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Article

Orbital and Suborbital Tourism Challenges—Some Legal Aspects

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Abstract Space tourism is recreational space travel, whether by government vehicles, such as the Russian Soyuz and the International Space Station (ISS), or by vehicles built by private companies. Since the flight of the world's first space tourist, American businessman Dennis Tito (28 April 2001), space tourism (orbital) has been slowly growing. Orbital space tourism is very expensive, so a number of private companies have decided to concentrate on building much cheaper suborbital vehicles, designed to take passengers to altitudes of up to 100 km. On 4 October 2004, SpaceShipOne, funded by Virgin Galactic and designed by an American engineer, won the X Prize and, in doing so, ushered in a new era of commercial crewed spaceflight and space tourism. Since then, the design and construction of suborbital spacecraft have become increasingly popular. Such ships, in principle, do not have the ability to cross the imaginary 100 km boundary and enter the Cosmos area. However, space tourists can find themselves weightless for a few minutes. In fact, not only technical but legal difficulties have caused suborbital tourism to develop at a slow pace so far. This article concentrates on some legal challenges regarding space tourism, not going into details about states' politics and international organizations' activities.

Keywords space tourism (orbital); suborbital tourism; International Space Station (ISS); near space; space business; space law

1. Introduction

Space transportation and space tourism issues are not new. Space transportation is more connected to the space activities of human beings in outer space for scientific purposes, meanwhile, space tourism (such as orbital or suborbital) is more connected to recreation and leisure. Those subjects have been discussed at many international fora in the past. Some observers noticed that the private sector was already active in outer space in the Sixties. Some observant are excited about it. Space journeys seem to be a great adventure and a new area to discover it by tourist industry is coming. However, some observers are still very skeptical and see a lot of challenges such as the legal or safety of passengers. One cannot be underestimated: space transportation of civilian passengers going to space for pleasure and not as space technical mission members is already a reality. International companies offer trips to space and there is a long "waiting" list of volunteers to make it. Certainly, it engages extremely big amounts of money, but as experts predict, this situation may change soon. Thanks to the fast development of technology, the safety of transport may be guaranteed in 10 to 15 years when space travel will become a kind of "routine" for the public. The ticket prices will go down by approximately 10–20 thousand USD per person [1]. This article examines a few challenges of space transportation referring to legal or safety areas. Space transportation today serves not only as freight services to International Space Stations or scientific missions but also more and more as tourist purposes. That is the reason why those challenges should be soon governed properly. However, the issue of suborbital flights which allow people to discover "terra nulla" and to observe the Earth from a different perspective than aviation allows, seems to be better managed than a few years ago [2]. Recently there is much interest from a few states in space mining (e.g., on the Moon), and Mars settlements. This causes people's imagination to grow in exploring the Cosmos not only in scientific missions but individually. In the article, there is no in-depth approach to the non-legal aspects of orbital and suborbital tourism, especially the role of space tourism in the politics of states and the activities of international organizations.

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This article is divided into a few sections. Section 2 considers the methodology and literature used by the author; Section 3 includes results with the following topics: Airspace and space delimitation projects (Section 3.1), Commercialization of Space (Section 3.2), Concept of Near Space (Section 3.3), orbital tourism (Section 3.4), suborbital tourism (Section 3.5), and liability and insurance (Section 3.6). Section 4 includes a discussion and conclusion. The following of the article is intended to answer a number of questions about orbital and especially suborbital flight and tourism, including whether it is possible to establish a precise delimitation between airspace and space, and whether suborbital space flight should be subject to civil aviation regulations or space law. All orbital and suborbital tourism enthusiasts can also be suggested to read this text carefully to become aware of the existing fundamental deficiencies and risks in the field of space tourism.

2. Materials and Methods

The subject of the article is innovative and not much literature on this subject is available. The bibliography on slowly growing space tourism (already in existence) and suborbital tourism (planned as a significant branch of the aerospace industry) can be divided into two unequal groups: the vast majority are journalistic articles, expressing conviction in the imminent exuberant development of space tourism (mainly suborbital); the second, scientific and lawyers, expose space and suborbital tourism problems not yet solved, and whose disregard may endanger the safety of tourists [3]. Besides, some legal documentation, such as the United Nations treaties or other regulations was used.

