (ICJ Reports 2004). The Court reasoned that the Covenant's object and purpose—protecting individuals from violations of their rights—would be defeated if states could violate rights abroad with impunity.

5.2 European Court of Human Rights jurisprudence

The European Court of Human Rights (ECtHR) has developed the most extensive jurisprudence on extraterritorial application of human rights, providing particularly relevant precedents for space activities.

5.2.1 The Banković decision and its limitations

In *Banković and Others v Belgium and Others* (2001), the ECtHR Grand Chamber addressed whether Article 1 ECHR—which requires states to "secure to everyone within their jurisdiction" Convention rights—applied to NATO airstrikes on a Serbian television station during the Kosovo conflict (Europeaon Couts of Human Rights 1999). The Court held that the applicants were not within the jurisdiction of respondent states, emphasizing that jurisdiction under the Convention is "primarily territorial" and that extraterritorial jurisdiction is "exceptional" requiring "special justification".

The *Banković* decision relied heavily on the concept of the Convention's "legal space" (*espace juridique*)—the territorial scope of the European public order created by the Convention. Since the Federal Republic of Yugoslavia was not a party to the Convention, the Court reasoned that the Convention did not create a jurisdictional link based solely on the causal impact of respondent states' actions.

Banković has been extensively criticized by scholars for conflating different concepts of jurisdiction, adopting an overly restrictive interpretation, and creating

potential human rights "black holes" where states can act with impunity (ECHR 1999). As Professor Marko Milanović observes, " Despite the fact that it clearly did not, the Court essentially pretended that all of its earlier rulings somehow fit neatly into a larger picture. (Milanović, 2008).

5.2.2 The Al-Skeini judgment and expanded extraterritoriality

The seminal case of *Al-Skeini and Others v United Kingdom* (2011) significantly expanded the extraterritorial reach of the ECHR and effectively limited *Banković*'s precedential scope (ECHR 2011). The case concerned six Iraqi civilians killed by British forces in Basra, Iraq, during the occupation following the 2003 invasion. The applicants alleged violations of the right to life (Article 2 ECHR) and argued that the UK failed to conduct effective investigations into the killings.

The ECtHR Grand Chamber held unanimously that the deceased fell within UK jurisdiction for purposes of Article 1 ECHR. The Court articulated several bases for extraterritorial jurisdiction:

Spatial Model (Effective Control of an Area): When a state exercises effective control of an area outside its territory through military occupation or otherwise, Article 1 jurisdiction exists over that entire area and all individuals within it. The Court found that UK forces exercised such control in Basra during the relevant period.

Personal Model (State Agent Authority and Control): Even absent territorial control, jurisdiction arises when state agents exercise "authority and control" over specific individuals. This encompasses situations such as detention facilities, checkpoints, and other circumstances where state agents exercise physical power over individuals.

Critically, the Court held that the UK could not "do outside its territory what it cannot do within its territory" and that allowing such a gap in protection would be inconsistent with the Convention's purpose of securing human rights protections.

The *Al-Skeini* judgment has been described as "set to become the leading Strasbourg authority on the extraterritorial application of the ECHR" and provides crucial precedent for extending human rights obligations beyond Earth (Miltner, 2011). Al-Skeini is "another example of a growing international custom indicating that human rights

treaties should be applied extraterritorially," according to Barbara Miltner's thorough study.

5.3 Application to space activities

The jurisprudence on extraterritorial human rights application is directly relevant to space activities through several analogies:

Effective Control: When a state or state-authorized corporation operates a spacecraft, space station, or lunar base, it exercises the kind of effective control over that environment and the individuals within it that triggers extraterritorial jurisdiction under the *Al-Skeini* spatial model. The spacecraft or facility functions analogously to a military base or detention facility abroad—a defined space where the operating entity controls all aspects of the environment, including life-support systems, communications, movement, and access to resources (Janig, 2021).

Authority Over Individuals: Even on celestial bodies not under territorial control, states and corporations exercise direct authority over space workers and tourists through control of essential resources, communications systems, transportation, and emergency response. This satisfies the personal model of jurisdiction articulated in *Al-Skeini*.

