

## LEGAL STATUS OF THE CREW IN THE INTERNATIONAL SPACE STATION

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### Abstract

The International Space Station "Alpha", is, at the moment, the most ambitious international scientific co-operation programme to be undertaken.

According to the programme, from the year 2003 six or seven persons will live and work on board the Station with a crew rotation every three months.

In space law, despite the conclusion in 1968 of a specific "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Objects Launched into Outer Space", the norms are not exhaustive and homogenous. The preparation and conduction of manned international flights lead to a series of legal problems concerning personnel, which must be specifically faced by national and international legislation.

Nevertheless, this paper wishes to outline a Legal Status of the Astronaut, as it can be gained from the international rules included in the multilateral agreements on outer space, in the co-operation agreements made by the States for the realisation of common programmes, and in some of the specific national regulations. Certainly, a special attention will be placed on the rules included in the Intergovernmental Agreement (IGA) for the realisation of the International Space Station "Alpha" and in

the relevant Memorandum of Understanding (MOU), in the versions revised in Washington on January 29<sup>th</sup> 1998.

The astronaut has his own qualification, and among the various figures the Station Commander arises, together with a series of control entities created to guarantee the observance of duties and the protection of legitimate rights. The most important innovation arising from the Agreement among the Partner States of the International Space Station and contributing to the configuration of the legal status of the astronaut, is the Code of Conduct, at the moment at the signing of the States. It represents a true agreement among the parties, offering the possibility to develop further rules for the regulation of the life of the space Station crew members.

However, it must be remarked that a development of the norms establishing a status of the astronaut has been achieved, and it can therefore be stated that this figure, being basically considered in a romantic aura as an "envoy of Mankind", is now the beholder of a series of rights and duties.

The legal status of the astronaut, starting from the qualification of the latter, will then consider some special rights (to health, to safety, to privileged communications, to compensation for damages) and the relevant duties (to submit to civil and criminal jurisdiction, to observe the rules established in the code of conduct, the duty of secrecy and protection of the discoveries made in outer space) and finally, the responsibility for any damage caused.

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## 1. Qualification of astronaut

Human sojourn in outer space has increased, from an initial period of a few weeks to a few months, albeit with a regular rotation. The subsequent steps will be the missions towards Mars and the construction of a lunar base.

The astronaut must be a pilot, an engineer, a scientist capable of carrying out a scientific experiment and of knowing not only his vehicle and his work, but also the work of his neighbours in the event of a replacement. The recruiting must be especially strict and respondent to the qualifications established by the Partners.

While in air law a specific discipline exists for the personnel on board, in space law a similar discipline is still in the early stages.

Air law has classified two different kinds of persons on board: the crew on one side and the passengers on the other; this division leads to a different legal consideration, and to a different protection and treatment. First of all, the crew members, according to art. 32 of the Chicago Convention must hold a licence which enables them to carry out the profession<sup>1</sup>. Within the crew itself it is also possible to make a further distinction between the "Commander", to whom the law attributes a particularly relevant *status*<sup>2</sup> and the rest of the crew. In air law passengers do not enjoy any specific rules, they are in fact considered by the discipline established for passengers of other transport systems and by the International Conventions on the responsibility of the carrier<sup>3</sup>.

The riskiness, the hazardousness, and the important value for Mankind of space activities have contributed to the formulation of the definition of the astronauts as "envoys of Mankind" (art. V Outer Space Treaty) in order not to deprive the subjects of their nationality and to allow them to acquire a super-national status. Experience shows that, even in international crews, the astronauts are representatives of their countries and that they cannot be submitted to other legal obligations other than those expressed in the Outer Space

Treaty and in other sources of space law<sup>4</sup>. The Astronaut does not benefit of a sort of diplomatic immunity, conferred by a higher authority, the contents of which are not clearly expressed. The qualification must not be overvalued and must be considered in connection with the second section of the article, where the protection of the life and health of the Astronaut is mentioned. The expression "envoys of Mankind" is to be considered in the context of the operations of assistance and rescue to which all the States are committed<sup>5</sup>.

The choice of the term was rather controversial and varied in the same U.N. Outer Space Treaties<sup>6</sup>. In actual fact, these terms have been used indifferently to designate all the persons on board or connected to the space object in space or on celestial bodies<sup>7</sup>.

In conclusion, the term "astronaut", albeit appearing rather archaic and ready for substitution by the more generic term "person"<sup>8</sup> - intended in the previously expressed sense - seems to be more characteristic. However, it is necessary to distinguish the different categories of the astronauts, such as the Commander, various kinds of crew, scientists and researchers, passengers and visitors having different characteristics, obligations and responsibilities.

A first division is to be made between crew and passengers. The latter do not enjoy a particular status because space law does not know the liability for damage to transported persons or objects, caused by activities of space transportation. Some cases have been taken into consideration in jurisprudence in the United States<sup>9</sup>, but it cannot be stated that a regime of private law has been established on the matter. When the cases of space transportation will be more frequent, even with the advent of the aerospace plane and the opening to private operators of the market of this sector for launching and transportation, a discipline of this sort of responsibility may be foreseen in the transportation contracts, based on the Warsaw Convention, its modifying protocols and the eventual European Community regulations<sup>10</sup>.

On the contrary, concerning the crew of a space vehicle there are considerable domestic and international laws.

In the Soviet Union the following titles for the crew members have been accepted: Commander of the flight, flight engineer, and researcher-cosmonaut. The international crew flying in an international program made up of foreign citizens is considered in the category of researcher-cosmonaut<sup>11</sup>.

American legislation<sup>12</sup> carries out a subdivision of the personnel on board which has been taken up in the agreements stipulated with other countries for the development of shared programmes. The **Commander** is a professional NASA astronaut. He holds absolute authority to decide for any action he might consider necessary for the respect of discipline and for safety on board. The **pilot**, who is also a professional astronaut, is employed in the flight operations and he can, in case of need, replace the Commander. The **mission specialist** is inserted in the shuttle systems connected to the pay load, he takes part in the planning of the mission and he is responsible for global co-ordination of the shuttle and the payloads. The **payload specialist** is not part of the flight crew, he is often a researcher conducting an experiment in close contact with the research centre on Earth to whose command he is submitted<sup>13</sup>.

The joint flight Apollo-Soyouz of July 17 1975 required the development of some special rules<sup>14</sup>.

