International Cooperation in Space, from USSR to Russia

Olga Zhdanovich, MSc
Secretariat of the European Cooperation for Space Standardisation

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This chapter presents a historical overview of international cooperation in space during the period of the Union of Soviet Socialist Republics (USSR) and to the present days of the Russian Federation. The post-Soviet era and current international cooperation in space are described through interviews with people who were or still are involved in the joint space programs. I asked Dr. Carlo Mirra from EADS/Astrium, who is responsible for the ISS Increment and Mission Integration from European side, Dr. Antonio Verga from ESA who was involved for a number of years in the Foton and Bion cooperative ESA-Roscosmos projects, and Dr. Mark Belakovskiy from the Institute of Medical and Biological Problems (IMPB), which recently completed a successful international experiment for a flight stimulation of mission to Mars – MARS 500, to share their opinions on the cooperation with Russia.

Introduction

During the Cold War from 1946 to 1991, the world was divided into two political camps: the Soviet Union and its partners (socialist countries, East), and the USA with its allies (capitalist countries, West).

Cooperation in space was conducted in the USSR with socialist countries through the Program Intercosmos. The USSR also cooperated with the Western world, mainly with France, Sweden and Austria. Despite severe competition in space, the Soviet Union and USA permanently spoke about possible cooperation, and that resulted in the Apollo-Soyuz Test Project (ASTP) in 1975, and was followed by the Mir-Shuttle Program, the Mir-NASA Program, and then the International Space Station Program (ISS).

In the period of the USSR, many projects were done on an exchange basis, not for profit. With the end of the Cold War and the decline in priority of space and the increase in importance of financial matters, the Russian space program has become more commercially oriented. Today Russia engages in vast international cooperation in the area of human space flight, especially long duration space flight, an area where the Soviet Union accumulated significant experience, more than any other nation.

Organization Of International Cooperation In Space, From The Ussr To Russia: Institutions And Activities

This section presents a brief history of the birth of the organizational infrastructure for the national space program and international cooperation in the USSR, and in the Russian Federation after 1991.

During decades of the Cold War there was a saying that the USSR was closed by an “iron curtain,” and Western countries were unclear as to what was happening behind this ”curtain.” For partners of the Soviet Union from the socialist countries, the situation was quite the opposite, as many had a close working partnership with the Soviet Union on matters pertaining to space.

In 1992 the Russian Space Agency (Roscosmos) was founded. The main difference from the USSR space program organization is that during Soviet times there was no single entity or structure doing space activities. Instead, there were many organizations defining and implementing different aspects of the Soviet Space Program, including the Ministry of General Machine-building, the Soviet Academy of Sciences, and the Inter-ministerial Scientific and Technical Council for Space Research under the umbrella of the USSR Academy of Sciences. Other Ministries also contributed to the development of the national space program, mainly through the Inter-ministerial Council and the Commission for the Military and Industrial issues under the Central Committee of the Soviet Communist Party.

Permanent international cooperation in space officially started in 1958. After successful activities for the International Geophysical Year, the United Nations (UN) General Assembly adopted its resolution 1348 (XIII) on December 13, 1958. This resolution formed the basis for the international cooperation in space by creating the ad hoc Committee on the Peaceful Uses of Outer Space (COPUOS). Eighteen countries joined this Committee, including Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Iran, Italy, Japan, Mexico, Poland, Sweden, the Union of Soviet Socialist Republics, the United Arab Republic, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. One of the issues that the Committee was requested to report on to the 14th UN General Assembly was international cooperation in space:

> "(b) The area of international cooperation and programs in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices to the benefit of States irrespective of the state of their economic or scientific development, taking into account the following proposals, inter alia:
> (i) Continuation on a permanent basis of the outer space research now being carried on within the framework of the International Geophysical Year;
> (ii) Organization of the mutual exchange and dissemination of information on outer space research;
> (iii) Co-ordination of national research programmers for the study of outer space, and the rendering of all possible assistance and help towards their realization."

The 13th UN General Assembly requested the Secretary-General "to recommend any other steps that might be taken within the existing United Nations framework to encourage the fullest international co-operation for the peaceful uses of outer space."

As a UN permanent body, COPUOS was endorsed by the General Assembly in 1959, resolution 1472 (XIV) on December 12, 1959 with the mandate to promote international cooperation and peaceful use of outer space. In 1959 this Committee included twenty four countries, while today there are seventy-one countries which are members.[1]

The Soviet Space Program was a closed program, in that before 1991 almost all governmental documents were classified. Recent publication of USSR space program documents from 1946 to 1967 (Baturin, 2008) presents what happened from a government perspective. In 1965 the start of international cooperation in space occurred when the Government of the USSR officially approved the policy.

On December 10, 1959 by the Order of the Soviet Government N1388-618, "About development of research for outer space" the Inter-ministerial Scientific and Technical Council for Space Research, under the umbrella of the USSR Academy of Sciences, was formed (Baturin, 2008). For decades this Inter-ministerial Council was the central "think-tank" for the development of the Soviet Space Program. The Council was headed by Academician M. Keldysh, who was also the President of the Soviet Academy of Sciences. All chief designers of the Soviet space program, including S. Korolev, V. Chelomei, M. Yangel, and others, were members of this Council.

In response to the UN General Assembly resolution 1472 (XIV), the Soviet Government on March 10, 1960 issued the Order N300-188 "About USSR participation in the international organization for the peaceful use of outer space." This Order obliged the Inter-ministerial Scientific and Technological Council for Space Research, which was under the USSR Academy of Sciences, to prepare agenda items for consideration in the UN COPUOS by the request of the USSR Ministry of Foreign Affairs. Other Soviet ministries, including the State Committee for Defense Technology, State Committee for Radio-electronics, and State Committee for shipbuilding were instructed to provide necessary materials related to peaceful use of outer space to support the development of position of the USSR representatives in UN COPUOS. (Baturin, 2008).

In October 1963 the Institute of Space Biology and Medicine was

[1] Website of the UN Office for Outer Space Affairs, 2012.

founded in the Soviet Union under the USSR Ministry of Health. In 1965 the Institute was renamed as the Institute of Medical and Biological Problems (IMPB). Since then, the institute has played the key role in the area of space biology and medicine in Russia. In 1994 IMBP received status of the State Research Centre and in 2001 the Institute became a scientific center of the Russian Academy of Sciences.

The year 1965 marked the start of USSR international cooperation in space. In April the Soviet Government issued Order N302-103 "About cooperation of the USSR and socialist countries in the research and use of outer space." The Order proposed to organize a meeting to discuss fields of cooperation with countries that were considered friends of the Soviet Union.

On May 15, 1965 the Institute of Space Research of the USSR Academy of Sciences was founded.

On May 30, 1966, by the Order of the USSR Council of Ministers and Central Committee of the Communist Party N421-130 the Council for the International Cooperation in Research and Use of Outer Space under USSR Academy of Sciences was formed. Lately it received the name Intercosmos Council. The Council coordinated the work of other ministries and committees involved in international cooperation projects and programs (Russian Academy of Sciences, 2012). This was done mainly through the Inter-ministerial Scientific and Technical Council for Space Research.