Functional Jurisdiction: Legal scholars have proposed a "functional model" of jurisdiction particularly apt for space: jurisdiction exists wherever a state or state-authorized entity exercises functions that affect individuals' enjoyment of their rights, regardless of territorial control. (Giuffré, 2022). In space, where survival depends entirely on controlled systems for oxygen, water, temperature, radiation shielding, and other life-sustaining functions, the entity controlling these systems exercises profound functional authority over individuals. As Professor Steven Freeland and Ram Jakhu argue, " According to international human rights law, a state has "jurisdiction" over a person for the purposes of applying human rights law if its agents have control or power over that person outside of its borders. (Steven Freeland and Ram Jakhu, 2018). This principle applies with even greater force in space, where dependence on life-support systems creates a more intensive form of control than typically exists in terrestrial extraterritorial situations.

6 CHALLENGES TO HUMAN RIGHTS IN SPACE ENVIRONMENTS

6.1 Resource allocation and distributive justice

The resource-constrained nature of space environments creates fundamental challenges for implementing human rights principles developed in terrestrial contexts. Unlike Earth, where despite inequitable distribution, essential resources like water and breathable air exist naturally, space settlements depend entirely on technologically produced and controlled resources.

Oxygen, Water, and Energy: These resources, essential for life, must be generated, stored, and distributed through technological systems controlled by governmental or private entities. This creates potential for discriminatory allocation, monopolistic control, and use of resource access as a mechanism of control or coercion. (Steven Freeland and Ram Jakhu, 2018). Article 11 of the International Covenant on Economic, Social, and Cultural Rights recognizes the right to an adequate quality of living, which inevitably includes access to these vital resources. (International Covenant on Economic, Social and Cultural Rights, 1976).

Economic Inequality: The immense cost of space access threatens to replicate and exacerbate terrestrial economic inequalities. Only wealthy nations and individuals can currently afford space travel, raising questions about whether space will become an exclusive domain of economic elites while marginalized populations remain excluded (MACCHI, 2024). This contradicts the OST's principle that space exploration shall be "for the benefit and in the interests of all countries" and the common heritage principle articulated in the Moon Agreement (OST, 1967).

"Tragedy of the Commons": The potential for competitive exploitation of space resources without effective governance mechanisms poses risks analogous to the tragedy of the commons on Earth, where unregulated access leads to overexploitation and environmental degradation (Hardi, 1968). Effective governance frameworks must balance freedom of access with equitable distribution and sustainable use.

6.2 Labor rights and working conditions

Space workers—whether government astronauts, corporate employees, or contracted laborers—face unique occupational hazards that current labor law frameworks inadequately address:

Physical Hazards: Exposure to cosmic radiation, microgravity-induced bone density loss and muscle atrophy, cardiovascular deconditioning, vision impairment, and increased cancer risk represent severe occupational health hazards without terrestrial analogues. Long-duration missions exacerbate these risks. Current research indicates that astronauts on a Mars mission could receive radiation exposure exceeding recommended lifetime limits (Abbas, 2024).

Psychological Challenges: Extended isolation, confinement in small spaces with limited crew, separation from family, monotonous environments, and high-stress conditions create significant mental health risks including depression, anxiety, and interpersonal conflicts (Hardin, 1968). The lack of escape options and dependence on mission success for survival intensify psychological pressures.

Absence of Labor Protections: Traditional labor law protections—including maximum working hours, rest periods, overtime compensation, workplace safety standards, and freedom of association—have unclear application in space. Private space companies are not currently bound by International Labour Organization conventions for extraterrestrial operations (Freeland and Ireland-Piper, 2021).

Power Imbalances: The hierarchical command structures necessary for space mission safety can create power imbalances vulnerable to abuse. Workers in isolated space environments have limited ability to report mistreatment, seek alternative employment, or physically remove themselves from abusive situations (Ferreira-Snyman and Ferreira, 2019).