This article is an overview and did not involve experimentation.

3. Results

3.1. Airspace and Space Delimitation Projects

For commercial activities in air and space (including tourism), the problem of different legal conditions prevailing in these domains is important; commercial activities in the air are subject to states, and in outer space, they are essentially free; moreover, the boundary between these areas has not been established to date (the accepted boundary is the so-called Karman Line, nowadays usually set to be 100 km altitude). According to the Outer Space Treaty 1967 (Article 1), outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all states without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. Outer space is a common heritage of mankind and should be protected for future generations. Space sustainability would ensure that all humanity can continue to use outer space for peaceful purposes and socioeconomic benefit now and in the long term [4].

The problem of the delimitation of air and space has been discussed not only within the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) and its Legal Subcommittee but also in the broader forum of the First (Political) Committee of the UN General Assembly. On the doctrinal level (worldwide), at least dozens of concepts have emerged based on various types of criteria, such as physical or astrophysical; specialists, or functionalists [5]. None of these concepts, however, has led to the adoption of any binding agreements. Also, individual states, or groups of them, came up with proposals to establish a conventional boundary between air and space. This boundary was located in the range of a few tens to a hundred kilometers above the Earth's surface. However, the proposed heights have changed as space techniques have developed, allowing objects to be placed in increasingly higher orbits. Notwithstanding the repeated, in various international forums, opinions, projects, proposals, and even demands on the subject of the explicit delimitation of outer space, and especially its lower limit, states have continued and developed their space activities and international cooperation in this field without significant obstacles. In light of these facts, the question arises whether the legal delimitation of outer space, coupled with the legal definition of the upper limit of outer space, is really necessary [6]. The problem with defining state vertical sovereignty stems from the lack of a natural boundary separating air and space. Hence, there have been a number of proposals to extend state sovereignty to the highest altitude at which an aircraft can fly (Theodore van Karman, established that this occurs when the aircraft moves at a speed of about 8 km/s and reaches an altitude of about 100 km, the so-called critical line) [7]. In the absence of a normative definition of the lower limit of the Cosmos in international space law, the issue is sometimes regulated by national (domestic)

law—national legislators explicitly refer to the mentioned height of 100 kilometers above sea level, although not all states agree. A state's sovereignty extends to its airspace, but it is not entirely clear where its boundary is. In addition, the use and exploration of space are recognized as the domain of all mankind, thus ruling out any claim of national appropriation; however, it is not clear from which lowest end of the Earth's atmosphere such a claim would apply [8].

3.2. Commercialization of Space

In the situation of lack of specific international law referring the space activities, such as space tourism or space resources, states decided to regulate those issues at the national level. Particular countries have introduced national legislation favoring space commercialization (e.g., in the case of space tourism) in their national law. In the Act of 1998 such states like Australia, provided protection for the activities of the private space sector or the US (significant actor in space), which in the Act of 1984, amended in 1988, introduced certain powers for the private sector. The US and other states, such as Luxemburg, Japan and the United Arab Emirates regulated space resources and space mining issues. Moreover states such as Great Britain, Ukraine, Finland, Portugal and New Zealand regulated their space activities in separate acts or bills. In the commercialization process, apart from ensuring safety and the correctness of operational procedures, what matters is the economic factor (i.e., profitability). Likewise, it is crucial that appropriate government authorities issue commercial spaceports and commercial operating licenses based on an assessment of the operators' ability to ensure public safety and protect property and the environment. A spaceport is not defined by international law or by US domestic law. This term denotes the place from which spacecraft are disembarked, take off, and landing. Each spaceport must be properly adequately equipped and have appropriate facilities. Everyone's business must be insured. In the US, spaceports were initially used only for military purposes, but with time, they also came into private hands. Government spaceports that undertake commercial activities must comply with registration and licensing requirements, as do commercial spaceports (government ports performing government functions are not subject to these regulations). Spaceports can be classified as terrestrial or off-Earth. In space tourism by space shuttle (RLV—Reusable Launch Vehicle), crew, passengers and cargo must be safely returned. The system must be operational and checked for quality; on the other hand, it must bring certain economic benefits. To run such a business, however, numerous procedures are required, in particular, related to transportation (ship equipment, types of routes, insurance for the crew and passengers, emergency procedures, spaceport infrastructure, and the like) [9].