During the Soviet Union era the International Council Intercosmos of the Soviet Academy of Sciences, Institute of Space Research and Institute of Medical and Biological Problems were the known faces of the space program, and were playing the key role for the international cooperation in space.

In February 1985 the General Department for the Development and Use of Space Technology was created inside the Ministry of General Machine Building, known as USSR Glavkosmos. This Department has become the point of contact for international activities of the Soviet Space Program until 1992. Glavkosmos' goal was to commercialize Soviet space technology internationally, as well as promote applications of space technology inside the Soviet Union. At that time it appeared as a Soviet Space Agency to the outside world. For the very first time the whole civil part of the Soviet Space Programs was suggested for cooperative projects with the actual names of the Soviet space technology items that were used inside the Soviet Union by Soviet engineers. Before 1985, for example, the majority of the Soviet Union satellites were known to the rest of the world simply as "Cosmos" satellites.

The booklet entitled "Commercial space services rendered by Glavkosmos of the USSR" states that Glavkosmos' responsibility was the "organization and coordination of work to develop and use space technology," as well as "enforcement of international agreements in the field of development and use of space technology to implement programs of international cooperation." Glavkosmos offered the following space technology available for international partners:

- Launching a wide variety of payloads into various orbits utilizing Soyuz, Vostok, Molniya, Tsyklon, Cosmos, Energiya-Buran, Zenit and Proton launchers;
- Performing scientific and technological experiments in microgravity through spacecraft Foton and Bion and/or using specialized hardware as Splav-2 and Kashtan (for material science and crystal growth), Pion-MA (for biological research) etc.
- Flights to Mir-Soyuz-Tm-Progress-Kvant space station complex;
- Data from remote sensing satellites Okean and Resurs-O;
- Leasing communication channels of the Soviet communications spacecraft, etc. (Glavkosmos, USSR, 1990).

Glavkosmos signed agreements with the European Space Agency, and research onboard the Foton and Bion satellites was part of the cooperation agreement. In 1990-1991 joint space flights of a Japanese journalist, British and Austrian cosmonauts were performed.

After the collapse of the Soviet Union, the Russian Space Agency was founded in 1992 using Glavkosmos and the Ministry of General Machine building as its base.

USSR – France cooperation in space

France was the pioneer of international cooperation with the Soviet Union, and 2011 marked the 45th anniversary of cooperation with Russia in space. Cooperation began in June 1965 with the Order of the USSR Council of the Ministers N510-195 "About cooperation between USSR and France in the field of research and use of outer space," which requested the USSR Ministry of Foreign Affairs to inform the Ambassador of France in Moscow of the readiness of the USSR to start negotiations with France (Baturin, 2008). The Order defined the main fields of cooperation as:

- Data exchange from satellites launched by the USSR and France
- Joint research of upper atmosphere with meteorological rockets launched from India
- Development of the joint program for a launch of joint meteorological and geophysical rockets with data exchange follow-up
- Development of experiments for the radiotelephone communications and transmission of black and white and colored TV programs from the satellite Molniya-1
- Research in space communications, space meteorology and space studies for agreed programs
- Development of the joint scientific instruments by Soviet and French engineers and scientists
- Launch of French satellites by the Soviet boosters and placements of various scientific equipment developed by the French scientists on the Soviet satellites (Baturin, 2008)

The Order also notes that this is not an exhaustive list. The agreement was signed in 1966, and on the occasion of the signing French President General De Gaulle became the first foreigner to visit the USSR cosmodrome at Baikonur.

During 1967-1969 the CNES-Intercosmos Council bilateral commission met twice a year, and since 1970 once a year, and it was referred to as the "Great Commission." Five working groups were created: geophysics, astronomy, space biology and medicine, telecommunications, and meteorology. Some of the many accomplishments achieved during this long lasting bilateral international cooperation are listed below.

- High atmosphere studies where done in the period 1967-1979.
- Study of ionosphere and magnetosphere with balloons was performed from 1968 to 1974. For example, in 1974 six French and ten Soviet balloons were launched from Kiruna, Sweden. French spectrometers, to study electrons and protons of low energy throwing down to Earth atmosphere during aurora borealis, were put in 1971 and 1973 on Russian satellites Oreol-1 and Oreol-2.
- French satellites SRET-1 and SRET-2 were launched in 1971 and 1975 by the USSR piggybacked on Molniya satellites.
- Space geodesy experiments on Luna-17 in November 1970, at Lunakhod-17 in 1973 and Luna-21 in January 1973 with

practical implementation of laser-reflectors for space triangulation.

- Lunar samples brought back by Luna-16, 20 and 24 were given to French laboratories between 1971 and 1977.
- Space biology experiments were done on 11 spacecraft titled Cosmos in a period from 1973 to 1996.
- Since Cosmos-1514, monkeys were equipped with flying suits produced by French CERMA.
- Elaboration of materials (ELMA) started in 1978. French experiments were performed onboard of Salyut-6 and Salyut-7 Soviet space stations, as well as on 13 Foton satellites from 1985 to 2002.
- Earth observation experiments were done on satellites Meteor-3, Resurs-O, as well as onboard space station Mir (Lardier, 2001).

In 1979 the Union of the Soviet Socialist Republics signed an agreement with France for human space flight. J.-L. Chrétien made his flights in summer 1982 and later in autumn 1988.

In 1989 a new agreement between the Soviet Union and France was signed for a further 10 years in addition to the First Agreement of 1966. The new Agreement covered periodic flights of French cosmonauts, such as the flight of M. Tognini in August 1992.

This was followed by a global agreement for four human spaceflights that included J.-P. Haigneré in 1993, C. André-Deshays in 1996, Leopold Eyharts in 1997, and J.-P. Haigneré in 1999 (Lardier, 2001).

Program Intercosmos

In April 1965 the Soviet Government issued Order N302-103 “About cooperation of the USSR and socialist countries in the research and use of outer space.” The Order called for a meeting of representatives of partners of the Soviet Union, and Soviet Premier A. Kosygin sent an invitation to the leaders of those countries.

The meeting was held in Moscow November 15-20, 1965 with the representatives of Bulgaria, Hungary, Cuba, North Korea, Mongolia, Poland, Romania, and Czechoslovakia. China and Albania refused to participate in the meeting, and Yugoslavia did not reply to the invitation at all.

At that time Vietnam also declined to participate due to its ongoing war and the absence of space research activities. Towards the end of the 1970s, Vietnam did send a cosmonaut onboard the Soviet space station. Order N302-103 also defined the following fields of cooperation: visits of representatives of the socialist countries to the Institute of Medical and Biological Problems (IMBP), laboratories of the Academy of Sciences and Medical Academy, Central Observatory of the Hydro-meteorological Service and space data acquisition stations in the Moscow region and Yevpatoria (today, Ukraine). The Order also permitted the use of a number of boosters and geophysical and meteorological rockets for international cooperation, and allowed members of the socialist countries at a defined list of launching pads (Baturin, 2008). At that time the basics of proposed cooperation looked as follows:

- Development of the hardware for scientific research on the Soviet boosters and geophysical and meteorological rockets by the specialists from the socialist countries, with the support of the Soviet scientists;
- Participation of socialist countries in the development of an international system for long range radio telecommunications, TV, and meteorological services, as well as development of the ground segment;
- Data exchange received from Soviet satellites and/or by Soviet scientists;
- Development of radio technical and optical monitoring ground stations;
- Scientific research in space physics, space meteorology, communications, space biology and medicine due to programs approved by the Inter-Ministerial Council Scientific and Technical Council for space research under the USSR Academy of Sciences (Baturin, 2008).

