# 25 Years of European Human Spaceflight

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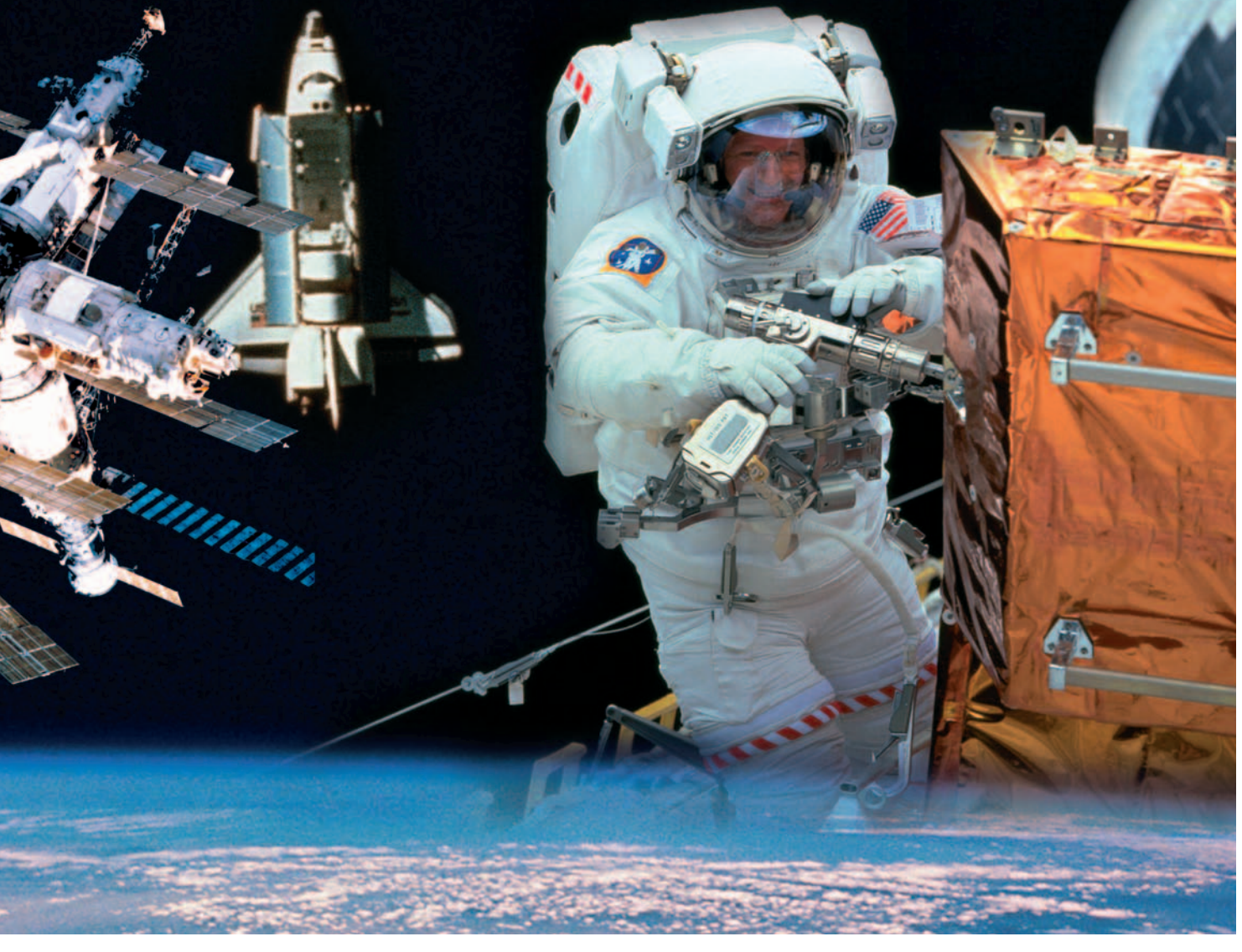
Just a few weeks ago, on 28 August 2003, in the company of the President of the Federal Republic of Germany, Johannes Rau, we celebrated the 25th Anniversary of Sigmund Jähn's flight to the Russian Salyut 6 space station aboard a Soyuz spacecraft. This flight lasted from 26 August until 3 September 1978 and was actually the third flight by a European astronaut, following those of Czechoslovakia's Vladimir Remek and Poland's Miroslav Hermascewski in 1978.

This year we also celebrate the 20th Anniversary of the first Spacelab flight (STS-9) with the ESA astronaut Ulf Merbold, who was in orbit from 28 November until 8 December 1978, together with five American astronauts. He had trained for more than five years for that flight, together with his ESA colleague Wubbo Ockels who served as his back-up.

A total of 44 missions involving 30 astronauts from ESA Member States have taken place, 26 of which were performed in co-operative programmes with NASA, whilst 18 flights used Russian space vehicles.

Two more missions are presently planned, one with the Soyuz vehicle and one with the Space Shuttle, all to the International Space Station (ISS). With an average of two flights taking place per year and a good balance of cooperative missions with Russia and the United States, Europe has achieved a high level of astronaut missions with outstanding scientific results and operational experience.

The integration of all European astronauts into a single European Astronaut Corps, presently comprising 15 astronauts, and the creation of an EAC Team made up of experts from several Member States and ESA, has created an efficient support organisation enabling Europe to master future missions and their effective preparation.




*Cosmonauts and astronauts during the celebration of "25 Years of German Spaceflight" in August 2003, together with German President Johannes Rau and Edelgard Bulmahn, Minister of Education and Research (fourth and second from right in front row)*

## The Beginnings

The start of Europe's involvement in human spaceflight activities dates back to 1969, when NASA invited ESA to participate in the Post-Apollo Programme. In December 1972, Europe opted to develop the modular Spacelab system as an integral element of the US Space Transportation System. The maiden flight of Spacelab in November 1983 saw the first ESA astronaut, Ulf Merbold, venturing into space as the first non-American astronaut on a US space vehicle.

In 1971, while in the USA the Apollo Programme was still in full swing, the Soviet Union had launched and tested its first space station, Salyut 1. After making several modifications to the following Salyuts, the second-generation Salyut 6 and 7 stations appeared in 1977 and 1982, respectively. With an additional docking port to receive the unmanned Progress logistics spacecraft, the crews could stay aboard the station for a longer period, and visiting crews were able to join them. Cosmonauts mainly from other Soviet-bloc countries were invited during the 'Intercosmos Programme' to visit the stations. The first non-Russian was Vladimir Remek from Czechoslovakia in 1978, and the third was the German Sigmund Jähn from the German Democratic Republic in the same year.

*Signing of the Memorandum of Understanding for implementation of the Spacelab programme on 24 September 1973*

*Ulf Merbold during the Spacelab-1 mission*

Until the disintegration of the Soviet Union, the Russian-built space stations hosted other astronauts from ESA Member States, selected and trained for their missions through their national space agencies. The first of them was the Frenchman Jean-Loup Chrétien from CNES, who visited Salyut 7 in 1982.

The subsequent years were characterised by cooperative programmes between the two providers of human-rated transportation systems, the USA with its Space Shuttle and Russia with its Soyuz rocket on one side, and ESA, national agencies and even private ventures, with Helen Sharman as the first female European cosmonaut to visit Mir (in 1991), on the other.