Today there are not many players in the space tourism market. In December 2018 Virgin Galactic conducted its first trip to near space. Two pilots reached an altitude of over 82 kilometers. They made additional test flights with the possibility of taking its first passengers—founder Richard Branson being first of all—to space. Virgin Galactic already sold tickets at a cost between 200–250 thousand USD [10]. On each flight, there are six passengers, who experience several minutes of weightlessness and be afforded incredible views of Earth as the space plane hops into space, before returning to a runway landing. Virgin isn't the only company reaching space. Sharing Amazon CEO Jeff Bezos' dream-come-true adventure was Wally Funk, from the Dallas area, one of 13 female pilots who went through the same tests as NASA's all-male astronaut corps in the early 1960s but never made it into space. Blue Origin, with Bezos at the helm, has been making waves with its reusable New Shepard rocket, which has flown to space 10 times. The Amazon founder was accompanied by a hand-picked group: his brother, an 18-year-old from the Netherlands, and an 82-year-old aviation pioneer from Texas—the youngest and oldest to ever fly in space. Bezos' capsule was completely automated and required no official staff on board for the anticipated 10-minute, up-and-down flight. Blue Origin was shooting for an altitude of roughly 66 miles (106 kilometers), more than 10 miles (16 kilometers) higher than Branson's 11 July ride. The 60-foot (18-meter) booster accelerated to Mach 3 or three times the speed of sound to get the capsule high enough, before separating and aiming for a vertical landing. Blue Origin is working on a massive rocket, New Glenn, to put payloads and people into orbit from Cape Canaveral, Florida [11]. Now the company is gearing up to launch humans with the bigger rocket. Blue Origin plans to start selling tickets for its reusable rocket, with rumors suggesting they will charge a similar price to Virgin. Each launch, like Virgin, will also take six passengers to the edge of space. They will be free to float around the rocket's capsule for several minutes, before returning to Earth via parachute.

Another two private US companies—SpaceX and Boeing—are launching astronauts to orbit. Both are contracted by NASA to take astronauts to the International Space Station (ISS), but the companies also plan to fly their own astronauts, a key step towards making space more accessible and opening up new doors for tourist flights. SpaceX has already begun talking about paid trips to the Moon as early as 2023. Space tourism has been taken much more seriously over the past several years. As we see more humans flying on commercial rockets from the US, space tourism will gain credibility [12].

Space commercialization (used for commercial purposes such as space tourism) will be definitely a future challenge for the regulators. Even today outer space is seen as having "a high potential" for the private sector. There are gaps in regulations on existing governance in space treaties, such as state responsibilities for the actions of their private companies, or lack of definitions (such as space passenger, space objects, space debris, etc.).

Transport services for passengers and payloads with the innovative technology in use is a very promising business for many entities [13].

The question, which arises, is the following: if the private sector of space needs any kind of regulation, or if there is not necessary or even can be an obstacle to undertaking any space activities [14]? One is certain. It will be crucial to construct and introduce such a new legal regime (such as liability or insurance), which can support the private sector [15]. Some observers noticed that a new regulation for space tourism should be based on the Chicago Convention of 1944 regulating Air Navigation [16].

3.3. Concept of Near Space

Although there has been a lot of activity in space over the past sixty years, it is only recently that interest has been aroused in the Earth's upper atmosphere, used by both the private and military sectors. This region (around 18–160 km) is also important for environmental reasons. However, from a legal point of view, it is unclear whether the operations that take place there are covered by aviation conventions or space treaties, particularly with regard to the freedom of overflight that is associated with space operations. Meanwhile, there is a great deal of interest by large corporations in suborbital space tourism and future hypersonic communication; hence the debates as to the legal regime that would apply to such vehicles and operations. It seems necessary, therefore, to establish a boundary line, defining where state sovereignty ends and extraterritorial space begins. Defining an additional legal regime, however, for suborbital flights and other stratospheric activities, can be complicated and hinder business innovation [17].