6.3 Corporate accountability and governance

The increasing role of private corporations in space activities creates accountability challenges that existing legal framework struggle to address:

Regulatory Gaps: While Article VI of the OST requires states to authorize and supervise non-governmental space activities, implementation varies widely among spacefaring nations. Many states lack comprehensive national space legislation establishing clear standards for corporate conduct (MACCHI, 2024). The United States Commercial Space Launch Competitiveness Act (2015) authorizes commercial resource extraction but contains no human rights provisions (US Commercial Space Launch Competitiveness Act, 2015).

Profit vs. Welfare: Corporate entities operating in space may prioritize cost reduction and profit maximization over worker welfare and safety. Without binding regulatory frameworks, market pressures could drive a "race to the bottom" in labor and safety standards (MACCHI, 2024).

Jurisdictional Complexity: Determining which state's law applies to corporate conduct in space is complex. Potential bases include the corporation's state of incorporation, the launching state, the state of registry of the spacecraft, and potentially the nationality of victims. This complexity can create enforcement gaps (Ireland-Piper and Freeland, 2021).

Limited Remedies: Individuals harmed by corporate conduct in space currently have limited access to effective remedies. Traditional tort litigation faces jurisdictional challenges, forum non convenience dismissals, and difficulties obtaining evidence from space operations. International arbitration mechanisms do not exist specifically for human rights claims arising from space activities (Ireland-Piper and Freeland, 2021).

As Claudio Macchi argues in his analysis of corporate accountability in space, "The increasing involvement of private actors is creating accountability gaps that current treaties, designed in a state-centric era, are ill-equipped to manage" (MACCHI, 2024).

6.4 Privacy, autonomy, and dignity

The confined, isolated nature of space environments creates conditions where privacy rights and personal autonomy are particularly vulnerable:

Surveillance: Spacecraft and space stations necessarily include extensive monitoring systems for safety purposes, but these systems can readily be used for comprehensive surveillance of crew members' activities, communications, and physical

condition. Without clear legal protections, such surveillance could extend to private communications, personal spaces, and medical information (Ferreira-Snyman and Ferreira, 2019).

Bodily Autonomy: Space workers may be subject to mandatory medical procedures, drug testing, genetic screening, or reproductive controls without adequate informed consent protections. The medical necessity of monitoring health in space environments must be balanced against bodily autonomy rights.

Freedom of Expression: Corporate employers or mission commanders may restrict communications to prevent disclosure of information deemed proprietary or mission-threatening, potentially infringing on freedom of expression and whistleblower protections (Ireland-Piper & Freeland, 2021).

Dignity in Extreme Conditions: Space environments may require compromises to privacy and dignity—such as shared sleeping quarters, limited sanitation facilities, and public medical examinations—that would be unacceptable in terrestrial employment contexts. Legal frameworks must establish minimum standards while recognizing practical necessities. (Ferreira-Snyman and Ferreira, 2019).

7 LEGAL REFORMS AND POLICY RECOMMENDATIONS

7.1 Amendment of existing space treaties

The OST and related space treaties require updating to explicitly incorporate human rights protections:

Proposed Article VI Amendment: States parties should bear international responsibility not only for authorization and supervision of non-governmental space activities but also for ensuring that such activities comply with international human rights law. This amendment would create clear accountability for corporate human rights violations.

A new article should be added to the OST explicitly stating that all space activities must respect fundamental human rights as recognized in the Universal Declaration of Human Rights, the ICCPR, and the International Covenant on Economic, Social and

Cultural Rights. This would eliminate ambiguity about the applicability of human rights law in space.

Space treaties should incorporate specific provisions addressing labor rights, including maximum working hours, rest periods, occupational safety standards, right to refuse unsafe work, freedom of association, and collective bargaining rights adapted to space contexts.

7.2 Establishment of a UN Human Rights in Space Commission

A specialized body within the United Nations system is necessary to monitor human rights compliance in space activities:

Institutional Structure: The Commission should be established under the Office of the UN High Commissioner for Human Rights, with representation from spacefaring and non-spacefaring nations, human rights experts, space law specialists, and civil society organizations.