The time after the first recruitment of European astronauts in 1977 by ESA, followed by the establishment of astronaut offices at CNES and DLR in 1980 and 1983, respectively, saw the cooperation between ESA and NASA grow within the Spacelab development and utilisation plan, and thus also the training of ESA astronauts as mission and payload specialists to fly on the Space Shuttle. During this period, DLR had its own cooperative bilateral programmes with NASA, by exploiting its national Spacelab-D1 and D2 missions. Also, CNES had a strong cooperative programme, with its astronauts flying on both the Russian and the US space vehicles.

Altogether, therefore, ESA, CNES and DLR astronauts made a number of such cooperative flights with the USSR/Russia on the Soyuz rocket to the Russian Salyut and Mir space stations, and with NASA on the Space Shuttle for science, satellite deployment and repair missions, and missions to the Mir space station and lately to the ISS.

When US President Ronald Reagan first announced the Space Station (called 'Freedom' at that time) project in 1984 and invited in following years the active participation of Europe, Japan and Canada, ESA began its own ambitious programme, encompassing the Columbus Programme with the Attached Pressurised Module for the Space Station, the Man-Tended Free Flyer, the serviceable Polar Platform and the manned Hermes spaceplane. In addressing the resulting long-term need for astronauts, ESA also established the European Astronaut Centre (EAC) in 1990 in Cologne (D), and initiated its second astronaut-selection process a year later. Only in 1998 did the ESA Council decide to create a single European Astronaut Corps by integrating astronauts from the Member States' national space agencies into the existing ESA Astronaut Corps.

Hence the legacy of Human Spaceflight in Europe is now being carried forward by ESA, based on the heritage of 44 astronaut missions with 30 European astronauts on 37 missions, 19 with the Space Shuttle and 18 with the Soyuz transportation system.

## Milestones in Human Spaceflight

| | | |
|---|---|---|
| 12 April 1961 | 1st human in space: | Yuri Gagarin |
| 21 July 1969 | 1st human on the Moon: | Neil Armstrong |
| 2 March 1978 | 1st European in space: | Vladimir Remek (CSR) |
| Nov/Dec. 1983 | 1st ESA astronaut in space: | Ulf Merbold (Spacelab-1) |
| May 1990 | Birth of European Astronaut Centre (EAC) | |
| Sept. 1995/Feb. 1996 | Longest European spaceflight: | Thomas Reiter (Mir) |
| March 1998 | Formation of the single European Astronaut Corps, integrating all ESA Member State astronauts | |
| April/May 2000 | First European visit to the ISS: | Umberto Guidoni (STS-100) |

# ESA and ESA Member State Astronauts in Space

| Ass. | Name | Fl# | Organisation | Mission Programme/ Payload | Space Vehicle(s) | Year |
|---|---|---|---|---|---|---|
| 1 | (1) S. Jähn (D) | 1 | IKF (former GDR) | Interkosmos | Soyuz-31 / Salyut-6 / Soyuz-29 | 26 Aug. – 03 Sep. 1978 |
| 2 | (2) J.-L. Chrétien (F) | 2 | CNES | Premier Vol Habité | Soyuz T-6 / Salyut-7 | 24 Jun. – 02 Jul. 1982 |
| 3 | (3) U. Merbold (D) | 3 | ESA | Spacelab-1 | STS-9 | 28 Nov. – 08 Dec. 1983 |
| 4 | (4) P. Baudry (F) | 4 | CNES | Spartan-1 | STS-51 G | 17 Jun. – 24 Jun. 1985 |
| 5 | (5) R. Furrer (D) | 5 | DFVLR | Spacelab-D1 | STS-61 A | 30 Oct. – 06 Nov. 1985 |
| 6 | (6) E. Messerschmid (D) | | DFVLR | | | |
| 7 | (7) W. Ockels (NL) | | ESA | | | |
| 8 | (2) J.-L. Chrétien (F) | 6 | CNES | Aragatz | Soyuz TM-7 / Mir / Soyuz TM-6 | 26 Nov. – 21 Dec. 1988 |
| 9 | (8) H. Sharman (UK) | 7 | Private Funding | Juno | Soyuz TM-12 / Mir / Soyuz TM-11 | 18 May – 26 May 1991 |
| 10 | (9) F. Viehböck (A) | 8 | ASA | Austromir | Soyuz TM-13 / Mir / Soyuz TM-12 | 02 Oct. – 10 Oct. 1991 |
| 11 | (3) U. Merbold (D) | 9 | ESA | Spacelab International Microgravity Lab IML-1 | STS-42 | 22 Jan. – 30 Jan. 1992 |
| 12 | (10) K.-D. Flade (D) | 10 | DARA / DLR | Mir'92 | Soyuz TM-14 / Mir / Soyuz TM-13 | 17 Mar. – 25 Mar. 1992 |
| 13 | (11) D. Frimout (B) | 11 | Belgium | ATLAS-1 | STS-45 | 24 Mar. – 02 Apr. 1992 |
| 14 | (12) M. Tognini (F) | 12 | CNES | Antares | Soyuz TM-15 / Mir / Soyuz TM-14 | 27 Jul. – 10 Aug. 1992 |
| 15 | (13) F. Malerba (I) | 13 | ASI | Eureca-1, Tethered Satellite System | STS-46 | 31 Jul. – 08 Aug. 1992 |
| 16 | (14) C. Nicollier (CH) | | ESA | | | |
| 17 | (15) H. Schlegel (D) | 14 | DARA / DLR | Spacelab-D2 | STS-55 | 26 Apr. – 06 May 1993 |
| 18 | (16) U. Walter (D) | | | | | |
| 19 | (17) J.-P. Haigneré (F) | 15 | CNES | Altaïr | Soyuz TM-17 / Mir / Soyuz TM-16 | 01 Jul. – 22 Jul. 1993 |
| 20 | (14) C. Nicollier (CH) | 16 | ESA | Hubble Telescope 1st Servicing Mission | STS-61 | 02 Dec. – 13 Dec. 1993 |
| 21 | (3) U. Merbold (D) | 17 | ESA | Euromir 94 | Soyuz TM-20 / Mir / Soyuz TM-19 | 03 Oct. – 04 Nov. 1994 |
| 22 | (18) J.-F. Clervoy (F) | 18 | ESA | ATLAS-3; CRISTA SPAS 1 | STS-66 | 03 Nov. – 14 Nov. 1994 |
| 23 | (19) T. Reiter (D) | 19 | ESA | Euromir 95 | Soyuz TM-22 / Mir | 03 Sep. '95 – 29 Feb. 1996 |
| 24 | (14) C. Nicollier (CH) | 20 | ESA | Tethered Satellite System-1 Reflight USMP-3 | STS-75 | 22 Feb. – 09 Mar. 1996 |
| 25 | (20) M. Cheli (I) | | | | | |
| 26 | (21) U. Guidoni (I) | | ASI | | | |
| 27 | (22) J.-J. Favier (F) | 21 | CNES | Spacelab LMS-1 | STS-78 | 20 Jun. – 07 Jul. 1996 |
| 28 | (23) C. André-Deshays (F) | 22 | CNES | Cassiopée | Soyuz TM-24 / Mir / Soyuz TM-23 | 17 Aug. – 02 Sep. 1996 |
| 29 | (24) R. Ewald (D) | 23 | DARA / DLR | Mir'97 | Soyuz TM-25 / Mir / Soyuz TM-24 | 10 Feb. – 02 Mar. 1997 |
| 30 | (18) J.-F. Clervoy (F) | 24 | ESA | 6th Shuttle flight to Mir | STS-84 | 15 May – 24 May 1997 |
| 31 | (2) J.-L. Chrétien (F) | 25 | CNES | 7th Shuttle flight to Mir | STS-86 | 25 Sep. – 06 Oct. 1997 |
| 32 | (25) L. Eyharts (F) | 26 | CNES | Pégase | Soyuz TM-27 / Mir / Soyuz TM-26 | 29 Jan. – 19 Feb. 1998 |
| 33 | (26) P. Duque (E) | 27 | ESA | SpaceHab | STS-95 | 29 Oct. – 07 Nov. 1998 |
| 34 | (17) J.-P. Haigneré (F) | 28 | CNES, ESA | Perseus | Soyuz TM-29 / Mir | 20 Feb. – 28 Aug. 1999 |
| 35 | (12) M. Tognini (F) | 29 | CNES | Chandra X-Ray Observatory | STS-93 | 22 Jul. – 27 Jul. 1999 |
| 36 | (14) C. Nicollier (CH) | 30 | ESA | Hubble Space Telescope 3rd Servicing Mission | STS-103 | 19 Dec. – 27 Dec. 1999 |
| 37 | (18) J.-F. Clervoy (F) | | | | | |
| 38 | (27) G. Thiele (D) | 31 | DLR, ESA | Shuttle Radar Topography Mission | STS-99 | 11 Feb. - 22 Feb. 2000 |
| 39 | (21) U. Guidoni (I) | 32 | ESA | 9th ISS flight (6A) Raffaello MPLM | STS-100 | 19 Apr. - 01 May 2000 |
| 40 | (23) C. Haigneré (F) | 33 | CNES, ESA | Andromède – ISS flight | Soyuz TM-33 / Soyuz TM-32 | 21 Oct. - 31 Oct 2001 |
| 41 | (28) R. Vittori (I) | 34 | ASI, ESA | Marco Polo | Soyuz TM-34 / Soyuz TM-33 | 25 Apr. – 05 May 2002 |
| 42 | (29) P. Perrin (F) | 35 | CNES | ISS flight UF-2 | STS-111 | 05 Jun. - 19 Jun. 2002 |
| 43 | (30) F. De Winne (B) | 36 | Belgium, ESA | Odissea | Soyuz TMA-1 / Soyuz TM-34 | 30 Oct. – 10 Nov. 2002 |
| 44 | (26) P. Duque (E) | 37 | Spain, ESA | Cervantes | Soyuz TMA-3 / Soyuz TMA-2 | 18 Oct. – 28 Oct. 2003 |
| *Mission assignments* | | | | | | |
| 45 | (31) A. Kuipers (NL) | 38 | Netherlands, ESA | Delta; back-up: (27) G. Thiele (D) | | April 2004 |
| 46 | (32) C. Fuglesang (S) | 39 | ESA | ISS assembly flight 12-A.1 | STS-116 | 2005 |