The proposal to establish a legal regime for near space is related to the right of overflight and territorial sovereignty. In general, the vertical flight of a rocket lasts only a few seconds after launch. Then, after leaving the launcher, the rocket takes a turn and maneuvers to climb into space at an altered angle, which generates the risk of overflying foreign territories. Currently, this risk is covered by insurance only to the extent of liability under space treaties. This problem was debated at the beginning of the space age but then remained undecided for decades, until the debate resumed as to commercial vehicles for suborbital flights. In the near future, all sorts of devices will be built, such as suborbital vehicles, which will often use the near space area. Of course, it could be the country over which such a vehicle is located that will have the right to control it [18].

Near space operations are among the most difficult but can bring great benefits (e.g., placement of equipment providing various types of telecommunications or internet services). For now, the implementation of concrete plans is hampered by the uncertain legal status of the area. Nevertheless, near space operations are the future of aerospace activities. In recent years, thanks to technological advances, it has become possible to perform operations at altitudes of 18 to 100 kilometers. The importance of this fact should not be underestimated, since until now such operations have taken place either at lower altitudes (most civil aviation operations occur below 18 kilometers) or in space (i.e., more than 100 kilometers above sea level).

Recently, near space has once again attracted the attention of investors. Several projects have been announced, including the construction of various types of high-altitude platforms. In 2013, the US company Google X (now simply "X") announced the Loon project, which aims to create an aerial wireless network via balloons placed at an altitude of 18 to 25 kilometers. Similarly, in 2014 Facebook unveiled a project to develop a network of solar-powered devices for areas hith-

erto not covered by the service. Asian-based entities are also actively involved in near space initiatives. For example, the Chinese company Kuang-Chi is developing helium-filled balloons for this space to provide also space tourism [19].

Three factors are receiving increasing attention in the near space issue. First, it is expected that its use will be profitable. Analysis reveals that the market for High Altitude Platform Stations (HAPS) is expected to grow at an annual rate of 8.7% and reach $4.77 billion by 2023. Second, near space offers opportunities for start-ups and new companies (traditional areas of operations such as air and space are overflowing). Third, HAPS are cheaper to launch and operate than satellites [20]. In near space, unmanned aerial vehicles can operate as well. On 3 December 2020, the Ravn X drone, a large unmanned aerial vehicle from the private company Aevum, was shown to the public (via the internet) to serve as the primary stage of a satellite launch system. Its integral part will also be a lightweight, two-stage space rocket (in the role of the second and third segments of the entire launch system). The biggest novelty of this drone is the use of a fully autonomous system—based on a large unmanned carrier platform. The airframe acting as the main segment is nearly 24 meters long and has a wingspan of nearly 20 meters, with a maximum total weight of nearly 25 tons (including payload). The device is powered by two turbojet engines, with which it is expected to reach cruising speeds of up to 925 km/h and altitudes of up to more than 18 km. Its task is to launch light rockets with satellites practically every 180 minutes—including the time it takes to prepare and set up for flight again. The drone can take off and land in virtually any weather on an airstrip about 1.6 km long [21].

3.4. Orbital Tourism

Space tourism issues are not new. They were discussed in many international forums as early as the 1960s. Some believe that a new era of space tourism will soon be upon us. Besides, tourism itself may become a factor in the popularization of the space economy [22]. Transportation services for people and cargo using innovative space technology is a very promising business for many players. Space tourism, on the other hand, is more costly and risky, and requires even more support from governments and also the resolution of safety and compensation issues. The US, no less, has introduced a series of space and near space regulations to stimulate private partners to conduct profitable business based on passenger transportation.

Other observers are still very skeptical and see many challenges for the industry, such as passenger safety and the still high cost of such flights. Current space tourism can be described as travel by very rich people for leisure purposes. There are several different types of space tourism, including orbital, suborbital, and lunar tourism. Between 2001 and 2009, seven space tourists made eight flights aboard the Russian Soyuz spacecraft (the US shuttle has been withdrawn from service). The publicly reported ticket price ranged from 20–25 million dollars [23].