Mandate and Functions:

- Monitor state and corporate compliance with human rights obligations in space
- Receive and investigate complaints from individuals regarding rights violations
- Issue interpretive guidance on application of human rights treaties to space contexts, analogous to General Comments issued by UN treaty bodies
- Conduct periodic reviews of national space legislation and corporate codes of conduct
- Facilitate dialogue between space agencies, corporations, and human rights advocates.

Reporting Requirements: States and corporations conducting space activities should submit regular reports detailing measures taken to protect human rights, analogous to the reporting requirements under existing UN human rights treaties.

7.3 Development of a Space Human Rights Convention

A comprehensive, binding treaty specifically addressing human rights in space is necessary to fill existing gaps:

Substantive Provisions:

Article 1—Scope: The Convention should apply to all human activities in outer space, including the Moon and other celestial bodies, conducted by states, international organizations, or private entities.

Article 2—Non-Discrimination: Equal rights and protections shall be guaranteed without discrimination based on nationality, race, sex, language, religion, political or other opinion, national or social origin, property, birth, or other status.

Article 3—Right to Life and Safety: States and private actors shall ensure that space activities incorporate the highest attainable safety standards, conduct rigorous risk assessments, provide adequate life-support systems, and establish emergency response protocols.

Article 4—Labor Rights:

- Maximum working hours and mandatory rest periods
- Right to safe working conditions meeting established standards
- Right to refuse work posing unreasonable risk to life or health
- Protection against forced labor and exploitative employment practices
- Right to fair compensation, including hazard pay
- Freedom of association and collective representation.

Article 5—Resource Rights: All individuals in space shall have equitable access to essential resources including oxygen, water, energy, nutrition, and medical care without arbitrary restriction or discrimination.

Article 6—Privacy and Communications: States and corporations shall respect privacy rights, including:

- Protection against arbitrary surveillance beyond that necessary for safety
- Right to private communications with family and legal representatives
- Protection of medical and personal information
- Clear protocols for monitoring and data collection.

Article 7—Medical Care and Bodily Autonomy:

- Access to highest attainable standard of medical care
- Informed consent for medical procedures except in emergencies
- Protection against non-consensual human experimentation
- Right to comprehensive health information and health education.

Article 8—Access to Justice:

- Right to effective remedy before competent tribunal for rights violations
- Establishment of specialized dispute resolution mechanisms
- Prohibition of contractual waivers of human rights protections
- Clear rules on jurisdiction and applicable law.

Enforcement Mechanisms:

The Convention should establish:

- A Space Human Rights Committee with authority to receive individual complaints
- Binding arbitration procedures for disputes between individuals and space operators
- Inspection rights allowing international observers to access space facilities
- Sanctions for non-compliance, including suspension of launching privileges.

7.4 National implementation measures

States must adopt comprehensive national space legislation incorporating human rights protections:

Regulatory Frameworks: National space agencies should promulgate detailed regulations addressing labor standards, safety requirements, resource allocation protocols, and grievance procedures for space operations.

Corporate Licensing: States should condition authorization of private space activities on compliance with human rights standards, conducting human rights impact assessments, and maintaining adequate insurance for potential liability.

Extraterritorial Criminal Jurisdiction: States should establish criminal jurisdiction over serious human rights violations committed by their nationals or corporations in space, analogous to universal jurisdiction for international crimes.

7.5 Industry best practices and voluntary standards

While legal reforms are essential, industry self-regulation can complement binding obligations:

Corporate Human Rights Policies: Space companies should adopt comprehensive human rights policies aligned with UN Guiding Principles on Business and Human Rights, conduct human rights due diligence, and establish grievance mechanisms.

International Certification: Industry associations should develop voluntary certification programs recognizing companies meeting high human rights and labor standards, creating market incentives for responsible practices.

Multi-Stakeholder Initiatives: Collaborative forums bringing together space agencies, corporations, workers' representatives, human rights organizations, and affected communities can develop practical standards and share best practices.