As mentioned, in May 1966 the Council for the International Cooperation in Research and Use of Outer Space under USSR Academy of Sciences was organized.

During a meeting of April 5-13, 1967 in Moscow, the first program of cooperation among the USSR with Bulgaria, Hungary, East Germany, Cuba, Mongolia, Poland, Romania and Czechoslovakia was developed, which lately became the Intercosmos Program. On April 13, 1970 at the meeting in Poland this cooperation program was officially named Intercosmos Program (from two Russian words International Cosmos). The Program was run by the Intercosmos Council and for two decades Soviet

Academician B. Petrov was the Head of the Council, followed later by Academician V. Kotelnikov. The Intercosmos Council was active until 1991, and performed a significant number of space research experiments in areas that include space meteorology, communications, space biology and medicine, space physics, Earth observation, and human spaceflight.

Each country participating in Intercosmos Program had its own coordinating committee, and joint projects were done through Joint Working Groups. No special budget was defined for these projects, and while the Soviet Union offered Soviet space technology for free, each participating country developed their own national space programs in space science and engineering according to their needs and their own budgets. High level Intercosmos Council meetings were conducted regularly.

The first satellite for the Intercosmos research program, Cosmos-261, was launched in December 1968. It mission was to study the upper atmosphere of Earth. On October 14, 1969 the first real "baby" of the Intercosmos cooperation program was launched, a satellite officially named Intercosmos-1.

During the period from 1969 to 1979, 20 satellites of the Intercosmos series were launched, as well as eight meteorological vertical-launch rockets for joint research. In 1976 an automatic universal orbital platform was launched as a new generation of Intercosmos satellites. The newly developed Intercosmos spacecraft was able to carry 2 to 3 times more scientific payload than previous Intercosmos satellites. The spacecraft had also a unified telemetric system that allowed all participant countries to acquire scientific information directly by ground stations on their own territories (Kozyrev, 1979).

A new round of the Intercosmos Program started in 1976 when the Soviet Union proposed to participate in human space flight. Nations that sent cosmonauts to space onboard Soviet space stations Salyut-6 and Salyut-7 include Czechoslovakia, Bulgaria, Hungary, Cuba, Eastern Germany, Mongolia, Poland, and Romania. Later this program was joined by Vietnam and Afghanistan.

The first human spaceflight of the Intercosmos Program was on March 2, 1979 by the joint USSR - Czechoslovakian crew A. Gubarev and V. Remek. In the post-Soviet Union era when Europe started to look into space history, apparently V. Remek was the first European man in space (Kozyrev, 1979).

In 1972 the International Communication Union Intersputnik was created by the USSR and its partners. Intersputnik and Intercosmos had long standing cooperation in space telecommunications. The Intercosmos

Program stopped in 1991 after the split of the Soviet Union.

Soviet Union – United States Cooperation in Space

The story of Soviet–US cooperation in space requires special consideration and a separate history book; in this chapter the major steps of bilateral cooperation are outlined.

During the Cold War, political rhetoric and activities between the USSR and the USA were far from positive. American U-2 spy planes flew over USSR territory, the Caribbean Crisis, the US war in Vietnam, and Soviet troops in Afghanistan all created very heavy and difficult environment for cooperation between the two countries. However, behind the diplomatic and mass media scenes, space engineers and scientists were constantly trying to build cooperation between the two superpowers. The period of political détente in the early 1970s was also quite helpful.

In the article, "United States – Soviet Space cooperation during Cold War," published on NASA's website, former Director of the Institute of Space Research of the USSR Academy of Sciences Roald Sagdeev recalls that in 1957-1958 US President D. Eisenhower wrote a number of letters to the General Secretary of the USSR Communist Party N. Khruschev suggesting cooperation in space. Khruschev did not reply.

However, after the flight of Yuri Gagarin into space in 1961 and flight of John Glenn in 1962, Khruschev wrote to President Kennedy proposing cooperation in space (Eisenhower, 2008). Based on these exchanges, a three-part bilateral agreement between the USSR and the USA was prepared by USSR Academician A. Blagonravov and Dr. H. Dryden, Deputy Administrator of NASA. The 1962 bilateral agreement allowed for:

- Coordinated US and Soviet launches of experimental meteorological satellites with follow up of data exchange;
- Launch of both countries' spacecraft with absolute magnetometers on board with subsequent data exchange to produce Earth's magnetic field in space;
- Joint communications experiments using Echo 2, US passive satellite (NASA, 1975).

The Blagonravov-Dryden negotiations ended with a second agreement in October 1965 with the decision to make the joint publication outlining a Soviet-American research in space biology and medicine. The

Institute of Medical and Biological Problems was the key in this cooperation from the USSR side. The bilateral scientific research was published in three volumes in 1975 in Russian and in English.

In 1969, NASA Administrator Dr. T Paine proposed to the Head of the USSR President Academy of Sciences M. Keldysh that cooperation in rendezvous and docking of a manned spacecraft as well as in space research (NASA, 1975) should be developed. In October 1970 negotiations for the possibility of the US and the USSR to each design a manned spacecraft with compatible docking mechanisms were held in Moscow.

Vladimir Syromyatnikov, father of the USSR docking mechanism recalls in his book 100 Stories about Docking that when the NASA delegation arrived in Moscow they were quite pessimistic about the possible cooperation. Twenty years later Glenn Lunney, an American Technical Director of the ASTP commented that, “Apollo-Soyuz was a miracle.” Three working groups were organized since 1970 and these groups formed the basis for the development of ASTP (Apollo-Soyuz Test Project) project until its docking in orbit. Working Group #1 was responsible for integration design, means of rendezvous and control were the responsibility of the Working Group number 2; and the third Working Group was responsible for docking (Syromiatnikov, 2005).

The next NASA-the Soviet Union Academy of Sciences Agreement of 1971 was focused on:

- Exchange of lunar samples obtained from the Apollo and Luna programs;
- Exchange of weather satellite data between the United States’ National Ocean and Atmospheric Administration (NOAA) and the Soviet Hydro-meteorological Service;
- Coordination of network or meteorological sounding rockets along selected meridian lines;
- Exchange of detailed medical information of human body reactions to the space environment (NASA, 1975).

On May 24, 1972 the US President Richard Nixon and the Soviet Union Prime Minister Alexei Kosygin signed the Agreement concerning cooperation in the “Exploration and Use of Outer Space for Peaceful Purposes.” The Joint Soviet-American mission was officially announced as the Apollo-Soyuz Test Project. This agreement also required both countries to fulfill a NASA-Soviet Academy of Science agreement of January 1971 (NASA, 1975).

In July 1975, Soyuz 19 and Apollo docked in space. The archive of Jaap Terweij includes the records from the onboard press conference of Soyuz 19 and Apollo spaceships held on July 18. Questions were sent separately from the USA and the USSR, but everything that the cosmonauts and astronauts told the press was strictly controlled and was verified extensively by both sides.