30 European astronauts participated in 37 spaceflight missions, the sum of missions for all astronauts is 44
Flown as astronauts: D: 10; F: 9; I: 4; B: 2; NL: 2; A: 1; CH: 1; S: 1; E: 1; UK: 1 (including current assignments)
Assignments per Country: F: 16; D: 13; I: 5; CH: 4; B: 2; E: 2; NL: 2; A: 1; UK: 1; S: 1

Status November 2003

## Cooperative Programmes with NASA

Within its cooperative programmes, and subject to the constraints of the Space Shuttle schedule, mission objectives and overall operations requirements, NASA offered 'best effort' flight assignments to ESA and national agency astronauts working and training at its Johnson Space Center in Houston. As far as possible, NASA treats these astronauts, once accepted and integrated into the NASA Astronaut Office, just like US astronauts in terms of flight assignments. In the past, its goal was to assign astronaut candidates to their first flight within three years of successful completion of their 'Basic Training'.

In this context, NASA and ESA have always recognised and supported the objective of a joint astronaut training approach under a 'Mission Specialist Training Agreement', to ensure the availability of qualified Mission Specialist members of the European Astronaut Corps as a key element in the continued success of ESA/NASA cooperation. This cooperation has led in the past to space flights developed through joint programmes such as Spacelab, Eureca, Hubble Space Telescope, Tethered Satellite, SRTM and MPLM, involving NASA, ESA and the ESA Member States, and now most recently the International Space Station.

Spacelab was the result of negotiations in which contributions to the Space Shuttle Programme and elements of space stations were discussed. Europe, at that time represented by the European Space Research Organisation (ESRO, which was ESA's predecessor), focused more and more on the development of a space laboratory in which scientific missions of up to nine days' duration could be conducted.

*Umberto Guidoni, Mission Specialist on STS-100, training at the NASA Johnson Space Center*

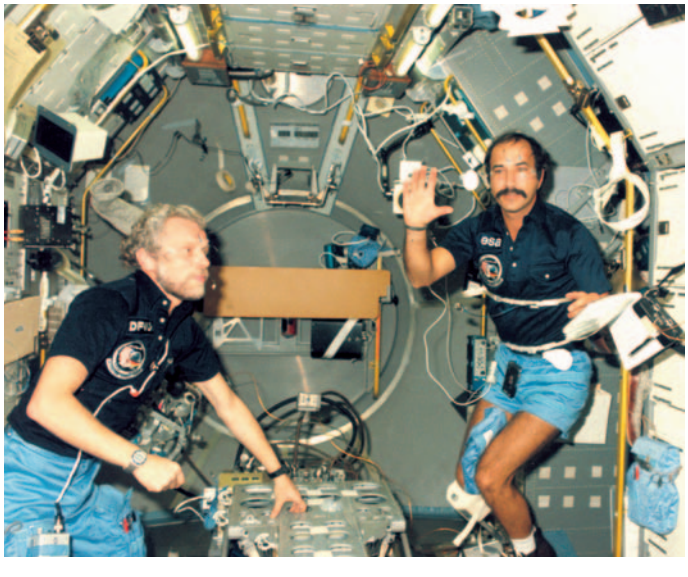
The laboratory's initial design was as a 'Sortie Can' to be carried into orbit in the Space Shuttle's cargo bay. Its initially agreed free-flying mode was later abandoned, and it thus became 'Spacelab'. Unlike Skylab, the first US space station which had been integrated mostly from existing Apollo hardware and was launched in 1973, Spacelab was a new construction offering a much wider range of applications.

As a result of its numerous missions, Spacelab turned out to be the most important and most frequently flown Shuttle payload system to date. Between 1982 and 1998, when the Spacelab Programme was terminated after the NASA Neurolab mission, the Long Module of Spacelab flew 16 times, primarily for life and physical sciences payloads, and Spacelab Pallet-only missions were flown six times, primarily for disciplines like astronomy, astrophysics and atmospheric physics. Together with the non-ESA astronauts, nine Europeans worked aboard Spacelab, as researchers and systems and payload specialists.