8 CONCLUSIONS

As humanity stands on the threshold of becoming a multi-planetary species, the legal frameworks governing space activities must evolve to protect the fundamental rights and dignity of individuals who will live and work beyond Earth. This research has demonstrated that while existing international human rights treaties contain principles applicable to space through extraterritorial application, and current space law instruments establish important foundational principles, significant gaps remain in protecting individuals from exploitation, ensuring equitable resource access, and providing effective remedies for rights violations.

The jurisprudence of international human rights bodies, particularly the European Court of Human Rights in *Al-Skeini v United Kingdom* and the International Court of Justice in its advisory opinions, establishes that human rights obligations follow states wherever they exercise effective control or authority over individuals. These principles apply with full force to space activities, where states and state-authorized corporations exercise comprehensive control over environments, resources, and the individual’s dependent upon them for survival.

The rapid commercialization of space, evidenced by SpaceX's Starship program, Blue Origin's New Shepard, and emerging space tourism industries, makes these legal questions urgently practical rather than merely theoretical. Without proactive legal safeguards, there is substantial risk that space will become a domain where exploitative

colonial models, authoritarian governance structures, and systematic human rights violations emerge unchecked.

This article has proposed concrete legal reforms to address these challenges: amendments to existing space treaties explicitly incorporating human rights obligations, establishment of a UN Human Rights in Space Commission to monitor compliance and provide authoritative guidance, and development of a comprehensive Space Human Rights Convention establishing binding protections for labor rights, resource access, privacy, medical care, and access to justice.

The choices made today regarding legal frameworks for space activities will shape human civilization beyond Earth for generations. As Professor Steven Freeland emphasizes, "It is important to be proactive and not wait until violations have occurred". The international community has a responsibility to ensure that the expansion of humanity into space reflects our highest values and commitments to human dignity, equality, and justice, rather than replicating the patterns of exploitation and inequality that have too often characterized terrestrial frontiers.

The right to freedom, dignity, and equal protection under law must not be Earth-bound. These fundamental protections must extend equally to orbit, to the Moon, and to Mars—wherever human being's venture. Only through comprehensive legal reforms grounded in the extraterritorial application of human rights law can we ensure that outer space truly becomes, as the Outer Space Treaty declares, a domain for "the benefit and in the interests of all" humanity.

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CONFLICT OF INTEREST

The authors have declared that they have no conflicts of interest. Every co-author has seen and approved the final manuscript, thus none of them has anything to conceal regarding their financial interests.

REFERENCES

Abbas, S. (2024). Apprehensions with regard to commercial space flight: outlook on space law. *Journal of Astronomy and Space Sciences*, *41*(4), 235-247.

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted 18 December 1979, entered into force 11 July 1984, 1363 UNTS 3, Article 11.

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1363 U.N.T.S. 3 (1979).

Agreement on the Rescue of Astronauts, 672 U.N.T.S. 119 (1968).

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, adopted 22 April 1968, entered into force 3 December 1968, 672 UNTS 119, Article 1.

Al-Skeini and Others v. United Kingdom, Application No. 55721/07 (European Court of Human Rights, 2011).

Banković and Others v Belgium and Others, Grand Chamber, Application No. 52207/99, Decision of 12 December 2001, ECHR 2001-XII.

Convention on International Liability for Damage Caused by Space Objects, adopted 29 March 1972, entered into force 1 September 1972, 961 UNTS 187.

Cvetković, I. R. (2023). Two sides of the same coin? Examining the interrelation between the proposed new human right and the law governing outer space. Digital War.

De Chiara, G., & Sivolella, D. (2025). Suborbital. In Privatizing Space: An Illustrated History of The Quest to Affordable and Profitable Spaceflight (pp. 69-95). Cham: Springer Nature Switzerland.

Ferreira-Snyman, A., & Ferreira, G. (2019). The application of international human rights instruments in outer space settlements: Today's science fiction, tomorrow's reality. Potchefstroom Electronic Law Journal, 22.

Freeland, S. (2022). International law and the exploration and use of outer space. Routledge.

Freeland, S., & Ireland-Piper, D. (2022). Space law, human rights and corporate accountability. *UCLA J. Int'l L. Foreign Aff.*, *26*, 1.