The press conference began with the official statements by Apollo Commander T. Stafford and Soyuz 19 Commander A. Leonov. The US Commander Stafford stated from the orbit: "We are happy to work today on the ASTP program. The success of the flight which is now followed by America, the USSR, and the rest of the world, is a result of the will, cooperation and efforts of the governments of our two countries, the mission commanders and the engineering and technical personnel, and other specialists. Yesterday as I opened the hatch for the first time and said "Hello" to Valery and Alexei, I felt that when we opened this hatch in space we were opening back on Earth a new era in the history of man. How this era develops further will depend on the will, efforts and faith of our two nations and other nations of the world. I am sure this era has a good future ahead of it. It is real pleasure for me to take part in this flight and to work together with the Soviet cosmonauts."

The Soviet Commander Leonov stated that, "We representatives of the two countries are performing this joint flight because our nations and Governments want to work together in the spirit of cooperation, because many specialists in the USA and in the USSR put tremendous effort into making this project a reality. The flight has become possible in the climate of international détente and developing cooperation between our two countries. This flight is an important step along the endless road for space exploration by the joint efforts of all mankind" (Press-kit, 1975).

This question to Vance Brand was transmitted from the US press center: "Now that the Americans have united with the Russians in space for the first time in an international space mission, what do you think manned spacecraft can do in the joint exploration of other planets?" He answered, "I think that we now stand good chances of that. But it is not likely to happen in the near future, to my mind. It will probably be another 20 or 30 years before we shall be ready to start the exploration of other planets. But modern progress is truly impetuous, as evidenced by the development of aviation. And it is quite possible, therefore, that within the next 20 or 30 years the time will come when we shall think of exploring other planets by joint effort. It seems to me it ought to take place. It would save time, effort and financial outlays. It would be the most interesting project that would benefit the whole world" (Press-kit, 1975).

In 1978, American engineers from Johnson Space Center prepared a proposal for the US Space Shuttle to dock with the Russian Salyut station in space including the SPACELAB module. In 1991, US President George Bush and Soviet President Mikhail Gorbachev signed an agreement that included visits of US astronaut aboard Soyuz-TM, and a fight by the Russian cosmonaut on a Space Shuttle mission. They also discussed the possibility of a US module to be docked to the Mir space station (NASA, Shuttle-Mir History/Background/Cooperation Timeline 1962-1993, 2004).

The Joint Cooperation Agreement in space with a Shuttle mission to visit Mir space station (Mir-Shuttle program), a US astronaut onboard Mir, and the US participation in Mars-94 Russian exploration project was signed in 1992. The next year this Agreement was expanded to include 10 Shuttle flights to the Russian Mir space station (Mir-NASA Program). In 1993 Russia was invited to join construction of the International Space Station.

Foton-Bion:
a brief history of European cooperation from the soviet union era to modern russia (1987-2007)

The following Foton-Bion story about the European Space Agency-Russian cooperation on joint microgravity projects for technological experiments onboard Foton and for biological research onboard Bion satellites is written by Dr. Antonio Verga, who participated in a number of years in cooperation with Russia as an ESA project manager. This presents a personal viewpoint, as his story goes far beyond engineering, as he witnessed significant changes in working culture in space, real ice-breaking from the Cold War era, but at the same time he also witnessed dramatic events that my country went through in the post-Soviet Union era.

I am simply jealous knowing that Antonio was privileged to know one of the most classified persons in the USSR, a colleague of Sergey Pavlovich Korolev, Dmitry Ilyich Kozlov. Dmitry Kozlov was the Head of the space enterprise in Samara from the end of 1950s until his death in 2009, and he was the Chief Designer of R-7 booster and Soviet reconnaissance satellites.

"The history of ESA's cooperation with the Russian aerospace world, actually with the Soviet one, started in May 1986 when, in the aftermath of the US-Space Shuttle Challenger tragic explosion, the national delegates at ESA's microgravity program board "urged ESA to look for new flight opportunities for all areas relevant to microgravity, and particularly for opportunities with the Soviet Union." What had until then been strictly forbidden, in line with the European politics about the Cold War, suddenly became keenly recommended. It was the time when Mikhail Gorbachev was planning the reconstruction of the Soviet Union, not knowing that his revolutionary ideas would finally lead to its political and economic fall. From May 1986, ESA flew its microgravity experiments three times with the Soviet Cosmos program, starting in September 1987 with Bion-8 (still called Cosmos 1887 at that time), then followed by Bion-9 in 1989 and Foton-7 in October 1991, just before the USSR's political and geographical entity began to fall into pieces.

I had no chance to participate in any of those pioneering missions, but I collected the personal experiences of many of my colleagues. Those were the times when commercial exchanges were unthinkable between the Western economies and the Soviet Union. Smart enough, the managers of the space business on both sides found a way to cooperate that was efficient and productive at the same time.

The Soviet Union in those days had the capability to launch satellites and human crews into space at a terrific pace and with unimaginable success rates. Conversely, the European space industries were still struggling to find their roles and their identities within a baby ESA that was setting its race for space well behind the American and the Soviet giants. However, the '80s saw tremendous technological leaps in Europe in all fields and disciplines, and the European applied science programs of those days was not equaled by any other academic community in the world. Hence, the cooperation between the young ESA and an old and almost finished Soviet Union was a natural partnership, and its sustaining vehicle was an exchange of services: ESA acquired the flight tickets to low-orbit Soviet platforms in return of technology spin off and support infrastructures. This nature of cooperation "in kind" lasted throughout the transition from USSR to Russia and continued, on a different basis until the most recent Foton flights in 2005 and 2007.

I had the impression from studying the testimonials recorded about those early days that beyond the initial steel-cold approach that the political etiquette imposed at both sides, there was a strong will and stubborn intent to break the ice and let the best ideas of those two very different worlds flow, meld and blend in search of a joint experience, venturing into a new "space romance." While this was certainly less glamorous than the Apollo-Soyuz rendezvous of the '70s, it was made to endure technical and political difficulties and to maintain a steady and constant role in the space stage worldwide. The most significant example of this cooperation is the pre-fab cabin of MOSLAB, which still stands on the IMBP grounds next to Moscow. Its outdated ESA and RKA logos still greet the European delegations on their way from the Sheremetievo International Airport to the city.

MOSLAB has a special chapter within this history. A 70 square meter laboratory with advanced installation for the preparation of biological specimens, it was completed by ESA by 1992 and traded in 1995 to the Russian Space Agency for opportunities given to ESA on three Bion flights and two Foton flights. The last of that series, BION-10, flew in January 1993 and although the Soviet Union did not exist any more by then, Bion-10 still carried the hammer-and-sickle logo on a red field, an homage to the flag that had waved for more than 30 years of journeys into space that mankind started in 1957. MOSLAB was used until the Foton-11 mission in October 1997, and served as ESA's "vanguard," or forefront, in Russian soil, a home base of many experiments duly readied in its labs before their transport to the launch site, the Plesetsk Cosmodrome, 18 hours away by train.