At the beginning of the Seventies the co-operation between the US government and Europe began, for the realisation of the transportation of the European **Spacelab**, a manned pressurised laboratory in outer space for the conduction of scientific experiments<sup>15</sup>, by the American **Shuttle**. An Intergovernmental Agreement (IGA) and an ESA/NASA Memorandum dated 1973<sup>16</sup> regulated the relations between the US government and Europe. The only disposition concerning astronauts is included in art. 7 of the Spacelab IGA:

"The Government of the United States of America will provide Spacelab flight crew opportunity to nationals of the European partners in connection with their space missions involving a Spacelab ... a European crew member will be included in the flight crew of the first Spacelab flight". The first flight of the European astronaut, German Ulf Merbold, took place in 1983.

The Spacelab was considered as an integral part of the USA Shuttle, and it was therefore not possible to obtain a separate registration for the shuttle and consequently the German astronaut was submitted to the American legislation.

## 2. Astronaut in ISS and the code of conduct

A different policy was adopted by the Partner States with reference to the participation of their astronauts to the International Space Station. The International Space Station "Alpha" is, however, the most ambitious international scientific co-operation programme to be undertaken. It groups five space agencies representing: the United States (NASA), Russia (RKA), Canada (CSA), Japan (NASDA) and the European Space Agency (ESA which represents Europe in this project<sup>17</sup>.)

In reply to the invitation of President Reagan to take part in the ISS project, the ESA established that "the Agency shall be responsible for tasks relating to the astronauts (selection, training and development of equipment)"<sup>18</sup>. This produced an Astronaut's Handbook specifying the criteria for the selection, the training and the qualification of the astronauts who must be submitted to a "code of conduct" which will be an integral part of the contract with the Agency. The Astronauts will be submitted to the authority of the "flight commander" of the manned Station. All these provisions were stressed in the ESA Resolution on European Astronaut Policy of June 28th 1989 which definitely created, with the European astronauts, an "ESA Staff members". The ESA Astronauts Centre (EAC) is in Germany, near Cologne, and

the relations between ESA and Germany are regulated by the Agreement signed on May 10 1990 19.

The arrival on December 17th 1993 of Russia in the Space Station, renamed "Alpha" instead of its first name "Freedom", led to a revision of the first **Intergovernmental Agreement** on September 29 1988. The works ended with the stipulation of an Intergovernmental Agreement among all the member Partners on January 29 1998, and of the relevant MOUs between the American Agency and the related agencies of the Partner States which include more detailed regulations for the functioning of the Station. The resolution, adopted on March 25 1998 by the ESA stressed the creation of a Unique European Body of astronauts according to which, at the latest, from June 30th 2000 the member States of the ESA must dismantle their national programmes concerning Astronauts<sup>20</sup>.

From 1998 to the year 2002, 16 national and ESA mission opportunities, including the COF launch, have been planned. The European body of astronauts foresees for the year 2000 to be made up of 16 members, however the number might vary.

At present two astronauts per country have been selected and they will alternate every three months in orbit<sup>21</sup>.

The new 1998 approach was characterised by the creation of many bodies: the "Multilateral Crew Operations Panel", a body for multilateral medical policies and a body for human research.

The basic principles concerning jurisdiction and control remain unchanged. Art. 11 of the 1998 IGA states that: "Each Partner has the right to provide qualified personnel to serve on an equitable basis as Space Station crew members". The selections will take place in accordance with procedures provided in the MOUs and implementing agreements.

The second comma of the same article names the developing "**Code of Conduct**", which is in the last discussion and is to be approved definitely by each Partner. Each Partner shall ensure that its

crew members observe the Code of Conduct.

In the Memorandum between ESA and NASA, art. 11, dedicated to the Space Station crew, establishes the rules, based on the principle of genuine partnership, for the recruitment of personnel and for the utilisation of the latter during the development of the programme.

Once completed, the Station will have a crew made up of seven members; the RKA has ensured three flight opportunities for its crew, while the remaining four are for the other agencies. The European partner will send out its own astronaut in the year 2003. The MOU provides for the creation of a Multilateral Co-ordination Board (MCB) which will ensure the co-ordination of the activities of the Agencies related to the operation and utilisation of the Space Station, and also of a Multilateral Crew Operations Panel (MCOP), which will be the primary forum for the top-level co-ordination and resolution of Space Station crew<sup>22</sup>. NASA, ESA and the other partners will establish a Multilateral Medical Policy Board (MMPB) to provide co-ordination and oversight of crew health issues<sup>23</sup>.

According to art. 11 of the IGA and to art 11.8 of the Memoranda stipulated by NASA and the relevant co-operating Agencies, the parties are developing the **ISS Crew Code of Conduct** which must be approved and signed by the astronaut and the co-operating Agency.

The code is to be applied to each crew member, that is to say each person having received the approval for the flight in the ISS, including the visiting crew, from the moment of assignment until the end of the mission, including all the related post-flight activities. The code of conduct sets forth the minimum standards of conduct applicable, but these may be subject to further requirements from the national Agency or from governmental bodies.

A first group of regulations, included in the "General Standards", forbids the crew members to use undue preferential treatment in favour of anybody or to abuse of their position in order to gain financial benefits for themselves or for other persons.

Crew members may, in accordance with the Earth to Orbit Vehicle (ETOV), take small personal objects on board as mementoes.

Crew members must submit to all the regulations established for the Station programme, to the operational procedures and, generally speaking, to the management policies, including those concerning health and safety. They are also subject to all the disciplinary rules developed and maintained by the MCOP. There are also rules concerning the secrecy of information concerning health, safety and research.

Special attention is placed on the protection of the human research subjects, which must be approved by the Human Research Multilateral Review Board (HRMRB) and to which the subjects must formally consent in writing. The research must not endanger the life and the safety of the subjects. The consent or the authorisation may be revoked at any time by the person, by the HRMRB and by the Station Commander.

Section VII of the Code deals in detail with the authority of the Station Commander. This authority is extended to all the elements of the Station in orbit and to those which might be added during its development; to all the personnel on board and in orbit close to the Station's elements; to the payloads, to the equipment, the data, the personal effects and to all activities taking place on board. During the joint ISS/ETOV operations, the Station Commander must co-operate for the success of the operations and with the Commander of the ETOV.