Froehlich, A. (2018). A fresh view on the outer space treaty (Vol. 13). Springer.

Giuffré, M. (2021). A functional-impact model of jurisdiction: Extraterritoriality before the European Court of Human Rights. QIL: Questions of International Law, 82, 53–82.

Greshko, M. (2024). First private spacewalk: What it means for science. *Nature*, *633*, 504-505.

Hardin, G. (1968). The tragedy of the commons: the population problem has no technical solution; it requires a fundamental extension in morality. science, 162(3859), 1243-1248.

Hassan, A., & Sheer, A. (2024). Cybersecurity challenges in outer space: Innovation, collaboration and legal reforms. Journal of East Asia and International Law, 17(2), 405–422.

Hathaway, O., et al. (2011). Human rights abroad: When do human rights treaty obligations apply extraterritorially? Yale Law School.

International Covenant on Civil and Political Rights, 999 U.N.T.S. 171 (1966).

International Covenant on Civil and Political Rights, adopted 16 December 1966, entered into force 23 March 1976, 999 UNTS 171, Article 2(1).

International Covenant on Economic, Social and Cultural Rights, adopted 16 December 1966, entered into force 3 January 1976, 993 UNTS 3, Article 11.

Ireland-Piper, D., & Freeland, S. (2021). Human rights and space: Reflections on the implications of human activity in outer space on human rights law. Groningen Journal of International Law, 9, 101–128.

Jakhu, R. S., Freeland, S., & Chen, K. W. (2018). The sources of international space law: Revisited. ZLW, 67, 606.

Janig, P. (2021). Extraterritorial application of human rights. SSRN Electronic Journal.

Kim, D. H. (Ed.). (2021). Global issues surrounding outer space law and policy. IGI Global.

Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory (Advisory Opinion), ICJ Reports 2004.

Macchi, C. (2024). Business, human rights and international space law: Filling the gaps of corporate accountability in the “New Space”. SSRN Electronic Journal.

Majeed, N., Ahmad, H., & Khan, A. N. (2023). Doctrinal research in law: Meaning, scope and methodology. Bulletin of Business and Economics, 12, 559–567.

Maxamataminovich, M. M. (2025). Status and Functions of the International Labour Organization. Central Asian Journal of Social Sciences and History, 6(1), 22-29.

McDougall, W. A. (1984). Heavens and the earth: a political history of the space age.

Milanović, M. (2008). From compromise to principle: Clarifying the concept of state jurisdiction in human rights treaties. Human Rights Law Review, 8, 411–448.

Miltner, B. (2012). Revisiting extraterritoriality after Al-Skeini: The ECHR and its lessons. Michigan Journal of International Law, 33, 693–740.

O'Connell, R. H. (2021). The international law of space exploration: From private actors to sustainable development. Springer.

Tomsia, M., Cieśla, J., Śmieszek, J., Florek, S., Macionga, A., Michalczyk, K., & Stygar, D. (2024). Long-term space missions' effects on the human organism: what we do know and what requires further research. Frontiers in physiology, 15, 1284644.

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, adopted 27 January 1967, entered into force 10 October 1967, 610 UNTS 205, Articles I and III.

Tronchetti, F. (2009). The exploitation of natural resources of the Moon and other celestial bodies. Brill.

UN Committee on Economic, Social and Cultural Rights, General Comment No. 15, "The Right to Water", UN Doc E/C.12/2002/11 (2003).

UN Human Rights Committee, General Comment No. 31, "The Nature of the General Legal Obligation Imposed on States Parties to the Covenant", UN Doc CCPR/C/21/Rev.1/Add.13 (26 May 2004), para. 10.

UN Human Rights Committee. (2004). General Comment No. 31: The nature of the general legal obligation imposed on States Parties to the Covenant (CCPR/C/21/Rev.1/Add.13).

UN Office of the High Commissioner for Human Rights. (2011). Guiding principles on business and human rights.

Universal Declaration of Human Rights, G.A. Res. 217A (III), U.N. Doc. A/810 (1948).

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All authors contributed equally to the development of this article.

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