My very first journey to Russia in 1993 had some dramatic moments. It was a cold and rainy evening in September when we arrived in Samara after an endless stop-over and airport commuting stage in Moscow. Samara was pitch dark on that evening, and with no vehicles along any of its deserted streets, except for white and red, noisy trams running in the middle of wide, empty boulevards. At each of their passings, the hotel room where I tried to sleep trembled from floor to ceiling, and the nightmare of an earthquake prevailed my waking and my emotions of those nights.

Samara had just been "opened" in February that year and renamed from the Soviet appellation after Kuybishev, but many of the Soviet marks survived until the late '90s, including bronze effigies of Stalin decorating some of its street corners. In a room of the Samara Aerospace State University I had my first meeting with the project team of TsSKB, called only KB or Konstruktorskoe Bureau (Design Office) at that time. The small TsSKB delegation of four equated exactly in number to me and my colleagues, and all communication went through an interpreter. Out of that group, only Valery Ivanovich and I had the chance to discuss in front of the blue prints and schematics of Bion-M2, on another cold and wet September morning in 2010, exactly 17 years after our first encounter.

TsSKB, nowadays complemented by a glorious suffix to become TsSKB-Progress, has been the largest and probably the most important space factory in Russia or former Soviet Union. Chosen by Josef Stalin himself in the city of Samara, at a safe distance from the risks of foreign military attacks, there the father of the Soviet Union had a special bunker dug for his own safety, 50 meters below one of the most central and most beautiful of Samara's squares. I had to be patient for a few more years, five indeed, before being allowed in May 1998 to admire the powerful capacity of TsSKB's integration halls, where no less than four 43 meters-tall, 3-stage Soyuz rockets were being assembled at the same time. But from that very first and rather dry meeting, I understood that a huge potential was ready to be deployed for our common intents of scientific research in space.

The drama of that first trip of mine culminated on our way back to Moscow the first day of October 1993, where we were to meet with managers of the newly founded Russian Space Agency. We ended up in the intense turmoil between President Yeltsin and the Russian Parliament of that time, supporters to the last tried to seize power and control of the Russian capital. We left one day earlier than planned, just before a curfew state was declared and all international flights cancelled. General Grachev and Boris Yeltsin swept all opposition away by mid-October 1993, but by then I was meditating at home on whether to accept or decline the challenge that I had ahead of me. Something suggested that I embrace that new course.

One year later we were back in Samara and, every year since then, I have been cruising back and forth for meetings, conferences, reviews, integration and test campaigns for five or more Foton missions, starting from Foton-11 in 1997. Meanwhile, Foton-9 and Foton-10 were completed in 1994 and 1995 respectively, yet with opposite fortune, with me being barely an observer or just at the edges of the data telemetry chains.

In 1995 ESA set an office in the heart of Moscow, and with MOSLAB on the brink of being disowned and forsaken, we sought alternative options to the logistic challenges that our project had to face and, sometime, to be pestered by. That was probably one of the most difficult periods, the transition from the stiff but well-structured Soviet organization to the more flexible but often confused Russian administrative regulations left us, more than once, mesmerized in between deceptive and unclear procedures. The help of ESA's office in Moscow became more and more essential, although our center of gravity was in TsSKB and in Samara. Samara was to me and many of us the true mirror of the Russian heartbeat of economy, culture, development, social and popular life. We saw this town falling apart in the late '90s and being reconstructed throughout the very beginning of the 2000s, an architectural revolution that managed to maintain the most striking and charming allure of the old times, and to respect the surrounding natural environment in a manner which has been dynamic and conservative alike. The local chocolate factory was sold to a Swiss competitor, but the hammer and sickle that decorated the gable of its gate resisted for a few more years before disappearing, while downtown the first McDonald's location was created in the space of a fortnight.

After years of frustrating hesitations, TsSKB finally opened their gates to us in 1998, just when the economic crisis hit Russia and put its population down on their knees. Empty food shops and queues at delivery points in street markets were a sharp contrast to our hi-tech instruments, our tool boxes, our satellite phones. But in those two years that closed the 20th century and marked the lift-off of Foton-12 on an unforgettable date, 9/9/99, our friendship with the project team at TsSKB tightened, our reciprocal respect grew, our mutual confidence and trust reached a level that was well beyond the professional boundaries. Little by little, all possible communication channels were surveyed and opened, the exchange of information widened, engineering teams started working together in an unprecedented way, technical solutions were studied and adopted by joint team of specialists, and the interest in our joint activities escalated to upper level managers. In October of that year, Dmitri Ilich Kozlov, General Director of TsSKB and number one of the enterprise invited me, ESA's number 4061, to share a drink for his 80th birthday; I was busy de-installing ESA's hardware from the scorched Foton-12 capsule just returned to Samara, but I dropped everything and ran.

The old barriers of secrecy and suspicion, meaningless remnants of the cold-war era, started crumbling down. Foton became the platform where brilliant technical solutions met, the test bed of our engineering skills, the product of our shared professional experiences, the battlefield where innovative scientific research found its path towards ever-ambitious objectives. To mark all these facets of the program and to hold a tangible example to be studied and further developed, the Foton-12 re-entry capsule was brought to ESTEC and proudly stands in our showcase in the Erasmus building as unique a piece of spacecraft ever flown to and returned from space.

In late November 1999 I flew back from the biting freeze of Moscow after a meeting in Roscosmos. On the flight to Amsterdam, unbelievable but true, I was seated next to Mikhail Gorbachev, who had recently lost his lovely wife Raissa and was heading to Munster to open a new ward of the local hospital, where she received her last attentive care. My command of the Russian language was still very poor and I managed to put together only a few limping sentences. Mr. Gorbachev is a man of immense culture, far visions and great social and popular consideration. He had been the leader of a country that was among the most prominent space powers of the world, yet during the four hour flight over those lands that once dealt with the balance between the NATO countries and the Soviet Union block alliance, he never dropped his attention from my words and always followed with interest my stories and explanations about my fresh and amazing experience with Russian space fellows. I could not, and still I can't, believe that my short and fragmented sentences about the new Russia captured the concern and empathy of a former president of the Soviet Union. I was very embarrassed for not being able to answer several of his questions about the ancient Roman history, one of his favorite studies of a lifetime.

Samara, in those years after Foton-12, became almost my second home town, not knowing actually which one is the first, and I began driving around in rental cars, partying at wedding celebrations and, at some very sad times, mourning deceased colleagues or members of their families. Shop assistants and waiters greeted and waved at me in the central pedestrian area calling by my first name. Police officers stopped me often for offences to the traffic rules, which I had to negotiate hard to clear. The hotel where we used to stay changed its name, its breakfast room, its decoration and its furniture, but always kept the very same room booked for me whenever I had been there. One of the nearby restaurants invited me once to cook some Italian dishes for its customers; we gathered public curiosity among the locals for swimming competitions, skiing trail excursions, basketball games, and even singing and dancing contests. At any achieved milestone of our joint projects, TsSKB never hesitated to host us to celebrate on their cozy boat while cruising the Volga river. That boat, named after the program we have been pursuing and where delicious food and inviting drinks were never at short, was the only ever manned Foton ship.