## Cooperative Programmes with the Soviet Union/Russia

The first generation of Soviet space stations, from Salyut 1 to Salyut 5, was characterised by a number of technological and operational achievements important for the sustained operation of space stations, but also by a number of failures. Although Salyut 1 was launched and tested successfully, this first mission ended tragically when all three cosmonauts lost their lives following the sudden decompression of their Soyuz capsule during reentry. After a brief pause and several redesigns, the crewed flights to the Salyut stations were resumed.

The second-generation Soviet space station Salyut 6 (1977-82) received 16 crews, carried aloft by 12 Progress capsules, and Salyut 7 (1982-1991) 10 crews, transported by 13 Progress capsules with 25 tonnes of equipment and propellant. Each of these



*ESA astronauts Reinhard Furrer (left) and Wubbo Ockels conducting experiments during the Spacelab-D1 mission in 1985*

stations hosted six long-duration flights, in which the stays onboard were increased from 185 days (Salyut 6) to 237 days. Thanks to the additional Progress logistics craft, many science-trained astronauts from Soviet-bloc countries were able to visit the two stations as part of the Interkosmos Programme. Vladimir Remek (CZ), Miroslav Hermascewski (PL) and Sigmund Jähn (GDR) were followed as non-Russian cosmonauts by G. Ivanov from Bulgaria in 1979, B. Farkas from Hungary in 1980, and D. Prunariu from Romania in 1981. The CNES astronaut Jean-Loup Chrétien followed in 1982 as the first astronaut from an ESA Member State to visit the Salyut station.

In February 1986, the third generation of Russian space stations was introduced with the launch of the Mir core module, and five other modules, Kvant (1987), Kvant 2 (1989), Kristall (1990) Spektr (1995) and Priroda (1996), followed. Unlike the earlier stations, Mir had at its front end a six-fold berthing adapter, which meant that four additional modules, besides Soyuz and Progress spacecraft, could be attached.

By 1990, the T-shaped Mir station measured 33 m in length, was 28 m high, and had an overall mass of 70 tonnes. However, the Soviet Union's political and social restructuring was already giving rise to public discussion about the aims and objectives of manned spaceflight. After the Union's dissolution this discussion continued, leading ultimately to the cancellation of the Buran spaceplane and Energia heavy-lift launcher programmes. Thus only one of the three main programmes survived, the Mir space station. Except for two short breaks, from July 1986 to February 1987 and from April to September 1989, this station was permanently crewed until just a few weeks before its de-orbiting in March 2001. European Astronauts made a total of 12 missions to Mir, including the record 179-day flight by Thomas Reiter in 1995/96.

*The Mir station*

*Thomas Reiter during his mision aboard Mir in November 1995*

## Current and Future Activities at the European Astronaut Centre

The roots of ESA's European Astronaut Centre (EAC) in Cologne (D) reach back to 1977. At that time, the Agency's first four astronauts were selected, following a pre-selection process by the Member States, for training for the Spacelab-1 mission. The Centre was formally created, to meet the developing long-term need for astronauts, in May 1990, when the Host Agreement between ESA and the German national authorities was signed.

EAC rapidly became the home base for all European astronauts, following the selection of six more astronaut candidates in 1992. As Hermes, the Free-Flyer and the Polar Platform had all been cancelled by then, the Centre focused on supporting ESA's astronauts assigned to International Space Station precursor missions aboard the Shuttle/Spacelab and Mir. Their training programme was developed in close cooperation with NASA and Russia's Gagarin Cosmonaut Training Centre, and was first applied to the payload training for the Euromir-94/95 missions.

A key milestone for EAC was the ESA Council decision in March 1998 to integrate all European astronauts henceforth into a single European Astronaut Corps. This integration process, recently finally completed, has resulted in a Corps of presently 15 astronauts. Its structure, including the number and age distribution of the astronauts,

*The European Astronaut Corps. From left-front: Duque, Thiele, Clervoy, Guidoni, Eyharts, Ewald, Vittori and Nicollier. From left-back: Nespoli, Reiter, Fuglesang, De Winne, Tognini (left Corps in May 2003 to become Head of Astronaut Division, EAC), Schelgel, Perrin and Kuipers*

is driven by the capabilities required to support European human spaceflight missions for the pursuit of space exploration, science and technology, and their applications, consistent with approved and planned funding, and with particular emphasis on flights to the ISS.

In parallel with the coming together of Europe's astronauts, an expert staff for astronaut training and medical support was also assembled at EAC, with team members being seconded from the German, French and Italian space agencies. Started in April 2000 for an initial period of 4 years, this initiative has recently been extended until 2007. This very successful cooperative endeavour covers all aspects of astronaut activities, such as the management of the European Astronaut Corps, the training of ISS-bound astronauts from ESA and all of the Partners, and the necessary medical support.

The formation of the single European Astronaut Corps and the build-up of the EAC Team were important decisions that have ultimately provided Europe with an organisation matching its responsibilities as an ISS Partner and allowing for significant savings in the national budgets. However, an updating of the originally established European Astronaut Policy was eventually needed to take into account many new developments, including the expected number of flight opportunities, the evolution of the ISS programme and the Station's commercial utilisation aspects, together with the inclusion of tools for flexible management of the Corps.

In June 2002, therefore, the ESA Council approved an updated Policy, including such important aspects as: Selection and Recruitment, Mission Assignment, Management of the Astronaut Corps, Astronaut Public Appearances, Support to Commercialisation, Nationally Sponsored Missions, Other Roles for European Astronauts, and National Agency Support to EAC. With this updated Policy, there are now clear guidelines in place for the future activities of the Centre, with training focusing for the next decade on the preparations for and execution of astronaut missions to the ISS, be they short-duration (about 2 weeks) or full-increment (up to 6 months) missions, either with Soyuz vehicles or with the Space Shuttle.

Apart from being the home base of the European astronauts and the management and technical base for ESA's astronaut activities, EAC has become the focal point for all ISS astronaut training on European elements of the Space Station, including the Columbus module, its onboard scientific facilities, and the ATV. These activities have already started and will reach their peak in 2004.

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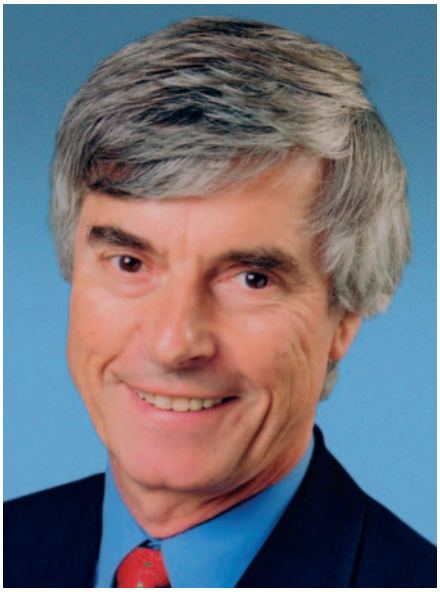

**Ulf Merbold, born in June 1941 in Greiz, Germany, was the first ESA astronaut to fly in space and the first non-American aboard a US spacecraft. Twenty years ago, from 28 November to 8 December 1983, Merbold flew on the Space Shuttle as a Payload Specialist for the NASA-ESA Spacelab-1 mission. He returned to space in January 1992 for the Shuttle's IML-1 International Microgravity Laboratory Spacelab mission, and he then became the first ESA astronaut aboard Russia's Mir space station for the Euromir-94 mission of 3 October to 4 November 1994.**

***In spaceflight, has anything changed significantly since you first went up on Spacelab-1 in 1983 as the first ESA astronaut?***

Yes – today, we have a very different and in my opinion better situation. First and most important of all is that the Cold War is now history and that consequently the major space powers have moved from confrontation to cooperation. All countries that have a potential to fly to space are involved in constructing the International Space Station (ISS). And on a more scientific and less political level: the ISS is a reality, it is a laboratory that is available to scientists not only for a few days, but for long periods of time – and they are using it 24 hours a day hopefully for the next 15 years.