In agreement with the decisional authority of the Lead Flight Director, the Station Commander may carry out any necessary action for the enforcement of order and discipline; for the health and safety of all personnel, including the necessary actions for crew rescue and return; to reinforce the safety of operations and data utilisation and finally for the protection of the elements of the Station.

In order to achieve these ends, the Commander may use any reasonable means, including physical force, and he may submit any person on board to

personal restrictions if necessary for the safety of the elements of the Station or of the personnel. Issues concerning the use of such authority are to be referred to the Lead Flight Director.

A chain of command is established, in which the Commander is the highest authority among all crew members. Matters excluded from the authority of the Commander are to be submitted to the authority of the Lead Flight Director.

Should the Commander no longer be capable of performing his duties, the decision concerning his relief from command, and the succession of the backup Commander, must be taken by the Lead Flight Director and discussed with the Mission Management Team.

The dispositions of the Code of Conduct must be an integral part of the contractual dispositions of the astronaut, with reference both to the contract binding him the (inter)governmental Agency he belongs to, and to the access contract which is to be concluded by the organisation employing him and the (inter)governmental agency ensuring the transportation from ground to the Station.

Therefore, a certain amount of rights and duties of the astronaut arise, which we will shortly examine and which derive from general international law, especially humanitarian law, from international space law, from the agreements stipulated for the implementation of joint ventures with various States, from the code of conduct and finally from the specific internal regulations.

### 3. Rights of the Astronaut

#### 3.a Right to health :

Mention must be made of the **right to health** of the astronaut, deriving first of all from international humanitarian law. In 1970 the World Health Organisation stated the principle that human health must be recognised as an essential primary benefit and that "health is a condition of complete physical, mental and social well-being and that it does not only consist in the lack of illness"<sup>24</sup>. The right is recovered in the Universal Declaration of the Rights of

Mankind (art. 25), by the 1966 UN Pacts on Human Rights, by the 1979 UN Convention on the Elimination of all Forms of Discrimination against Women (arts. 11 and 12) and in many conventions on work law. The Pacts on political rights, adopted in New York by the General Assembly of the UN on December 16 1966, establish in art. 6 that the right to live is inherent to the person, and in art. 7 that "nobody may be subject, without his consent, to a medical or scientific experiment". This concept was re-introduced in the above mentioned code of conduct, in sector VI (Protection of Human Research Subjects)<sup>25</sup>.

The Astronaut, being obliged- due to special conditions- to work in a restricted environment, in absence of gravity and subject to accelerations, has a special right to the protection of his health and he has the right to consent to experiments on humans carried out in space. Protection must begin **before the launch**, with a selection, based on criteria established by the Parties who must consider the consequences of the environment on the physique and mind of the astronaut, under the control of the Multilateral Crew Operations Panel (MCOP). A European Astronaut Centre is to be set up near Cologne, in Germany, and the European astronauts will be trained partly in Houston and partly in the European Centre.

The protection of the astronaut's health continues on board and special precautions must be taken in order to obviate the consequences of the absence of gravity on a human. In fact, a loss of minerals, and especially of calcium, has been ascertained, with a negative balance for the skeleton and the somatic muscle structure, with signs of muscular atrophy. The only useful remedy was physical exercise (at least two hours a day) and an appropriate timing the length of the stay in outer space<sup>26</sup>. The absence of gravity effects heart acceleration, nausea, the blood mass moving to the brain creating the "full Moon face" effect. Another danger for the astronaut's health comes from the potential dangerous effects of daily cosmic radiation and of the occasional "rain-fall" protons. This effect, which could be irreversible in a

female due to the fact that her genetic heritage is not renewable, is obviated by the application of effective protective screening on the outer surface of all space vehicles<sup>27</sup>. The cardiovascular problems are very important, above all on return, and in the period of quarantine the astronauts are subjected to countermeasures in arranged medical centres<sup>28</sup>.

The psychological health of the astronaut is also to be protected, because it could be seriously compromised due the prolonged stay in restricted space, without any reference points and in promiscuity.

Section V (Physical and Information Security Guidelines) of the ISS code of conduct forbids the disclosure of personal information on crew members, including medical, financial or other private information. Should information of this kind need to be transmitted to Earth it should be considered as classified information..

In order to co-ordinate and oversee the health of the crew in the international Space Station, a Multilateral Medical Policy Board (MMPB) has been created, supported by a Multilateral Space Medical Operations Working Group (MMOWG) which will be the co-ordinating group for issues concerning the health of the crew.

Each country will be financially responsible for the expenses concerning training, instruction and equipment, and for all the necessary facilities for the safeguard of health.

In order to avoid mutual harmful contamination of environment on Earth, Moon and other celestial bodies, as established by the Outer Space Treaty (art. IX), the States are obliged to keep the used persons and equipment in quarantine<sup>29</sup>.

### 3.b Right to safety

Different rules of space law set forth special obligations to ensure safety and the safekeeping of the life and health of the astronauts who, as "envoys of Mankind" enjoy a special protection.

Many detailed rules regulate the issue of the **rescue and return** of the astronauts in the event of an accident. life danger or emergency landing outside the

territorial limits of the launching State. The obligations, already established in art. V of the Outer Space Treaty, have been recovered and developed in the Agreement on the Rescue of Astronauts, the Return of Astronauts and Return of Objects Launched into Outer Space, dated April 22 1968<sup>30</sup>. The aim of the Agreement is to render all possible assistance to astronauts in danger and to achieve their prompt and safe return.

The Outer Space Treaty establishes the return to "the State of registry of their space vehicle", while the Agreement on Rescue foresees the return to the "launching authority". Neither consider the State of citizenship, probably because it is often an international crew, and furthermore because the launching State is more competent for the rescue and for the provision of all the necessary measures. However, a conflict of jurisdiction over the astronaut could arise, should the astronaut be in a territory different from the launching State<sup>31</sup>.

In order to carry out an immediate procedure for the rescue and return of the astronaut, it is necessary to place appropriate identification symbols on his space suit and in his documents.

The assistance foreseen by the Agreement is only for an emergency occurring in territory during landing, but not during the flight phase. Art. V of the Outer Space Treaty concerns the co-operation for any possible assistance to the astronauts in danger in outer space. Naturally, the assistance and rescue operations in outer space are extremely dangerous and technically difficult.

The safety of Astronauts is also mentioned in the last paragraph of art V of the Outer Space Treaty, where it is established that States Parties shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the Moon and other celestial bodies, which could constitute a danger to the life or health of astronauts. For example, they could be phenomena relevant to solar activity or the danger of an increase in radiation.