The first space tourist became an American multimillionaire Denis Tito in 2001. He visited the International Space Station (ISS). This modular space station, located in low Earth orbit (400 km), was created through international cooperation between five space agencies: NASA (USA), Roscosmos (Russian Federation), JAXA (Japan), ESA (European Union), and CSA (Canada). The ISS to this day serves as a research laboratory for microgravity and the space environment, where scientific experiments are carried out, including astrobiology, astronomy, meteorology and physics, and other fields. Some space tourists (including Tito) have signed agreements with third parties to conduct certain research activities on the orbiting station. The ISS is scheduled to cease operations in 2030, after which some countries are expected to launch new space stations. The legal regime of the proposed space stations may be similar to that of the ISS [24]. The ISS is being considered as either a destination for space tourists or a break from further travel. Until 2007, space tourism was considered one of the first markets to see commercial spaceflight. Russia, whose spacecraft served the ISS crew and tourists, abandoned the latter service in 2009. It was only after a few years that space tourism attracted the interest of US companies [25].

SpaceX launched a rocket in November 2020, beginning regular commercial flights to the International Space Station. The two companies, Blue Origin and SpaceX, have signed a contract with NASA to transport astronauts to the ISS, but they also plan to hire their own astronauts, a key step toward making space more accessible and opening new doors for tourist flights. The contract extends NASA's trend of relying on private companies to ferry people, cargo, and robotic explorers to space [26].

Although space flight is still an expensive form of travel, experts predict that the situation may soon change, thanks in part to new space vehicles. There have also been opinions that organizing

space transportation and tourism could be handled by international aviation organizations. They have more experience in safety and security regulations (such as technical annexes approved by the states), which restrict aerial operations. Others believe that since space tourism is still a niche activity and is gradually developing through private companies, existing international forums dedicated to space, such as UNCOPUOS, are sufficient. In fact, space tourism, due to its high costs, has no chance of even coming close to air tourism (serving millions of passengers, even indigent ones) for decades to come [27].

3.5. Suborbital Tourism

Suborbital flight (non-orbital) is one type of spaceflight in which a launched vehicle reaches space, but due to the trajectory, it is unable to make a full orbital rotation. In the case of an object launched from Earth, after crossing a minimum of 100 km. Some suborbital flights are used to test spacecraft or launch vehicles intended for later orbital flights. Other vehicles are designed specifically for this type of flight. A typical flight consists of several phases. Assuming inter-continental travel (i.e., the commercial application of this type of flight currently under consideration), first, there is the ascent of the suborbital aircraft to several kilometers (more than the altitude at which a standard aircraft flies). This is followed by a phase of rapid acceleration with the nose of the aircraft pointing almost vertically. The engines are turned off and the resulting speed allows the aircraft to cross the Karman line. The next phase is the one in which the potential recipients are most interested. This is when the plane's free fall and state of weightlessness (lasting several minutes, depending on the flight) occur. The final phase is re-entry into the atmosphere, and landing is usually by glide flight. Tourists taking orbital flights (such as Tito) are called astronauts, while future participants in suborbital flights are already called space tourists [28].

Suborbital flights are much simpler to accomplish than a flight to Mars or the Moon, require fewer resources, and involve much less danger. However, they allow one to cross the conventional boundary of space, experience a state of weightlessness and look down on our planet. The main driving force behind the development of the suborbital flight market was the establishment of the Ansari X Prize. This was a space competition that offered the opportunity to win a $10 million prize to an NGO that would launch a reusable spacecraft, capable of carrying three people, to an altitude of 100 km twice [29].

Until now, only astronauts have been able to travel into space and observe Earth from a new perspective. But all this may change in the next few years with the growing popularity of future space tourism, based on suborbital flights, which reached a six milestone in 2021, following the SpaceX, Blue Origin, and Virgin Galactic missions. It seems that the future of space tourism will be based on suborbital flights, some will fly to the Moon and other celestial bodies provided that multimillionaires will continue to invest in this sector. Anyway, as early as 2019, Swiss investment bank UBS published a report calculating that the industry could be worth $3 billion over the next decade [30].