Another very recent important change is that China has just launched its first 'taikonaut'. This should lead to a more intensified initiative in Europe than there has been in the last ten years – either to cooperate with China or to push European research and development. A new crew capsule from Europe, for example, would make the ISS much more valuable. We do not have a rescue system on the ISS that could bring six or seven astronauts and cosmonauts back to Earth in an emergency. Ignoring the impact of the *Columbia* catastrophe, there is only capacity for a crew of three onboard ISS in the near future. A rescue capsule would mean a crew of six or seven and more time and manpower for science, and at the same time it would upgrade Europe from a junior partner to a major player on an equal footing with the United States and Russia.

As far as science is concerned, Europeans are well established and recognised in this field. This was already the case at the time of Spacelab. Our experiments – past and future ones – are at least of the same quality as US experiments, if not better. On Spacelab, we had 72 experiments from a huge variety of scientific disciplines – plasma physics, earth observation, atmospheric physics, material sciences, physiology, astrophysics and many more. Resources, including astronaut time and energy, were shared equally between the US and Europe, even though there were 13 American and 59 European instruments. Although in comparison this meant an advantage in resources for the Americans, our experiments were more sophisticated and extremely well prepared, so they delivered the more impressive results!

***How and why did you become an astronaut?***

I have a strong curiosity and I love science. I worked for ten years in the Max Planck Institute for Metals Research in Stuttgart, studying point defects in metals in the field of experimental solid-state physics. It was a fascinating time because Max Planck Institutes are leading scientific institutions in Germany. However, I did not like concentrating on a single narrow field of science in order to be efficient and create new scientific knowledge. Science nowadays is such a tremendously vast field that it is impossible for one single human being to know everything. I was about 35 or 36 and felt that I was at a point in life to take a strategic decision, either to continue in my career and become a professor or to add new disciplines to what I knew already. I browsed through weekend newspapers and came across an ad where the German Aerospace Centre (DLR) on behalf of ESA announced the opportunity to fly on the first Spacelab mission as a payload specialist. In terms of scientific fields this was a very colourful and attractive programme. I loved flying anyhow, and so I applied. After one year I signed my ESA contract to become one of the first three ESA astronauts – and I do not regret this!

At that time it was still not certain whether human spaceflight would be accepted as a permanent programme within ESA or whether it would be terminated after Spacelab-1. There were times when I did not feel secure, but it was a great endeavour. It was fascinating to work with so many different scientists, to talk to and learn from so many people from different backgrounds. Wubbo Ockels and I put our noses into all of the various fields – vestibular research, plasma research (trying to produce artificial northern lights by firing powerful electron beams into the atmosphere), biology, physiology, etc.

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## Space – Where Humans Make a Difference…

Twenty years since Spacelab-1! I remember the hard work, the excitement, the anticipation of great things, but also the concern about events possibly going wrong on this mission at the end of 1983. This was really a pioneering effort. The first time that ESA, NASA, aerospace industry groups and a large number of scientist teams from all over Europe and the United States worked together on a human spaceflight with the Shuttle freshly out of its official orbital test phase (and we know now that it never really got out of this test phase, even after more that 100 flights…), a laboratory made in Europe on its first flight, and an array of scientific experiments covering all disciplines of the space sciences. What a challenge! And what a success! I really think that Spacelab-1 set a positive tone for all the Shuttle-based space science missions that followed, and there were many of them. My congratulations to the whole team, and my gratitude for proving a capability that had never been demonstrated before! My deepest respect for the flight crew, also, led by John Young, with Brewster Shaw, Owen Garriott, Robert Parker, Byron Lichtenberg and, last but not least, Ulf Merbold.

As a member of the first group of ESA astronauts, together with Ulf Merbold and Wubbo Ockels, I followed the final steps of preparation for this mission and the mission itself with great interest, although I had stopped being directly involved with it since mid-1980. Wubbo successfully flew a couple of years later on the Spacelab-D1 mission. My turn came much later, in July 1992, and on a very different kind of mission: deployment of the Eureca Scientific Platform, and performance of the first test of the Italian-American Tethered Satellite System (TSS-1). I had the great privilege of taking part in three additional spaceflights before the end of 1999. Two of these were visits to the NASA/ESA Hubble Space Telescope (HST) for repairs and maintenance of the orbiting observatory. I did not fly on Spacelab but had the opportunity to serve the scientific community by other means!

Human intervention on HST has been very successful on all servicing mission so far. Although quite complex, the Telescope would have been immensely more complex and expensive had it been designed to be serviced by robotic means. It would have remained ineffective (spherical aberration caused by the faulty shape of the primary mirror, 1990; jitter caused by the original solar arrays, 1990), and later decommissioned (rate sensor unit failures, 1999) without in-orbit servicing capability. On numerous occasions during the three servicing missions so far the flexibility of human intervention was used to engage alternate vs. planned operational paths, which is typically the kind of action robots or automatic systems are not well suited for (solar array jettison, 1993; HST aft shroud door opening and closing problems, 1993 and 1999).

The Tethered Satellite System was another Shuttle payload whose operation was heavily dependent on humans. Satellite deployment and retrieval and the active damping of the satellite and tether oscillation modes were strictly dependent on manual intervention with the Orbiter's thrusters. Here again, this was a question of cost. The system was very experimental and it would have been unwise to pay the large cost of automation for a complex system in its early testing and development stage. The TSS concept has not been pursued in its dynamical and electrodynamical applications for International Space Station support, but it is only a question of time before the concept comes back as an effective way to control Station orbital altitude without the use of propellant.

In addition to Spacelab, HST and TSS are two examples of Shuttle-borne, operated or serviced systems where human involvement in orbit made a huge difference. In general, interactive space laboratory facilities, complex space systems servicing and maintenance, or new systems in their test or early development stage, benefit enormously from human intervention in space.

We have benefited tremendously from all aspects of space utilisation and exploration since we first ventured beyond the Earth's atmosphere more than forty years ago, and since the first Spacelab mission twenty years ago. I am absolutely convinced that we should continue the journey, build on what has been accomplished so far in research and exploration, and finally attempt to establish and exploit several working regions in space, properly interconnected. Achieving such objectives will make a significant difference to future human development.

*Claude Nicollier*
*ESA Astronaut*

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In my opinion, a good experiment has to be at the border between the known and the unknown because it tries to find new results. We not only had to familiarise ourselves with the basics of the new fields, we actually had to reach the top of knowledge, the grey area between the known and the unknown, in order to understand and operate the experiment properly. We learned the means and methods of all the experiments and the reasons why they had to do it in orbit. It was a sparkling intellectual atmosphere!