The safety of the astronaut has also been considered in the Agreement governing the Activities of States on the Moon and Other Celestial Bodies of December 18 1979. Art. 12.3 sets forth that in the event of an emergency involving a threat to human life, States Parties may use the equipment, vehicles, installations, facilities or supplies of other States Parties on the Moon. The involved State Party and the Secretary General of the UN must be informed immediately. The practical fulfilling of the above mentioned provision may cause considerable controversies for the issue of the protection of the national interests of the registering State<sup>32</sup>.

Only wider principles have been established until now for the crew's safety. The awareness of the necessity to regulate the situation generically was stated by the proposal presented by the United Kingdom and Czechoslovakia to the Legal Subcommittee of COPUOS, suggesting the extension of international co-operation in the even of accidents or critical situations on board a manned space station<sup>33</sup>.

Only in the programmes for international co-operation for the development of joint systems have technical emergency and rescue means been foreseen. For the Alpha Space Station, it has been foreseen that in the event of an emergency the crew members can return to Earth on board the "rescue dinghy", a Russian Soyouz capsule permanently moored nearby the Station. Starting from 2003, the future NASA Crew Rescue Vehicle (CRV) will remain moored at the Station and it will be able to return six astronauts at a time back to Earth, in case of emergency. NASA and ESA are studying the joint realisation of a CRV.

Point 10.4 of art. 10 of the MOU on the ISS states that "NASA, ESA and the other partners will establish contingency procedures for on-orbit emergencies to protect the safety of the Space Station and its crew." and the partners will also establish a process for the consultations in the event of on-orbit emergencies. In the event of a particular emergency, "NASA will have the responsibility for making

decisions necessary to protect the Safety of the Space Station and its crew.

To complete the measures to be taken to ensure safety in space, the necessity of a legal protection of communications between space and Earth must be mentioned. Optimising communications between a space object and the control centre in Earth is already extremely important in normal conditions. The six crew members of the Station will carry out piloting and research functions on board the Station. They shall keep a permanent telecommunication connection with the mission control centre in Houston, with the European Centre and with the various laboratories participating in the experiments, and they shall work interacting with the scientist on Earth. In emergency conditions the efficiency of communications is an extremely important factor. The assignment of special emergency frequencies is already established by the ITU Radio Regulations. The necessity to assign special protected frequencies for the communication between manned space objects and Earth is to be considered.

### 3.c Right to compensation for damage

The right to compensation for damage, which the astronaut may suffer on his person or on his properties while carrying out the mission from the launching to the landing, may be considered from different points of view.

The damage may be caused by an accident, elsewhere than on the surface of the Earth, caused by a space object of a **Third launching State** not participating in the mission. In this case, the regime of international liability established by the 1972 Convention on Liability<sup>34</sup> becomes effective. As it is known, the Convention establishes a double regime of liability: an objective absolute liability, that is to say without having to invoke fault, and further more unlimited, if the damage is caused on the surface of the Earth or to aircraft flight (art. II). and a liability for fault if the damage is caused, elsewhere than on the surface of the Earth to a space object or to

the persons or property on board such a space object (art. III).

To the commissive liability for national space activities, according to art. VI of the Outer Space Treaty, one must add the liability for activities carried out by non-governmental entities, that is to say private parties, who shall require authorisation and continuing supervision by the national State<sup>35</sup>.

The astronaut and his State of nationality, to which according to the Convention he may turn for diplomatic action for the compensation request (art. VIII), may not enjoy the waiver of the onus of the proof of the fault of the State whose space object caused the damage, except if the damage to the astronaut is caused on the surface of the Earth. In fact, if the damage has been caused, as is most probable, by another space object in air space or in outer space, the victims might find it difficult to prove fault or negligence. It has been suggested in doctrine that, as established in art. IV, that is to say when more States have caused damage to another State in outer space, the system of equal apportionment of the burden of compensation may be adopted between the two launching States: the author and the victim of the damage<sup>36</sup>.

Even if art. III exclusively mentions damage caused "on board" a space object, it would be preferable to adopt an extensive interpretation in order not to exclude damage eventually caused by a space object of another State to an astronaut outside his space object in outer space.

The Convention excludes liability for damage caused to **nationals of the launching State** or foreign nationals participating in the operation of that space object from the time of its launching to its descent (art. VII). Therefore, if the astronaut having suffered the damage is a national of the launching State, he may not make use of the Convention, but he may use - for the compensation by his own State - internal remedies according to the modalities established by national law and by the employment contracts. If, instead, he is a national of one of the States participating in the operations, it is foreseeable that in the co-operation



agreements with the national State or the employment contracts, all the modalities for compensation have been established, and therefore the astronaut faces an "accepted" risk (art. V.2).

However, the above mentioned rule for the safeguard of eventual agreements made between the Parties, is still valid. The IGA concluded between the States participating in the realisation of the International Space Station foresees a **cross-waiver on liability actions.**

The complex art. 16 of the IGA establishes the clause for cross-waiver. This clause foresees that each member State shall waive the presentation of the compensation claim against another Partner State, against its Co-operating Agency or the entities connected, for any damage which might derive from the activities on the Space Station. The cross-waiver is also extended to the compensation claims for damage to the involved entities, to contractors and sub-contractors involved in the activities of the Space Station. The astronaut, involved in the operations on the International Space Station and damaged during the carrying out of such activities, may only make use of internal possibilities established by the norms of his national State or by the norms undersigned in the employment contract.

The cross-waiver of liability also protects the astronauts when they are active and not passive subjects of the damage caused to third parties and therefore when they have the duty to give compensation. In general, the Agencies undertake all liability for damage caused by their astronauts. However, if the damage is caused by wilful misconduct, according to art. 16, the cross-waiver clause may not be applied<sup>37</sup>.

#### **4. The duties of the Astronaut**

##### **4.a Duty to observe civil jurisdiction**

"**Jurisdiction**" and "**control**" are terms which are not exclusively used in space law, but also in international law and in the domestic law of many countries.

According to an opinion to be shared, the term jurisdiction is to be referred to the exercise not only of judicial

power, but also to legislative and executive power in respect of the personnel and objects in outer space and on celestial bodies<sup>38</sup>.