After the enthusiastic and highly content-rich first international scientific conference that the Samara's academic and industrial institutions organized in summer 2000, the opening of the 21st century was signed by the darkest point in the history of Foton: the launch accident in Plesetsk on October 15, 2002. Foton-M1 was totally destroyed in the crashing explosion of the Soyuz rocket and the arson of its 250 tons of kerosene propellant. The accident, taking two human lives and severe injuries, could have meant the end of that program, but the pride of TsSKB-Progress' freshly nominated director and the convinced stern position of ESA, ready to restart and to continue, made two more missions possible anew with yet a larger complement of scientific experiments and technologically advanced instruments. Since the very first stages of work, the failure investigation board, which I had the honor of being a member of, had been clearly searching the root causes of the failure, a shared and common objective. In no one's mind ever comes the shadow of shame or the ploy of hiding evidence. The inquiry board reached the conclusion of its work before the year was over, with unbiased judgment and sticking to the forensic facts.

Having kissed good-bye to Plesetsk after 10 launch campaigns, ESA travelled along with the Foton machinery moving to Baikonur and invited new partners on board, such as the Canadian and the Italian Space Agencies, and US scientists. The joint work with our Russian partners, TsSKB-Progress, Roscosmos, IMBP, Design Bureau of General Machine Building (KBOM), scrolled out through weeks and months, with a very pleasant and high team spirit, renovated integration halls both in Samara and in Baikonur, nimbler and simpler procedures for transport and Customs clearance, new and more efficient ways to exchange engineering data, and a rather expectedly optimized set of operations both for the ground testing phase and for the in-orbit conduct. When Foton-M2 was about to lift off from Baikonur on May 31, 2005, I bribed the Tu-74 pilot and crew with some colorful stickers of the mission, and all the passengers were allowed to disembark the aircraft and watch the launch from the tarmac, a far but still convenient viewing point. We took off only after the Soyuz rocket completed its orbital injection task; tears were rolling down my cheeks while, standing in an airplane packed with a crowd of Kazakh and Uzbek peasants, their livestock of hens, eggs and any sort of vegetables, fruit, spices, sausages and cheese, I was trying to reach my dear father agonizing in hospital, thousands of miles away. I did not make it on time.

The quality of work and professional relations improved even further for the Foton-M3 mission, despite harsh negotiations for some financial issues risked, at times, undermining the contract. With that mission Foton reached its apex of success: 18 pieces of payload equipment, 40 scientific experiments, 4 technology prototypes, 2 application projects, and 2 educational student experiments, a total of almost 400kg of mass, found their places on board. The mission, assisted from three ground stations and two operational centers in Moscow and in Northern Sweden, was a bursting accomplishment and sent echoes of enthusiasm and recognition in Russia and Western Europe alike. With Foton-M3 completed, the 12th of such projects, ESA scored 3700 cumulative hours in orbit, completed 170 scientific experiments, uploaded and downloaded 1600kg of payload mass.

All this would have been impossible without the support, help, cooperation and friendship of our Russian, former Soviet, colleagues. Twenty years (1987-2007) have passed marked by intense work, highly emotional moments, gratifying achievements, attracting perspectives, and, above all, an everlasting friendship.

Since the Bion and Foton programs lacked the glamour and the show of manned missions, they never hit the front pages of press releases, and both in Russia and in Western Europe, the crew working with these projects were viewed as sons and daughters of a lesser God. Nevertheless, our motivation has always been undefeated and high in the hours spent in shabby and inadequate labs where only our inventive approaches and the unabridged support of our Russian colleagues sustained our struggles to carry on, to move any next step ahead, to try yet once more serving our sole goal: the progress of scientific research that the space environment could alone foster and nourish.

I gathered souvenirs, millions of pictures, celebration pins, books signed by the pupils of the great S. Korolev the true pioneer of the space era, the advice of humble heroes of meticulous tests and repeated trials, the simple but poignant gifts of those who served the big shows from behind the scene, the handshakes of great men and women who made those projects the scope of their entire lives, the moving tails of cleaners, street sweepers, bar keepers and taxi drivers. During those unforgettable years, I learned how and when to drink vodka to celebrate with style, how to toast with acknowledging and encouraging speech, how to wait with patience that time models and shapes our faults into new perspectives. I was taught how to face adverse circumstances, how to dare with calculated risks, how to adapt and focus my view on the essential things, on bare necessities, and how to accept the compromises that often bring about the only possible way forward. One gold medal in the name of Servey Korolev was handed out to me in 2008 by the Samara's Lord Mayor and the Dean of the State University; it hangs proudly next to my office, the only reward I felt I really deserved, proof that I would never give in.

In November 2010, on the way to enliven again ESA's love affair with Bion, idled for 15 years. Bion-M1 and Bion-M2 were just waiting for our consent to join in and proceed with new challenging science goals, but our upper management decided to stop and bring ESA's involvement with those projects to a "controlled end" after 20 years seeded by fruitful results.

I never understood this short-sighted strategy, or better lack of strategic plan, and the only explanation I was ever given was that this kind of endeavor "did not fit any longer in the political landscape of Europe." As a simple-minded engineer, I do not see what such a decision was worth and, as I seldom do, I have kept weeping for the shame and the pity of these missed opportunities. Bion-M1 will take off in September 2012: recalling and leveraging on the practical common sense and well-rehearsed habits of our Russian colleagues, I made sure that a little imprint of ours will be illegally on board." (Verga, 2012)

International Cooperation Of Russia In Space Medcine And Biology

The USSR Institute of Medical and Biological Problems (IMBP) was organized in 1963 and is the leading research establishment for the space biology and medicine in Russia. In response to my questions, Dr. M. Belakovskiy provided a brief report on international cooperation performed by the Institute.

The Institute began international cooperation in 1965 with the Soviet-American project to publish research in space medicine and biology. During flights of the Soviet Space Stations Salyut-6, Saluyt-7 and space station Mir from 1977 to 1999, significant experience in space biology and medicine was accumulated in international cooperative projects and programs of the Intercosmos Program as well as others. In the post-Soviet Union era the major cornerstones of international cooperation were the Mir-Shuttle and Mir-NASA programs. Experience received in these programs formed a basis for the international cooperation concerning management, assembly, operation and research for the International Space Station.

Today the Institute of Medical and Biological Problems have joint research and cooperation projects with space agencies, research institutions, industrial companies from more than 40 countries including the USA, ESA, France, Germany, Japan, Canada, China, Italy, South Korea, and Malaysia.

The main fields of international cooperation performed by the IMBP today are as follows:

- Sharing knowledge, results of previous research done by the IMBP;
- Ground simulation and research of influence of conditions of a

space flight on the human body;

- Development and testing of special Space Station equipment for biological and medical research, mostly for the Russian segment of the ISS;
- Pre-flight and post-flight medical check-ups of cosmonauts and astronauts;
- Organization of medical and biological experiments onboard unmanned spacecraft;
- Spin-off of space biology and medicine space experiments and its results, technology transfer;
- Educational programs for schoolchildren, Bachelor level and Master students, PhD and postdoctoral research.