From a legal perspective, the key issue is whether near space should be treated, as part of air or space, or whether it should be considered to have a separate legal status. In the absence of guidance in international legal instruments, it seems that the most viable approach is to analyze the conventions on air and space law. Although these conventions do not specifically regulate near space, they may provide useful elements for establishing a new legal regime. In general, it is clear that neither international aviation law nor space law will clarify the legal nature of near space. Therefore, it remains to analyze national initiatives. Indeed, the existence of similar laws could be an argument that near space is part of national airspace. Unfortunately, an examination of national laws does not yield a satisfactory result. Only one country, i.e., New Zealand, has passed legislation regulating near space operations (high-altitude activities) in detail. Other countries have dealt only with operations occurring below 20 km and have not answered the question as to the upper limit of their national post-airspace [31].

Air Communications have developed its own international method for managing civil air traffic (Air Traffic Management—ATM). Meanwhile, space communications operate under national regulations; moreover, there are no global regulations for managing traffic between aircraft, and space objects (according to the Outer Space Treaty from 1967). During suborbital operations, the atmospheric flight phase is responsible for most of the flight. For this reason, spacecraft performing suborbital flights are generally considered as aircraft, subject to the International Civil Aviation Organization (ICAO) regulations (technical annexes). In addition, it is expected that the suborbital safety standards being developed will not adversely affect the flights

of other orbital spacecraft. Some private companies are already involved in the training of Space Flight Attendants (SFAs) to ensure the highest standard of care, comfort, and welfare for passengers (according to Outer Space Treaty—astronauts) during flight. However, it will be necessary to establish levels of safety for suborbital operations [32].

As of yet, however, a number of legal issues have not been resolved even in the United States (e.g., the status of tourists or liability for accidents). Space tourism poses challenges to regulatory issues related to restrictions on the use of air and space, the definition of space objects and their legal status, and rules for navigation in the airspace. There is an element of environmental risk or risks from launch and rocket fuels that space tourism may carry, so management of air and space navigation is a major problem for those countries that are involved in the use of space. In addition, there are some security concerns because space is widely used for military purposes.

In order for space tourism to succeed, technical and environmental aspects must be taken into account: many experts speak out against the pollution this industry can produce, developing at a time when we are in a period of increasing climate change. Therefore, a way must be found to make this kind of travel sustainable. Jeff Bezos' flight with Blue Origin used hydrogen and liquid oxygen, which are fuels with a lower environmental impact. Legal problems seem even more difficult. However, since the problems of communication and air tourism have been solved, one can hope for success in the field of space tourism, which, however, requires adequate time and much consultation [33].

Suborbital flights, despite the fact that it is definitely a cheaper alternative to at least flights to Mars, still require a huge amount of money. This has led to the fact that at the moment there are only a few major players in the market [34]. They provide passengers with safety and prepare them for the travel carefully. The passengers are obliged to undergo a mandatory examination to confirm his or her health, and a week of pre-flight training. This training includes a flight simulator and being in a centrifuge to get the body used to the overload. SpaceShipTwo, for example, is capable of carrying two pilots and up to six passengers. During the flight, they will experience a microgravity phenomenon of several minutes, allowing them to feel like astronauts on the ISS. During these few minutes, passengers will be able to leave their seats, which will be moved to increase docking space. Due to the nature of the flight, it will be very important to be able to observe the Earth from the flight deck, which will be viewed through 17 windows. Since 2008, thousands of new passengers have booked such flights. It is predicted that by 2030 space tourism (mainly suborbital) could include five million passengers. This, in turn, could lead to the creation of adequate infrastructure for tourists with hotels and orbital sports clubs or space mobility centers in space [35].