The term "control", considered as an element of jurisdiction, has a more technical meaning, referring to the right of the State to guide and technically supervise, without interference, the object and the crew for the achievement of the mission of exploration and use of outer space<sup>39</sup>.

Art. VIII of the Outer Space Treaty determines the connection between the State, the space object and the personnel under its jurisdiction and control. The article states: "A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body". The 1975 Convention of Registration of Objects Launched into Outer Space states that the "launching State", meaning the State which launches or procures the launching of a space object or a State from whose territory or facility a space object is launched, is obliged to register the space object in an appropriate national registry and in the registry of the Secretary General of the United Nations<sup>40</sup>. When there are two or more launching States, they shall jointly determine which one of them shall register the object (art. II.2) and therefore carry out jurisdiction and control over the object and the personnel thereof.

If the object is launched by an international Organisation, it must be registered in the registry of the Organisation, if the latter has accepted the rights and obligations of the Convention of Registration, and if a majority of the States members of the Organisation are States Parties to the Convention on Registration (art. VII).

The Outer Space Treaty, adopting the criterion of "territoriality" or "quasi-territoriality" seems to exclude the concurrent application of the criterion of "nationality".

The concept of territoriality is insufficient, therefore, because art. VIII of the Outer Space Treaty mentions the

exercise of jurisdiction over "any personnel thereof, while in outer space or on a celestial body", and therefore also outside the space object. Since it refers to all the personnel thereof, it does not consider the national origin of the crew members.

Art. 12 of the Moon Agreement specifies that " States Parties shall retain jurisdiction and control over their personnel, vehicles, equipment, facilities, stations and installations on the Moon"<sup>41</sup>.

**Conflicts on the exercise of jurisdiction** could arise for those subjects being under the jurisdiction and control of a specific State and being, for various reasons, on installations belonging to another State. The only hypothesis foreseen by the multilateral agreements is the right to visit space objects on the Moon (art. XX of the Outer Space Treaty and art. 15.1 of the Moon Agreement). the visiting astronauts, representing the States wishing to verify the activities carried out on board, could be placed under the jurisdiction of both States. In this case, however, the obligation to give a reasonable advance notice of a projected visit in order to arrange the necessary precautions, made by the receiving State, for the safety of the visitors and for the avoidance of disturbance of the normal operations on the installations, lead to consider a prevalence of "quasi-territorial" jurisdiction of the launching and receiving State over the "functional jurisdiction" of the State sending the visiting astronauts<sup>42</sup>.

Another concurrent jurisdiction could arise in the event of an emergency or forced landing in the territory of another State or in high seas or in another free zone.

In the event of joint launchings, the agreement concluded between the parties will be most decisive. If it is the case of a payload on board a shuttle which intends to detach itself and remain independent in space, this must be registered separately from the shuttle and the personnel on board is under the jurisdiction of the State of registry.

The United States did not acknowledge, instead, the individuality of the Spacelab separated from the Shuttle: they did not allow the registration of the

laboratory by Europe, considering it to be a consistent element, a payload of the shuttle. In the MOU <sup>43</sup>.stipulated between NASA and ESRO on September 24th 1973, art. XI.3 establishes that, at least for the issue concerning the control of the mission, the safety of the space object and for all that concerns navigation, the shuttle commander being American, NASA has jurisdiction and control over the persons and properties on board. For other issues, the foreign State or the international organisation may have jurisdiction and control<sup>44</sup>.

Art. II of the Convention on Registration foresees that, where there are two or more launching they shall jointly determine which one of them shall register the object. In the Intergovernmental Agreement, even in the 1998 version, the issue of registration is faced and it is established in art. 5.1 that each Partner State and ESA, for the European States, shall register as space objects the flight elements produced for the construction of the International Space Station.

Where a space object is launched by an International Intergovernmental Organisation alone, par. 1 of the art.II of Registration Convention applies. The Organisation, when considering the registration of the space object, should consider also the question as to which of its member States could most appropriately exercise jurisdiction over the space object and its personnel. When the launch is jointly with one or more States, the Organisation and the States may enter into appropriate agreement on the jurisdiction and control over the space object and any personnel thereof<sup>45</sup>

The exercise of jurisdiction in the ISS finds its specific regulation in art. 5.2 of the IGA which foresees that each Partner shall retain jurisdiction and control over the elements it registers. The Partner States extend their jurisdiction over the personnel, within or on the Space Station, who are their nationals<sup>46</sup>. The IGA, adopting both criteria, that is to say the one we may define as "quasi territoriality" (exercise of jurisdiction over the registered elements) and the criterion of nationality (exercise of jurisdiction over their own nationals.

wherever they may be positioned, either in or on the Space Station), fosters possible conflicts of rules in the permanent base, made up of more elements, manned by people of different nationalities who must live and work together. Consider the central living module, supplied by the USA, where a mixed crew will live. Once again, in order to avoid the obstacle, the IGA refers to subsequent agreements to be stipulated between the parties, to the MOUs and to other transactions, for the establishment of more specific norms for the exercise of jurisdiction and control. However, the effort made by the draftsmen of the IGA, for a uniform regime, to be defined and accepted by all the Partner States, is to be remarked. The attempt is to avoid all possible jurisdiction conflicts between partners.

As for the personnel on board, in all those cases contemplated by the Code of Conduct where there could be a concurrence between the application of the rules of the State of registry of the ISS element and the rules of the national State of the crew member, it will be necessary, as a preventive measure, to clarify the exercise of simultaneous competence, by establishing priorities. A regime similar to the NATO Treaty on the status of armed forces abroad<sup>47</sup> stipulated in London in 1951, could be considered. It establishes that, in the concurrence of two jurisdictions, the national State has priority for issues concerning prejudice against persons or property of the national State, both for issues due to an act or negligence caused in the exercise of duty; in all other cases, the competent State is the State of sojourn.

Finally, the IGA offers no solution to the problem of jurisdiction to be applied to the crew members supplied by another Partner State, who are not citizens of any of the member States or who are nationals of more States. The provisions of the IGA do not consider the astronauts visiting the Station for a short period, for example in a capsule docked to the Station during crew rotation, because these are hardly ever nationals of the States who sent them.

#### 4.b The duty to submit to criminal jurisdiction

The rule on the exercise of jurisdiction determined generally by art. VIII of the Outer Space Treaty, also extends to the criminal jurisdiction according to which each State having registered a space object has criminal jurisdiction over the object itself and the personnel thereof.