Spaceflight is intensely emotional – but it is also intensely intellectual. I think I am really lucky to have had the opportunity to widen my views from a narrow field to a more general knowledge. We also had to learn many practical things, like drawing a blood sample, and got a lot of hands-on training. After all, performing experiments is like playing the violin or any other instrument: you have to know the theory to produce sounds, but you also have to develop skills and a sense for virtuosity.

***You said that spaceflight is both emotional and intellectual. You have spoken a lot about the intellectual side – how about your emotions when you heard that you would fly?***

That was a situation of mixed feelings – Wubbo and I were close friends, we had been working together for two years in Huntsville, Alabama and at the end of the training in the Marshall Spaceflight Center we knew that only one of us could be the first. However, when the German government decided to fly the German-D1 mission, Mr Finke, a high official in the Ministry, promised that the astronaut serving as backup for Spacelab-1 would fly on D1, so in the end it was not that complicated because we both had the guarantee that we would fly.

In Huntsville, we had been working with the computer system that simulated the complete Spacelab-1 configuration, scientific experiments and potential problems. We had the same knowledge, and in the end the investigators' working group had to take the decision between the two of us and their recommendation was in my favour. Of course I was happy, but I would have preferred to have the opportunity to share the experience with him. After all these years I am still grateful to Wubbo that he, after a very short moment of frustration, accepted to be the backup and to do his utmost to make Spacelab-1 a successful flight. The success of this mission was also a boost to continue with D1. After my flight, Wubbo and I went straight into training for the next mission, this time with reversed roles.

***Let's talk about the flight itself. What do you remember most, both in terms of science and the flight experience?***

*Valery Polyakov taking a blood sample from Ulf Merbold during his Mir mission*

I couldn't pick one memory above the other, there are so many… We as crew had different roles. For some experiments we were merely lab technicians – we put materials sealed in cartridges into furnaces, heated, melted, solidified the materials, pushed buttons and started computer programs. In other cases we were in scientific control of the experiments, and some of them were almost artistic – for example a silicon crystal experiment in a furnace called the Mirror Heating Facility. The investigator taught us to observe the liquid zone of the crystal rod, make an assessment of how long it would take until it would become unstable, what the material should look like and what to expect to be able to judge the next step. From a crew point of view, these experiments are more interesting of course.

I also remember experiments from a team from the University of Mainz in Germany – they had all sorts of different vestibular experiments, and we had to work in a team with one astronaut acting as test subject and another performing the tests. These experiments had many functional objectives, and after a lot of training the experimenters gave us carte blanche. "You have control because you know as much as we do, use your senses", they said. Of course this kind of relationship has two sides: we were proud that they trusted us, but we also felt a huge responsibility.

Many of the experiments were fantastic science with fantastic results. One of them is a phenomenon that is still unexplained today – the fact that the caloric nystagmus can also be stimulated in microgravity. Theory predicted it couldn't because it is a reflex that scientists thought had to do with convection in the inner ear. The nystagmus reflex originates from the inner ear and acts on the eye; the ear is in a way 'calling on the eye for help' to find out what kind of movement it experiences, and it can be stimulated either by spinning the test subject or heating one and cooling the other outer ear.

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## The Road Ahead is Open...

Coming from an operational background, I would like to focus on the particular need of 'operational expertise'. In the fifties and sixties, the space budgets of the space-faring nations were almost unlimited and dreamers and explorers shaped the conquest of space. These dreams have given way to reality. Nowadays, space exploration is dictated by accounts and budgets. But space is more than just short-term investment in technology and research. People are not only scientists or engineers; they are also poets, dreamers, explorers and adventurers. In the past, these explorers and adventurers have discovered and opened new frontiers. Humankind has conquered the land, the oceans and the sky, and finally we have made our first steps into space. We will always try to go beyond the next horizon, to explore the unknown; it is in our genes. Every time we have done so, the long-term results have proved to be beneficial. Every day, we travel safely on the seas and in the air. Now the time has come for humankind to take the next logical step: the establishment of a civilisation that routinely ventures out in space. Despite budget difficulties and dramatic setbacks such as the loss of the Space Shuttle *Columbia*, we now have established a permanent human presence in space with the ISS. It is imperative that we continue to invest wisely. In the past, Europe has done this and has acquired independent unmanned access to space. However, if it wants to be a major player in further space exploration and in establishing day-to-day space travel, it will also have to establish a capability in human access to space. This will require not only the further development of new technologies but also the establishment of solid operational expertise. In my past career as a military pilot I have participated in several operations. Although technology has always played a big part in the success, the biggest contributor was without doubt the people (ground crew and aviators alike) who participated in the operations. Their motivation, resourcefulness and inventiveness to solve problems, their ability to adapt quickly to ever-changing situations and their capacity to work as a team made all the difference. These capabilities were acquired through many years of training and investment in operational skills. In reading the initial reports of the crew aboard the International Space Station, I find much resemblance to this. The years of investing in training, operation centres, procedures and Mir and Shuttle operations are really paying off. The role of Europe in manned spaceflight will depend greatly on the quality of its operators and on the will to invest in people as well as in technology. Therefore it is absolutely necessary as we move towards more operational capabilities by developing additional hardware that Europe also continues to invest in human operational expertise. The first steps into space have already been taken. The road ahead is open. All Europe really needs is the will to travel.

*Frank De Winne*
*ESA Astronaut*

We didn't have many real ESA Spacelab flights. It is a pity that we built this wonderful laboratory and did not have a utilisation programme. We participated as 'guest agency' in other Spacelab flights, for example the International Microgravity Laboratory, which was basically a NASA mission with ESA participation. Mission management, astronaut training, etc. were in the hands of NASA. ESA also participated in D1, which was a German flight. Again, there was no ESA mission management responsibility; we were just flying experiments, just like on D2. After D1 came the decision not to continue with vestibular experiments because space was needed for the Anthrorack, which concentrated more on cardiovascular experiments. So it is still an open question why the caloric nystagmus can be stimulated in microgravity.

### *How was life on board?*

It was marvellous. Spacelab was a very comfortable lab, and it is sad that NASA stopped with it after roughly 20 flights and switched to Spacehab. Spacelab worked perfectly, it was quiet, had a good life support system, super air quality, nice illumination and other fantastic features, for example the airlock through which we could transfer experiments into space and back into the lab. There was also a high-quality optical window in the ceiling of the module, so you could turn the Shuttle so that the window faced Earth for an undisturbed view. A camera system took distortion-free pictures, and in the few free moments between experiments we had breathtaking views through the viewports. Next to all the other impressions, the views are what make an astronaut's life an incredible experience. Earth is incredibly beautiful, and so are the stars in the black sky, the Sun in the black sky…

### *How was working on Spacelab different from working on Mir?*

Spacelab and Mir are two completely different science laboratories. On Mir, you had 15 years for experiments – on Spacelab ten days. That means that we had a strict timeline and there was almost no extra time if an experiment developed problems. On Mir, we were more flexible in that respect – but there were great deficiencies in data acquisition and

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*German space jubilees: Sigmund Jähn, left, celebrates the 25th Anniversary of his flight with the Russians; Ulf Merbold, right, the 20th Anniversary of his Spacelab-1 mission.*

transmission because it was only possible to transmit data to ground stations while we were crossing Russian territory, which was only about four hours per day. Spacelab used relay satellites, so we were in constant contact with the investigators on the ground. On Mir, data had to be recorded on board in various different ways. To sum up, I think Spacelab was a more powerful lab than Mir, with the strong disadvantage of the limited duration. Eventually, this led to our decision to participate in the ISS programme in order to have a laboratory of Spacelab quality in orbit for years rather than days.