A major part of the international cooperation projects which are performed by the IMBP are connected with the International Space Station. The IMPB participates in the work of the following ISS multi-national medical bodies: Multilateral Medical Policy Board, Multilateral Space Medicine Board, Multilateral Medical Operations Panel, Multilateral Crew Operations Panel (ISS) Integrated Medical Group, Mission Management Team, Stafford-Anfimov Joint Expert Commission, Multilateral Radiation Health Working Group, and Human Research Multilateral Review Board.

That includes development of the regulation and operation documentation for various issues related to the health of the ISS crews, and development of a set of procedures and its practical implementation for the medical, biological, sanitary and hygienic support of the main crews, visiting crews for the ISS, Soyuz-TM and Space Shuttle. The activities of the IMBP also include organization of works for scientific and technical preparation and operation of the onboard equipment for the medical and biological support of the ISS crews.

The IMBP has played an active role in the preparation of space flights of citizens from the USA, Europe, Brazil, Malaysia, South Korea, Canada, and other countries. Their flight programs included medical and biological experiments based on special techniques developed by the IMBP scientists, including:

- A flight program called Centario of the first Brazilian astronaut Pontes Marcos Cesar, which included one biological experiment Gosum (growth of plants from the seeds in the weightlessness conditions) and three biotechnological experiments;
- The first ESA long-duration program, Astrolab, performed by Thomas Rheiter, which included six medical and biological

experiments (for example, ETD, CULT, NOA1,2, IMMUNO, ALTCRISS, CARDIOCOG);

- Program ANGASA, made by Sheikh Muszaphar Shukor, including four experiments on space biology and medicine such as ETD-M, MOP-M, MUSLE-M, FIS and three biotechnological experiments (CIS, MIS and PCS).

There are number of successful cooperative research projects between Roscosms and the European Space Industry which are already completed or still ongoing onboard the International Space Station including:

- MATREOSHKA experiment is looking into development of the onboard means to study consistent patterns of forming of space radiation in major organs of a human body with the use of scientific equipment Pille, LYULIN and dosimeters from Canada. The project is done together with ESA, DLR, CSA and scientific institutions from Hungary, Bulgaria and Japan;
- Experiment IMMUNO is research of immune reaction of a human body before and after space flight. The experiment is performed together with ESA;
- CARDIOCOG is the joint research of adaptation of specific features of a heart and circulatory systems to the conditions of the long duration space flight. The experiment is done together with ESA.

One of the fields of international cooperation that is suggested today by the Institute of Medical and Biological Problems is development of onboard equipment and separate devices for space biology and medicine research. This is done on the basis of bilateral or multilateral cooperation projects. For example:

- The EUROLAB experiment, is done by IMBP jointly with DLR and Koralevski Industry, developing special equipment to study the psychological and physiological conditions of a cosmonaut in a long duration flight;
- CARDIOME is performed together with CNES, development of hardware for a medical checkup of cosmonauts on the Russian segments of the ISS;
- LADA, together with Space Dynamics Laboratory of the Utah State University, USA, is developing space green houses for the

ISS.

Finally, but not least, the Institute of Medical and Biological Problems has deep experience in the ground simulation of long duration space flights with broad international cooperation. The Institute has made a number of ground simulations with long duration isolation, dry immersion, and hypokinesy with the participation of foreign partners. In November 2011 it successfully completed the Russian project Mars-500, an imitation of the human space flight for Mars. Crew members of Mars-500 spent five hundred days in an isolation chamber. The institutions that participated in the project include the European Space Agency as general partner, NSBRI from the USA, DLR, Chinese Cosmonaut Training Center, Italian Space Agency, ANGKASA Malaysian Space Agency, and research establishments from the South Korea, Italy, Germany, Austria, Spain and other countries.

Looking forward in the near term and far term futures, Russian experts in space biology and medicine are interested in the further cooperation on the following themes:

- Adaptation of the human body to the conditions of the short and long term space flights, including interplanetary flights;
- Means and techniques of directed counter measures for the non-positive changes in a human body during space fight;
- Life support during space flight, including EVAs, and development of next generation biological system for life support;
- Search for extra-terrestrial intelligence.

Some of themes listed above are already the subject of cooperative projects, while others wait for further examination and preparation for international cooperation in a near future. (Belakovskiy, 2012)

Cooperation With Russia For The International Space Station: A European Industry Prospective

Dr. Carlo Mirra, Senior Manager of EADS/ASTRIUM, is involved in the Increment and Mission Integration for the International Space Station, and has worked in cooperation with Russia for many years. Below are his answers to my questions on European-Russian cooperation for the International Space Station.

1. How long you are involved in the cooperation with Russia? In what projects have you participated?

I have been involved in cooperation with Russia since the first Dutch Soyuz Mission – the Delta Mission in 2004. After several years of experience with western space programs, mainly Shuttle based including Spacelab and SpaceHab, the discovery of the Russian space program was a very attractive and professionally rewarding experience.

Since then I have been involved in the preparation and management of the Eneride Soyuz Mission and the Astrolab mission, performed in direct relationship with Roscosmos. After the ESA Columbus module launch, we have participated in joint research activities and to upload and sometimes operate experiments on Soyuz and Russian segments. In total I have spent nine years in continuous collaboration that have disclosed a lot on the Russian space heritage, their working environment, and relationships.

2. What are the Lessons learned from joint Russian-European cooperative projects?

We have learned a lot from our Russian colleagues in our baby steps toward manned space flight, such as the important steps and milestones to be taken care of during the mission preparation, the attention to crew training and cosmonaut well-being. The completeness of the operational products accompanying the scientific program, the proper design of the launch packages were additional examples that the long lasting experience of the Russian colleagues helped to shape our thinking in preparation for the Columbus operation period.

I particularly remember the working relationship with several colleagues at Russian Space Corporation (RSC) Energia, IMBP and Gagarin Cosmonaut Training Centre (GCTC). It took some time to build some mutual trust, but communication was always open and never teacher-pupil like. I recall the extreme professionalism of the RSC Energia management. They were very sensitive to customer needs, engaged in problem resolution, and responsive to last minute issues. This is what today we would call a "customer-focused" mentality that I did not expect to find in an environment that was not really used to a commercial relationship.

3. What are the benefits to both Europe and Russia from international cooperation in space?

Europe learned a lot from the cooperation with Russia in the manned space field. Not only on how to design and conduct long duration space missions, which we were not accustomed to until Astrolab in 2006, but also in the mission integration process. I am also convinced that these projects have fostered scientific collaboration with Russian research institutions, and today some of these relationships still exist as legacy of this long collaboration.

I believe these experiences were also eye-openers for the Russian colleagues. Only few of them had had contact with European institutions before, and some did not speak English. It was very important for them to develop their working mode with ours.

4. What are the prospects for future further cooperation in space?

The legacy of the first bilateral collaborations in the manned space field exists today: joint research projects, exploitation of know-how on Russian vehicle design and mission definition are helping the operation of Columbus and ATV on a regular basis. Scientific research experiments have just finished (MARS 500), are ongoing (e.g. Immuno) or are going to be re-launched (e.g. PK4).

New initiatives are developing in the field of planetary exploration, long term medical research and robotic technologies. The path is open; it is up to the people who can exploit it to make good use of it in the years to come.