In the event of a crime taking place on board the ISS, the criminal jurisdiction of the State of registry of the element might concur with the jurisdiction of the national State of the author of the crime, and therefore it could be necessary to define a primary jurisdiction. Criminal jurisdiction is taken into consideration by art. 22 of the IGA. By establishing the connection between the State and the alleged perpetrator in citizenship, art. 22 establishes that "Canada, the European Partner States, Japan, Russia, and the United States may exercise criminal jurisdiction over personnel in or on any flight element who are their respective nationals". In the previous version of art. 22 of the 1988 IGA, primary jurisdiction was given to the United States if the crime had been committed in any element and by a subject of any nationality, if the safety of the Station or of a crew member had been prejudiced. With the participation of Russia to the program it obviously became urgent to amend this article.

The new art. 22 establishes any of the Partner States, except the national State, may exercise criminal jurisdiction over the alleged perpetrator only if, having suffered prejudice for the life or safety of one of its nationals or damage to one of its elements due to a crime committed in orbit or within its element, it has immediately consulted with the Partner State whose national is the alleged perpetrator concerning their respective prosecutorial interests. These, however, may not be opened before 90 days or a reasonable amount of time to be decided between the parties, and if the State concurs in such exercise of criminal jurisdiction or fails to provide assurances that it will submit the case to its competent authorities for the purpose of prosecution. The main aim of the parties is not to leave a crime committed on board unpunished.

The extradition of the alleged perpetrator may be requested if an extradition treaty exists between the two States, otherwise the Parties may consider the IGA as a legal basis for extradition.

The last paragraph of art. 22 reconciles the dispositions of the Code of Conduct with the disposition of art. 22. As mentioned above, the code of conduct establishes a chain of command lead by the Commander. The latter may carry out any action he considers necessary in order to achieve order and discipline and the other members have the duty to observe these measures. In order to safeguard the health and safety of the personnel, even in the event of rescue and return of the crew, but also to protect the safety of operations and the utilisation of data, the Commander may use any reasonable measure, including physical force and he may place any person on board under personal restrictions.

#### 4.c The duty to protect intellectual property

The astronauts are the first persons to have access to the data concerning new discoveries made in the Spacelabs in outer space and they have the duty to respect all the established procedures for the protection of the intellectual property of the users of the Space Station.

It is useful to examine which regime the IGA has established for the protection of the intellectual property of inventions made in the laboratories of the Station, which is, par excellence, an international environment.

The draftsmen of the Agreement faced the difficult task of protecting the intellectual property of the inventor reconciling the application of different concepts such as the "first to invent" and the "first to file an application for patent" which are at the basis of the different systems foreseen by the regulations of the Partner States<sup>48</sup>.

The negotiators of the IGA identified some common principles and art. 21, dedicated to intellectual property, seems to prefer the connection determined by "territoriality". For purposes of intellectual property law each State shall consider an invention made in its own registered

element as having occurred on its territory, and for the ESA element each European Partner State shall deem the activity as having occurred within its territory. The protection of the rights of intellectual property in all the European Partner States has been agreed upon, once protection for one of these has been obtained, and also the suspension of judgements for infringement in case of a previous appeal has been forwarded in another Partner State (principle of the first appeal). Even in the event of the participation of another Partner State, of its Co-operating Agency or related entities, in an activity taking place in the element in or on any other Partner State's element, the legislation of the latter shall be applied (art. 22.2). The patent application for the invention made by an astronaut of a nationality other than the State having registered the element where the discovery occurred, must be forwarded in first issue to the registry State of such element and in observance of its laws.

Paragraph 3 of the same article establishes that if the inventor is not a national or resident of the State in whose element the invention occurred, he may subsequently forward a patent application in another Partner State.

A first remark to be made on such a regime of protection is that it is possible to foresee conflicts between the laws establishing different systems and procedures for protection, since the automatic acknowledgement of the patent is only contemplated by the European partners. The latter must still define a mechanism for the practice of the disposition of the IGA concerning the inventions made in the ESA laboratory. A system ensuring complete secrecy of information, of the data previously supplied by the experimenters for safety reasons, and of the data acquired on board and subsequently transmitted to the ground is not guaranteed. Finally, the issue concerning the property of the rights on the technical information deriving from the same joint venture is still unsolved.

#### Conclusions

In an era where manned flights or the positioning in orbit of objects or complex space stations, being the fruit of a co-operation effort among various States, have become more and more frequent, we have realised that human presence in outer space is to be regulated with precise dispositions to solve the new situations the astronaut might have to face.

It is not easy to reconcile the different domestic regulations of the veteran space States who faced the matter long ago and those of countries new to these activities, especially when they have joined for a co-operative effort such as the European one. It is neither easy to reconcile the new situations the astronaut might have to face, because these are the first attempts, such as the International Space Station, to realise co-operative programs in space and carried out by an increasing number of States.

The conflicts between the different laws to be applied, justified by a relationship of nationality or jurisdiction over the registered object and persons therein, must be solved equally, with the aim of a positive result of the mission, of the safeguard of the basic human rights, of equality which the States must ensure in the carrying out of the joint program and finally of the progress of the mission for peaceful ends and for the benefit of all Mankind.

However, it must be remarked that a development of the norms establishing a status of the astronaut has been achieved, and it can therefore be stated that this figure, being basically considered in a romantic aura as an "envoy of Mankind" is now the beholder of a series of rights and duties.

We have tried to reconstruct a legal status determined principally by the norms of international outer space law and by the existing domestic laws. The dispositions of the Outer Space Treaty, of the Rescue Agreement and the Convention on Registration are pre-eminent. However, the agreements concluded between Partner States participating in international space flights, have greatly helped the development of a more specific regulation: in particular, the regulations issued in

occasion of the joint launching of the Spacelab in the Shuttle and the agreements which are being concluded between the parties for the realisation of the International Space Station.

The astronaut has his own qualification, and among the various figures the Station Commander arises, together with a series of control entities created to guarantee the observance of duties and the protection of legitimate rights.

The astronaut's right to health and safety derives from a humanitarian appeal, whereas economic and social needs have led to the characterisation of the right to damage compensation and the duty to protect intellectual property.

As for the exercise of civil and criminal jurisdiction over the crew, instead of identifying uniform law rules, the agreements refer to criteria which are at times conflicting, and therefore still arguable, relating to the applicable law.