Mir was also a chaotic lab to live in. I arrived there in 1994 after it been in operation for ten years. It reminded me of an old farmhouse in the country where many generations of people have lived and collected clutter. The Russians did not provide stowage for every piece of equipment and all the newly delivered material from Progress ferries had to go somewhere. It always took me a while to find what I was looking for…

***How does flying on the Shuttle compare to flying on a Soyuz?***

While there is more legroom in the Shuttle there is also much more vibration. I hope that, if Europe builds a new manned carrier system, we will learn from the different experiences with Soyuz and Shuttle. Although the small Soyuz capsule is less comfortable, it is safer than the Shuttle. For future systems escape capability during all phases of the flight needs to be a prime design requirement.

***How was it to be the first non-American on an American spacecraft?***

When we started training for Spacelab-1 in Huntsville we received a warm welcome. After all, it was also for them the first flight where they had operational responsibility, what we now call payload operation, meaning the execution of the experiments. They made sure everything was more than perfect. In Houston you could feel that not everyone was happy that Europe was involved; some also resented the new concept of the payload specialist 'astronaut scientist', who was not under JSC control like the pilots. A couple of small things made us realise that JSC management was suspicious. Now, of course, all this has changed. I think we broke the ice and all our colleagues who came after us had much easier lives.

***Are there any direct descendants on Columbus of experiments you had on Spacelab?***

There was one experiment on Pedro Duque's list that is a direct descendant of an experiment from D1 with fruit flies where it was discovered that the male flies died after a shorter lifetime. Pedro's experiment was based on these findings. Lots of general experiments have been done on many other flights; there are always follow-ups. In medicine, knowledge is based on statistical data, and it can never be a mistake to continue the collection of data on a group of test subjects in order to draw conclusions.

***How is your relationship with Sigmund Jähn, the first East German astronaut who flew in 1978?***

We know each other very well; I think it was me who managed to bring him back into the Western space programme. We met for the first time in 1984 at an event to celebrate Hermann Oberth's 90th birthday and in the following years at the IAF Congress. We discussed our experiences and views and we had a nice surprise: although we had lived our lives in controversial systems and directions we were born in places very close to each other in Germany. After school I had escaped a system I did not agree with and started a new life in West Germany, while he was an important officer for that same system I had rejected. Still we reached the same conclusion: it only takes 90 minutes to complete one orbit around Earth to experience a change in comprehension. The planet loses its large dimensions and becomes very small and fragile, and the worst that could happen to it is a global war. Remember that this was at the height of the Cold War, the Pershing missile crisis and the Star Wars Programme.

Then the world changed in November 1989 with the fall of the Berlin wall, and less than a year after that Germany was unified. Despite his immense experience, Jähn could not join the West German Bundeswehr, so I managed to install him in DLR and later on in ESA – much to everybody's advantage. All ESA people, especially astronauts training with the Russians, could draw on his experience.

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He knew Star City, the Russian training centre, inside out and could help ESA people when they moved there. He speaks Russian like a Russian and knows all the key figures of the Russian system. For him, this career move was a chance to continue working in the field he loves and use all the knowledge he had acquired over the years.

***Do you think that the Spacelab programme was worthwhile for Europe?***

Absolutely no question: yes! Without it we would not be where we are. Being a valid partner in the International Space Station would be inconceivable if Europe had not qualified as a partner in the Spacelab programme.

***How do you see the future of spaceflight?***

I think it is crucial that, even facing problems as we do now, we continue with the ISS Programme. I think it is vital that we build an escape system for emergency situations in order to be able to increase the crew size to six or seven and thus improve the value of the ISS as a laboratory. To keep the whole system in balance we need more people up there and to build up more exploration-related experiments.

The next big challenge is a flight to Mars. I think we need to know more before we decide to go straight to Mars or whether, as an intermediate step, we should return to the Moon first. We need more operational experience and can achieve that by using the ISS. We also need to investigate the human side of it – how do crew members behave in such a closed environment on longer trips? Only based on this kind of knowledge can we take a decision; it is impossible now. For a possible Mars flight we need to build better propulsion systems, for example plasma propulsion, to shorten the flight time.

## European Flag on the ISS and Beyond...

I will never forget a comment from one of my classmates in the NASA astronaut class of 1996, composed of 35 Americans and nine people from other countries. He was confused because there were European astronauts coming from different national agencies: "I cannot understand, all Europeans look alike to me…" This example shows that overall, despite the fact that each country of Europe has its own history and culture, Europeans are much closer than we would like to admit. People from other continents, with diverse cultures, can recognise that at a glance.

I mention this episode firstly because we took a big step forward in creating an integrated European Astronaut Corps that represents the European identity. This identity combines our common heritage while at the same time preserving the diversity, the individuality of each nation.

Secondly, it is only by recognising our differences and unifying our strengths that we can look forward to the challenges of the new millennium. Among them is one that I consider worthwhile pursuing for the future of Europe and all humankind: building infrastructures and space ships that would allow a true human exploration of space!

The experience of building the International Space Station has demonstrated that space exploration is an endeavour that requires the cooperation of many countries and, among these, Europe has a leading role to play.

When I first stepped, or rather floated, into the US module I felt for a split second the responsibility of representing not only my Italian countrymen, but also the culture and history of Europe.

I had the same feeling of pride and responsibility when I spoke to the President of the European Commission, Romano Prodi. I was in the logistics module 'Raffaello', a beautiful piece of machinery designed and built in Europe and temporarily attached to the Space Station, and I was showing the European flag I brought with me. Mr Prodi was asking me about life on board when he saw the little flag drifting slowly in front of the camera; he was surprised, but also very pleased to see that little symbol of unified Europe present in this lone outpost orbiting the Earth.

I believe these memories from my last flight in 2001 are the best way to celebrate the 25th Anniversary of the first European in space. Since then, a great deal of experience has been gained in human spaceflight, and Europe is ready to face the challenge of leaving Low Earth Orbit and venturing out to explore the Solar System.

I hope to see again, in the not too distant future, another beautiful European flag on the harsh landscapes of the Moon and Mars. Europeans have always been bold explorers. We should not forget that exploration is an essential element of cultural and economic development.

*Umberto Guidoni*
*ESA Astronaut*

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**Vladimir Remek, born in Ceske-Budejovice in Czechoslovakia in 1948, celebrated the 25th Anniversary of his flight to the Russian Salyut-6 space station this year. He was the first European – 'non-Soviet and non-Armerican', as he puts it – to travel into space. He now works in the Czech Embassy in Russia.**

***How did you become an astronaut, how did you plan your career?***

That was long ago – there was no human spaceflight yet. I was a little boy of nine when Sputnik was launched and 13 years old when the first cosmonaut, Yuri Gagarin, flew. I found that very interesting and thought that I also wanted to be a cosmonaut. The first cosmonauts and astronauts were military pilots, so after finishing school in 1966 I went to a military flight college. I became a pilot and wanted to get a higher education, so I went to the same pilot academy that Yuri Gagarin studied at. It is now named after him. Sigmund Jähn, the first East-German cosmonaut, also graduated from this academy.