Elon Musk's rival SpaceX has a different approach to suborbital flights. It wants to use them for intercontinental transportation, which will reduce passenger travel time from London to Hong Kong from nearly 22 hours to just over 30 minutes. The new ship will take off from specially built platforms, which will be located at some distance from cities, for example, on the ocean [36]. SpaceX is also preparing to arrange a future trip from New York to Shanghai in 39 minutes; currently, the route is covered by an aircraft in 15 hours. This business (point-to-point travel) will certainly help many passengers in making their long trips shorter and saving time, but it seems to be very expensive. UBS believes that, if the obstacles to point-to-point space travel can be overcome, the service would represent an annual market of more than $20 billion. But some disagree, saying the technology's safety is nowhere close to being reliable or that the travel method doesn't solve key logistical issues to long-haul air travel [37].

3.6. Liability and Insurance

There are two parallel areas of international law applicable to space tourism (orbital and suborbital)—international Aviation law and Space law. It can be said that Aviation law applies if suborbital space tourism is treated as Aviation, and space law if treated as space activity [38]. The nature of suborbital vehicles means that they may be covered by international Aviation law or be excluded from its regulations, depending on the circumstances regarding the design of the vehicle and the nature of the flights performed with the vehicle. This is because international Aviation law is directed only at regulating aircraft but not any vehicle capable of moving through the airspace. In turn, the subject of the provisions of the Treaty on the Principles of the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies ("OST") is outer space, understood as the physical space and activities of states, including their non-governmental entities in such space, and not activities of a specific "space" nature, such

as activities carried out for a specific purpose or using vehicles with specific parameters. Referring to the above considerations regarding suborbital vehicles, it should be considered that suborbital vehicles will not be subject to the provisions of the OST if they do not fly in space. OST in Art. VI makes states internationally responsible for national activities carried out by non-governmental entities, obliging them to authorize and supervise such activities. But the UN treaties do not define what qualifies as a "space object", so it's unclear whether suborbital flight vehicles could qualify as such. Besides, space treaties do not extinguish between the crew and paying passengers (tourists).

One of the important legislative challenges in the regulation of suborbital aviation is the determination of the private-law liability (and insurance) of the operator of a suborbital vehicle. There is no cap of liability, and no opportunity for passengers on third parties to present claims for compensation directly to the operator. Nationals of the launching state may be excluded from presenting the claim under Liability Convention 1972 [39], which is inadequate for a paying passenger (tourist) on board a commercial flight. The system of air law on the contrary is clear and might be applied to international suborbital flights, but this would also present difficulties [40]. This legal gap could either be filled through applying for waiver, as has been introduced in the US national legislation, or through a policy of informed consent by which the traveler agrees into travelling at his/her own risk. The traveler agrees to a waiver of liability of the transporter [41]. Without the proper coverage of risks of orbital or suborbital flights, space tourism development is severely hampered. It seems that international regulation of space flight, including suborbital, is in an earlier stage form of development, which may follow a similar path in the future as the industry grows. In this context, some countries in order to help the growing space business are preparing their own regulations in this area [42].

4. Discussion and Conclusion

Until now, only mostly astronauts have been able to travel into space and observe Earth from a new perspective. But all this may change in the next few years with the growing popularity of future space tourism, based on suborbital flights, which reached a six milestone in 2021, following the SpaceX, Blue Origin, and Virgin Galactic missions. So it seems that the future of space tourism will be based on suborbital flights. The biggest advantage of suborbital flights is the relatively low cost, which makes them have a much larger audience who can afford such a trip. These flights will no longer be seen as just another product for extremely wealthy customers. The relatively low price makes a wide range of people want to realize the desire for space travel, experience the state of microgravity, and observe the Earth from space. Multinational companies that are based around the world may be interested in further fields to use this technology, such as super-fast transportation between distant cities. Suborbital aircraft also offers the possibility of carrying shipments or scientific experiments on their deck. The relatively low cost of such a service would allow dynamic development in the field of research conducted in space, which in turn would result in the development of further technologies. However, today some legal issues resulting from the lack of delimitation of air and space and not clear liability and insurance regulations for space operations seem to be a challenge for law stability in the growing space business environment. However, since the problems of space and air tourism have been solved, one can hope for success in the field of space tourism, which, however, requires adequate time and many consultations by the international community. The unification of international legislation such as technical safety annexes in Air Law can be a good example to follow for the space community.

Conflicts of Interest

The author declares no conflict of interest.

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