The most important innovation arising from the Agreement among the Partner States of the International Space Station and contributing to the configuration of the status of the astronaut, is the Code of Conduct. It represents a true agreement among the parties, offering the possibility to develop further rules for the regulation of the life of the space Station crew members.

We hope the Code of Conduct will be signed and ratified by the parties, at least before the arrival of the first Russian-American crew, made up of three members, in the Russian module.

#### NOTES

<sup>1</sup>Convention on Civil Aviation, Chicago, December 7th 1944 and Convention on Air Transportation, Warsaw, October 12th 1929, see the texts in BALLARINO BUSTI, *Diritto aeronautico e spaziale*, Milan 1988

<sup>2</sup>VENET, *Statut juridique et responsabilités du Commandant de bord*, in *Rev. Franç. de droit aérien et spatial*, 1990, p. 169; PESTEL, *Le commandant de bord et la sureté*, in *Rev. Franç. de droit aérien et spatial*, 1997, p. 5; KANE-PYNE, *The legal status and liability of the Co-pilot*, part I, in *Air & Space Law*, 1994, p. 290, part II in *Air & Space Law*, 1995, p. 1

<sup>3</sup>KAYSER, *Aux confins de l'air et de l'espace, d'accursius à l'avion spatial*, in *Annals of Air and Space Law*, 1994, p. 479; CATALANO SGROSSO, *Must the special typology of aerospace planes lead to the supplementation of the rules of the Outer Space Treaty?* in *Proc. of the 40th Colloquium on the Law of Outer Space*, Turin 1997, p. 402

<sup>4</sup>VERESCHETIN, *Legal Status of international Space Crews*, in *Annals of Air and Space Law* 1978, p. 545

<sup>5</sup>LAFFERRANDERIE, *Pour une charte de l'Astronaute*, in *Annals of Air and Space Law* 1987, p. 263

<sup>6</sup>CATALANO SGROSSO, *Legal Status, Rights and Obligations of the crew in Space*, in *Journal of Space Law* 1998, vol.26, n. 2, p.163; DIEDIRICKS VERSCHOOR, *Quelques réflexions sur les aspects juridiques des mesures de sécurité relatives aux équipages des vols spatiaux*, in *Annuaire de Droit maritime et Aérospatial*, 1993, p. 382; On the legal status of astronauts see DIEDIRICKS-VERSHOOR, ROBINSON, GORBIEL, CHRISTOL, *Hastings International and Comparative Law Review*, vol. 7, n. 3, Spring 1984; HARA, *Legal Status of Astronauts and other Personnel on the Moon*, in *Proc. 26th Coll. on the Law of Outer Space*, Budapest 1983, p. 165;

<sup>7</sup> In the same sense one must consider the term "personnel on board", used by NASA regulations and designating "the astronauts and other persons during the flight phase, including any person who may transfer into another vehicle and any person who carries out activities outside the vehicle associated to the mission". 14 C.F.R: ch. V, sec. 1214.701(f) (1990) in GOROVE, *Developments in Space Law*, Dordrecht, Boston, London, 1991, p. 11

<sup>8</sup>CHENG, "Space Object", "Astronauts" and related Expressions, in *Proc. of the 34th Coll. on the Law of Outer Space*, Montreal 1991, p. 17

<sup>9</sup>For the cases see KAYSER, *Aux confins ...*, note 3, p. 478, note 35

<sup>10</sup>CATALANO SGROSSO, *Must the special Typology of Aerospace planes ...*, note 3, p. 407

<sup>11</sup>VERESCHETIN, *Legal status ...*, note 4, p.552

<sup>12</sup>The President Executive Order of 1977 constitutes the NASA Space Shuttle Astronaut's Program, with the nomination of pilots and mission specialists; the Agreement between NASA and DOD for the selection and training of astronauts; the US Code of Federal Regulations (title 14- Chapter V- NASA-part 12/4) on the regulations for the personnel on board the Shuttle, on the personal preference kit, on the commander's authority, on the chain of command and on the penalties for the non-observance of these regulations.

<sup>13</sup>LAFFERRANDERIE, *Pour une charte de l'astronaute*, note 5, p. 471

<sup>14</sup>EZELL and NEUMAN EZELL, *The Partnership-A History of the Apollo-Soyouz Test Project*, NASA History Series, 1978, NASA SP 4209

<sup>15</sup> GOROVE, *Space Shuttle and the Law*, Univ. of Mississippi Law Centre 1980, series n.3: SLOUP.

*The NASA Space Shuttle and other aerospace vehicle: a primer for lawyer on legal characterisation*, California Western School of Law 1978, vol.8, n.3

<sup>16</sup>For the text of the 1973 Spacelab Agreement see *Journal of Space Law* 1974, p. 53-64

<sup>17</sup>Belgium, Denmark France, Germany, Italy, Netherlands, Norway, Spain, United Kingdom, Sweden, Switzerland took part in the programme of the European Space Agency. See: CATALANO SGROSSO, *La responsabilità degli Stati per le attività svolte nello spazio extra-atmosferico*, Padova, 1990, p. 95 (The European co-operative programme "Columbus") and for all, the latest articles of FARAND, *Space Station Co-operation: Legal Arrangement*, in *Outlook on Space Law over the Next 30 years*, 1997, p. 125, ed. LAFFERRANDERIE-CROWTHER

<sup>18</sup>The Columbus Declaration, drawn up on 15 December 1987

<sup>19</sup>LAFFERRANDERIE, *The European Space Agency and the Astronaut's Policy*, in *Proc. of the 1988 IISL/ECSL Symposium, A/AC.105/C.2/1998/ Crp. 4*, 24 March 1998

<sup>20</sup>ESA/C/CXXXIV/Res. 2 (Final)

<sup>21</sup>An international crew made up of three astronauts will begin living on board the ISS. The crew, which began its training for the mission in 1996, includes: the Station Commander Bill Shepherd, a USA astronaut; the Soyuz Commander Yuri Gidzenko, a Russian cosmonaut; the flight engineer Sergei Krilae, who is also Russian. The first crew will remain on board the International Space Station for five months. When they arrive, the ISS will be made up of three modules: the Russian Service Module, to be used as living quarters and control centre on board; the Functional Cargo Block, a module providing supplementary energy with propulsion functions, financed by the USA and built by Russia; and the Node 1, built by the USA, a connection module providing the attachment points for the future segments.