I graduated in1976, and at around that time the Soviet Union proposed for the first time that people from other countries could participate in their flights. I applied and, probably because I had the right education and quite some experience from my time in the Czechoslovakian air force, I was lucky enough to be selected. We were six new cosmonauts – two each from Czechoslovakia, Poland and the German Democratic Republic. The training in Star City started in December 1976, and it was extremely interesting! Everything was new and fascinating to me.

***How and when did you learn that you were going to fly?***

Well, I only really realised that I was a real cosmonaut when I was in orbit… Actually, we did not know who was going to go until it was announced only two days before the flight. We were two from each country, and we did not know which of the two of us was selected. When I heard that it was me I was very happy. I had dreamt of it all my life, and suddenly my dream comes true! I was still very young, 30 years old, and very excited.

***Please tell us about your flight. What did you do, what did you see?***

That's a very long story – I could talk about it for many, many hours! But to sum it up, it was one of the most interesting periods in my life to work with all the different people. We trained and worked together with the Soviet cosmonauts, we were an international team, and we were united byof spaceflight.

I only spent eight days in space, but I am very grateful to hawhat many other people can only dream about. The greatest impression that will stay with me my whole life is: Earth is really round. It has finite dimensions. You can actually fly around it in tens of minutes. What was equally impressive, though more of a detail, were the meteors. People usually say that these are 'falling stars', but when you're in space they are not above your head; I could see them far beneath my feet. Stars were shining above me and other 'stars' were falling below me at the same time. The spaceship with me in it floated between them. It was beautiful. Of course we only watched these phenomena outside our scientific schedule!

Our science programme wasn't as extensive as they are today. To give you a few examples, we had a couple of experiments to study microgravity, material science crystallisation experiments. We studied the stars and how they behave, the level of oxygen in tissue of the human body – we had a couple of very interesting experiments. One of them was from my hometown, which is well-known for its excellent beer. Unfortunately we didn't have any beer on board! Instead, we grew single-cell plants. In our short flight we grew a couple of generations. But of course it is quite difficult to speak about the details of the scientific experiments after 25 years.

***You said that you enjoyed working and training in an international team. Do you think that your flight as the first European in space lay the foundation for a more international cooperation and collaboration in space?***

Personally, I believe it has. Other cosmonauts and astronauts probably think the same. Projects like ours facilitate better understanding between different countries. One proof of the pioneering role my flight had is that the following Russian flights had more international crews, and nowadays they are international by default. It is a pleasant feeling and makes me proud to have been one of the first to start this tradition.

By the way, I never knew I was regarded as the first European in space until 12 years ago when I visited the Royal Military Museum and Space Information Centre in Belgium as a guest. In their space section I was surprised to see my name listed as the first European cosmonaut. I did not understand this at first – at that time, the Soviet Union still existed and to me,

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Soviet cosmonauts also belonged to Europe… but one thing is certain: I was the first non-Soviet and non-American in space – not a bad result after all!

***What did you do after your stay on Salyut? Are you still involved in space?***

For a while, I stayed in the space field until I switched back to the Military Service. I became Director of the Czech Air and Space Museum in Prague. Thanks to my function as Director, I came to Belgium and learned of my reputation!

I then retired from the military in 1995 and started working in Russia, representing Czech trade companies in Moscow. For a while I was the Director of the Moscow branch of a Czech company Z Strakonice, and since 2002 I have been a Counsellor at the Czech Embassy in Moscow. In my role as Head of the Trade and Economic Department I also deal a lot with scientific cooperation, and I often come across space issues, only this time I see them from the other side. I have a very interesting life at the moment, I meet many fascinating and talented people and have a position of high responsibility – but I do miss space!

***How do you see the future of human spaceflight? What do you think will happen in the next 20 years?***

I have always tried to avoid answering this question – I can only say what I hope. Let me explain this with an example from my flight. At one time aboard Salyut, I was floating; the only physical contact I had with the station were two fingers on a handle. Through a window I watched the Earth. At that moment, I felt my heart stronger than ever before, I heard each heartbeat, and I was aware of all my dreams and hopes for myself and the world. I asked myself: What will this world be like when I return? What will it be like in 20 years? I told myself that I don't want to guess or gamble – I can only hope.

We human beings always go further, we explore, we take the next step. Many people even lost their lives because they claimed that the world was round. I went up to see that it really is, and I am extremely grateful that I had the chance to do so.

I believe that the coming years will be very interesting for human spaceflight. I hope to be still alive to witness this – that mankind is clever enough not to destroy itself. I hope that spaceflight will be continued.

There is a lot of talk about going to other planets, and I hope that we don't just discuss it but do it. Future generations will certainly lead interesting lives.

There will always be two categories of people: optimists and pessimists. Optimists think that the world develops as it should, and pessimists think, "Unfortunately this is true." I am definitely an optimist.

*Claudie Haigneré visited Mir in 1996 for two weeks during the Franco-Russian mission 'Cassiopée'. She then spent eight days on board the International Space Station in October 2002. She was the only woman in the European Astronaut Corps, until she was appointed Minister of Research and New Technologies in the French Government in 2001.*

## First Steps in Microgravity – Watching Earth from Space

When one arrives in orbit and the engines are turned off, all the noise and vibrations of the launch stop. Still fastened to the seat by seat belts, I did not immediately perceive the absence of gravity. I only noticed it by looking at the objects floating around me. I was very impatient to unfasten the seat belts and finally experience what I had studied, for a long time, in books and documents during training. The reality is very different. When you are on the ground, it is difficult to understand what floating upside down or on the ceiling really means.

I felt my body fluids flowing towards my head rather like when you stand on your head for a long time on Earth. This gave me a bit of a headache, which fortunately stopped after a few days. When I finally got on board Mir everything was like in the simulator used in training in Russia. Therefore, I knew the architecture of the modules and the position of all the objects well, so I knew how to move around. However, I required a few days to reconstruct a reference system that enabled me to orient myself. It took me 2-3 days to learn how to use my muscles again, adjusting them to move around or hold objects. I had to re-establish new rules to stabilise my body before attaching objects to velcro or elastic.

It only takes 3-4 minutes to pass over Europe. From space I could see the change of colours during every sunrise and sunset, the clouds and snow on the mountains. After a while I was able to recognise the continents that we were flying over from their colours or even from the position of the clouds. Due to my ability to read all the meteorological elements, I was able to identify the approaching coasts and to follow the meteorological events in the formation of a storm or a cyclone.

I will also never forget the impressive vision of the darkness of the Cosmos! Looking at all that blackness, I perceived the meaning of real infinity and of how small the Earth is inside our solar system. Realising how thin the terrestrial atmosphere is, I could not help thinking about the responsibility that all of us have to defend and preserve our magnificent planet. Looking at the Moon rising above the horizon of the Earth several times per day is an unforgettable and poetic memory that I will always carry in my heart!

*Claudie Haigneré, former ESA Astronaut*