Concluding Remarks

In the summer of 1996 I was a participant at the Summer Session Program of the International Space University in Vienna, Austria. There was an interdisciplinary essay exam question to answer, asking about legal, engineering, and medical issues concerning an experiment done by an astronaut from a non-spacefaring nation onboard the space station, working on Russian hardware, and going down with US Space Shuttle.

For me and for my ISU SSP'96 classmates, this exam question was not from real life, it was more of an inspirational science fiction written by Arthur C. Clarke (who, by the way, was the ISU Chancellor at that time). ISU stands for more than two decades for teaching in international, intercultural, interdisciplinary and peaceful use of outer space, with inspiration and vision for multi-national cooperation in space.

In 1996, the International Space Station was expected to be launched soon; eleven years later, in 2007, at ISU SSP in Beijing, I organized an inter-agency panel on International Space Station utilization. I did share with ISU SSP'07 class my thoughts about this particular exam question at

ISU in Vienna in 1996 when I was SSP participant, but the difference is that by 2007 such cooperation was the reality: I was at that time responsible for the integration of an ESA medical experiment that would be done by a Malaysian astronaut, on the Russian research hardware, onboard the ISS.

So today's ISU exam questions should be dealing with flight of the international crew to Mars. As mentioned above, Soyuz-Apollo crew member Vance Brand predicted that joint flight to other planets would be a reality 20-30 years from middle of 1970s. Now we are 40 years after the ASTP event and we are already halfway through with the International Space Station in orbit, but the question as to when the flight to Mars can come true, in twenty or thirty years still from now, or less, remains open.

I think it is really good that in the era in which private space tourism is beginning, and in which broad commercialization of space is occurring, and quite severe competition in Earth the observation, telecommunications and other space integrated applications areas, there are still many opportunities left for international cooperation in space. Of course, current economic and financial challenges do reflect significantly on funding of national space programs worldwide, that subsequently influence or even sometimes threaten international cooperation projects and programs. From my point of view, it is still quite symbolic that nations of Earth cooperate and learn how to go together from the cradle, Planet Earth, to explore the far ends of the Universe, as the Russian space philosopher and pioneer Konstantin Tsiolkovsky dreamed in the 1900s.

The basis for that was formed by international cooperation started in the USSR with the Intercosmos Program, the Soyuz-Apollo Test Project, USSR-France collaboration, USSR-ESA cooperation, as well as others, all of which have shown that people from different nations and cultures share many of the same goals and aspirations, and can effectively meld their technical expertise to accomplish demanding mission goals while developing mutual respect, friendship, and tremendous new learnings for the benefit of all.

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Olga Zhdanovich, MSc

Olga Zhdanovich works in the secretariat of the European Cooperation for Space Standardization at ESTEC/ESA in the Netherlands. In 2006-2010 she worked as Payload Integration Manager for the International Space Station via RheaTech, responsible for the integration of various European research payloads for the ISS, as well as University level educational projects and programs.

She graduated with honors from the Moscow Institute of Engineers in Geodesy, Aerial Surveying and Cartography, Russia as engineer of cartography in 1990. Seven years later she received an MSc in Environmental Science and Policy from Central European University, Hungary/University of Manchester, UK. Although her principal area is remote sensing, during twenty years of her professional career she worked as a consultant on commercial application of space technologies in Earth observation, satellite navigation and telecommunication, as well as educational projects. Ms. Zhdanovich is Faculty of the International Space University and Co-Chair of IAF Sub-Committee on Global Workforce Development. She was the coordinator of the Forum on Space Activities in the 21st Century at UNISPACE III in 1999 in Vienna, and was the member of the Russian Federation Delegation to UN COPUOS in 2004-2005. Olga is recipient of national and international awards and scholarships that include a scholarship from the Royal Dutch National Academy of Sciences in 1995 for the International Institute of Applied Systems Analysis Young Scientist Program, and an award from the European Space Agency.

Olga was one of the three founding editors of the Novosti Kosmonavtiki magazine in Russia in 1991. She has authored a number of publications as chapters in books and conference papers on various applications of space technology as well as the Russian space program.

Contributor
Antonio Verga, Ph.D.

Antonio Verga has worked since 1988 for the European Space Agency at its establishment in Noordwijk, The Netherlands. He holds a doctor degree in nuclear engineering but he has been dealing for the last 25 years with physical science experiments in weightlessness. In this context, ESA deployed him in the early 90s to exploit the possibilities offered by Foton and Bion as platforms for science experiments in Microgravity.

He is currently the Head of the Unmanned Microgravity Platform Office at ESTEC (European Space Research and Technology Centre), Noordwijk, as part of the Directorate of Human Space Flights Programmes, Utilisation Department, Payloads and Platform Division. As the cooperation with unmanned Russian space project is standing still, he is nowadays managing the Sounding Rocket programs at ESA. During his professional carrier, Antonio Verga, participated in 2 SpaceLab missions with NASA, 6 Foton missions, 2 Bion projects, 6 European Sounding Rocket launch campaigns and 1 parabolic flight campaign with the Canadian Space Agency, published more than 30 scientific/technical papers, attended several international conferences, contributed to various issues of space journals and magazines, and lectured at seminars and topical schools for students. He is referee for SPIE and AIAA proceedings and papers. He is father of three children and fills his free time with sport activities and organizing events close to his Italian origin and traditions.

Contributor
Mark Samuilovich Belakovskiy, Ph.d., M.D.

Dr. Mark Samuilovich Belakovskiy, Ph.D., M.D., graduated from the First Moscow Institute of Medicine (1972) and finished postgraduate courses at the same institute in 1975. He has been working as the Head of Department at the Institute of Medical and Biological Problems since 1988.

Dr. Belakovskiy is a specialist in the field of research in nutrition and human body metabolism in different extreme conditions. He participated in a biomedical support of various activities such as: a) manned space flights on the Soyuz spacecraft series, orbital stations Salyut, Mir and the ISS; b) research on biological satellites; c) preparation and implementation of high-latitude scientific polar expeditions; d) the first expedition of Soviet mountain climbers to Mount Everest; e) expeditions to deserts; f) biomedical support of sportsmen for the participation at Olympic games, World and European championships, etc.

In IMBP Dr. Belakovskiy is responsible for the external relations and international cooperation, technology transfer of space medicine and biology. Since 1988 his Department has signed more than 350 contracts with organizations and companies including ESA, USA, Canada, Japan, Austria, Germany, France, Switzerland, Italy, and Chile. Dr. Belakovskiy took an active part in the preparation, organization and implementation of the international experiments HUBES-94, ECOPSY-95, ANOG-96, SFINCSS-99, MARS-500, performed at the Institute's facilities in Moscow, Russia.

The Department Headed by Dr. Belakovskiy also successfully performs innovative activities both in Russia and abroad. These activities are looking into transfer of space medicine and biology technologies into the daily practice of national public health service and industry.

Dr. Belakovskiy is Laureate of the Russian Federation State Prize Award, he is the Full Member of International Academy of Astronautics and Russian Academy of Cosmonautics named after Konstantin E. Tsiolkovsky.

The results of research carried out by Dr. Belakovskiy are presented in more than 180 scientific publications.

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