<sup>22</sup>Art. 11.3 MOU between NASA and ESA concerning cooperation on the Civil International Station, January 29th 1998

<sup>23</sup>FARAND, *The Astronaut in the Space Station Era*, in *Outlook on Space Law over the Next 30 Years*, ed. LAFFERRANDERIE-CROWTHIER, The Hague, London, Boston 1997, p. 147

<sup>24</sup>Text in *Annuaire des Nations Unies*, New York. Département de l'information, 1984, p. 799

<sup>25</sup>The concept was introduced previously in the national USA legislation (NASA Human Research, Policy and Procedures) and ESA regulations (Guidelines and General Procedures for the Conduct of Spacelab experiments using Humans as Test Subjects) NASA NMI 7100-8-1987; ESA/SL-79-01 - 12 March 1979. The 1978 Alma Ata Declaration, signed by 134 countries, is very important, because it is the result of the International Conference on Primary Health Care.

<sup>26</sup>XIII National Congress of Italian Association of Air and Space Medicine, 29 Nov. - 1 Dec. 1995, in *Giornale di medicina Militare*, luglio-ott. 1996, p. 595; *ibidem* ASCENZI, *Le missioni spaziali nei loro riflessi scheletrici*, p. 474

<sup>27</sup>Valentina Tereskova, the first woman launched in outer space in June 1963, performed 48 orbits round the earth. The birth, in 1964, of her daughter Aljona, a physically perfect and healthy child, demonstrated that flights in outer space do not influence fertility and the eventual pregnancy of a female astronaut. See ROTONDO, *La donna e il volo nella storia dell'aviazione nella medicina aerospaziale*, in *Giornale della medicina militare*, luglio-ottobre 1996, p. 536

<sup>28</sup>Interview to Dr. Anne Pavy-Traon in the Centre (TSOUP) of Korolev, near Moscow, where are in quarantine the french-russian crew, after the long residence in the Space Station MIR, Agence France Press, August 25, 1999

<sup>29</sup>STERN TENNEN, *Exobiology and the Outer Space Treaty: from Planetary Protection to the Search for Extraterrestrial Life*, in *Proc. of the 40th Coll. on the Law of Outer Space*, Turin 1997, p. 141

<sup>30</sup>In United Nations Treaties and Principles on Outer Space, United Nations, 1997, A/AC.105/572/Rev. 2

<sup>31</sup>VERESCHETIN, *Legal status of International Space Crew*, note 4, p. 555

<sup>32</sup>The procedure for the resolution of any controversies foreseen in art. 15, par. 2 and 3 of the same Agreement might not be sufficient. A suggestion has been made for the creation of an International Committee of experts under the auspices of the UN, which would serve as an advisory organ in the even of disputes for the use of the installations, see: HARA, *Legal Status of Astronauts and Other Personnel on the Moon*, in *Proc. of the 26th Coll. on the Law of Outer Space*, Budapest 1983, p. 166

<sup>33</sup>Working doc. A/AC-105/C-2/L 159, 27 March 1987; Working doc. A/AC-105/C-2/L 161, 1 April 1987

<sup>34</sup>Convention on International Liability for damage Caused by Space Objects, March 29th 1972, in *United States Treaties and Principles on Outer Space*, United Nations, New York 1997, p. 14

<sup>35</sup>CATALANO SGROSSO, *La responsabilità degli Stati per le attività svolte nello spazio extra-atmosferico*, see note 17, pages 13-14

<sup>36</sup>DUPUY, *La responsabilité internationale des Etats pour les dommages d'origine technologique et industrielle*, Paris, 1976, p. 75

<sup>37</sup>On the ESA legal Liability, see ESA/C/XXII/Res.3 adopted in Paris the 13 Dec. 1977

<sup>38</sup>VERESCHETIN, *Legal status of international space crew*, see note 4, p. 547

<sup>39</sup>LACHS, *The Law of Outer Space*, Sijthoff-Leiden, 1972, p. 69-70

<sup>40</sup>Convention on registration of Objects into Outer Space. 14 January 1975. in *United Nations Treaties*, see note 34

<sup>41</sup>The Agreement Governing Activities of States on the Moon and Other Celestial Bodies, December 18th 1979, in *United Nations Treaties*, see note 34

<sup>42</sup>SICO, *Lineamenti di una disciplina dell'attività svolgentesi a bordo delle stazioni spaziali*, in *Il diritto internazionale al tempo della sua codificazione*, studi in onore di R. AGO, Milano 1987, p. 402; HARA, *Legal Status of Astronauts and other Personnel on the Moon*, see note 6, p. 167

<sup>43</sup>For the text of the Memorandum see 2 *Journal of Space Law*, L 40, 1974; for the text of the 1973 Spacelab Agreements see *Journal of Space Law* 53-64, 1974

<sup>44</sup>BOURELY, *Legal Regime of International Space Flight: Legal Issues Relating to Flights of the Spacelab*, in GOROVE (ed) *The Space Shuttle and the Law*, 1980, p. 73-76; GOROVE, *The Space Shuttle: some of its Features and legal Implications*, in GOROVE, *Developements in Space Law*, see note 7, p. 193

<sup>45</sup>See letter of Mr. Suy, U.N. Legal Counsel (19 Sept. 1975), in reply to the question on the Organisation jurisdiction and control, emphasised in the letter of Mr. Kaltenecker, ESA Deputy Dir. (28 Jan.1975

<sup>46</sup>Art. 5.2 "Pursuant to Article VIII of the Outer Space Treaty and Article II of the Registration Convention, each Partner shall retain jurisdiction and control over the elements it registers in accordance with paragraph 1 above and over personnel in or on the Space Station who are its nationals. The exercise of such jurisdiction and control shall be subject to any relevant provisions of this Agreement, the MOUs, and implementing agreements, including relevant procedural mechanisms established therein"

<sup>47</sup>For the Conventions concerning civil and criminal jurisdiction over armed forces and for the study in particular of the NATO Treaty, see CATALANO SGROSSO, *Giurisdizione civile e penale sugli aeromobili militari stranieri*, in *Il diritto aereo*, 1975, p. 82

<sup>48</sup>FARAND, *The Astronaut in the Space Era*, see note 23, p. 158; CATALANO SGROSSO, *La responsabilità degli Stati per le attività svolte nello spazio extra-atmosferico*, see note 17, p. 116-128