

Mir Principal Expedition 19

Commander Anatoly Solovyev

Flight Engineer Nikolai Budarin

Crew code name: Rodnik

Launched in Atlantis (STS-71) June 27, 1995

Landed in Soyuz-TM 21, September 11, 1995

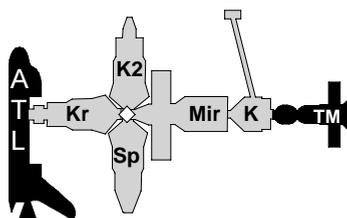
75 days in space

Highlights: The only complete Mir mission of 1995 with an all-Russian crew, Mir 19 had

many international elements. The first Mir crew launched on a Space Shuttle Orbiter, Solovyev and Budarin began their work in conjunction with a visiting U.S. crew and departing Mir 18 international crew. Two of their EVAs involved deployment and retrieval of international experiments. And they ended their stay by welcoming an incoming international crew.

Mir 19 crew officially take charge. Solovyev and Budarin officially assumed their duties aboard Mir on June 29. The Mir 18 crew moved their quarters to Atlantis for the duration of the STS-71 mission. Once there, they would continue their investigations of the biomedical effects of long-term space habitation.^{77,78}

June 29 - July 4, 1995



Continued

Triple cooperation. On June 30, the ten members of the Mir 18, Mir 19, and STS-71 crews assembled in the Spacelab on Atlantis for a ceremony during which they exchanged gifts and joined two halves of a pewter medallion engraved with likenesses of their docked spacecraft. The crews began transferring fresh supplies and equipment from Atlantis to Mir. They also moved medical samples, equipment, and hardware from Mir to Atlantis for return to Earth. New equipment included tools for an EVA to be performed by the cosmonauts to free the jammed Spektr solar array. Another commodity loaded onto Mir was water generated by Atlantis fuel cells.⁷⁹

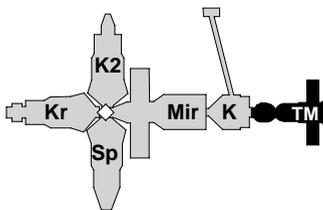
Tests of docking effects. On July 1, Gibson and Precourt fired Atlantis's steering jets to change the station's attitude, to evaluate the integrity of the Mir-Atlantis docking mechanism and tunnel adapter during orbital maneuvers, and to test the effect of jet plumes on the station's solar arrays.⁸⁰

Goodbye again. After a farewell ceremony aboard Mir on July 3, the Atlantis and Mir 18 crew departed and began preparations on Atlantis for the next day's undocking. After the hatches of both spacecraft were closed, Harbaugh began depressurizing the transfer tunnel to equalize it with the vacuum of space before the separation of Atlantis from Mir.

The "cosmic ballet." On July 4, Solovyev and Budarin donned their flight suits, entered Soyuz-TM 21, and undocked from Mir to a stationkeeping position from which they photographed Mir and Atlantis, still docked. About 15 min later, Atlantis undocked from Mir when Gibson released the hooks that held the two craft together and allowed the docking system springs to nudge Atlantis away. As Atlantis slowly flew around the station, Soyuz-TM 21 redocked, and the two craft continued to

take pictures of each other and Mir. Gibson called this set of celestial maneuvers a “cosmic ballet.” However, the Soyuz module had to redock a few minutes sooner than planned when the Mir onboard computer which controls station attitude and solar array pointing malfunctioned. The station complex, about 10° off the correct attitude, was becoming unstable and starting to drift. The cosmonauts had to get back quickly to regain attitude control of the station. TsUP controllers left the station in free drift while the cosmonauts replaced attitude-control hardware in the computer.^{81,82,83}

July 4-17, 1995



Kvant 2

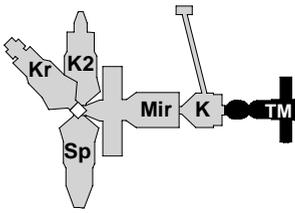
Kristall - Mir - Kvant - Soyuz-TM 21 Spektr

Mir 18 crew completes 115-day mission. After Atlantis left the Russian space station, the homeward-bound Mir 18 crew continued their medical and scientific investigations in the Spacelab module in Atlantis’ payload bay. They used the lower body negative pressure unit and a baroreflex neck cuff to test cardiovascular orthostatic function response to microgravity. They also continued their daily exercise sessions on the treadmill. During Atlantis’ reentry and landing on July 7, they rode in special recumbent seats that allowed them to take the force of reentry in a reclining position. After the landing at Kennedy Space Center’s Shuttle Landing Facility, they were flown in an Air Force C-9 Medevac plane to Ellington Field in Houston. They followed up their spaceborne biomedical investigations with medical tests at Johnson Space Center.⁸⁴

First EVA of Mir 19. Before their launch, Solovyev and Budarin had trained to use the new tools created for releasing the stuck Spektr solar array. On July 14, they exited the Kvant 2 hatch and made their way to Spektr using the Strela boom. They quickly cut the offending restraint, and all but one section of Spektr’s jammed solar array deployed.⁸⁵ Then they were able to route the power input to the complex. They inspected the -Z port docking mechanism and found no signs of damage or pollution, clearing the port for relocation of the Kristall module. Before reentering the Kvant 2 hatch, they inspected one of that module’s solar arrays which was not tracking the sun correctly. The EVA ran 5 hr and 34 min, about 20 min over the originally budgeted time.^{86,87}

July 17-22, 1995

Kristall Kvant 2
- Mir - Kvant - Soyuz-TM 21
Spektr



Kristall relocated once more. In a 90-min session on July 17, Kristall was transferred by means of its Lyappa arm to the -Z docking port from the -X port, where Progress-M 28 would dock later in the month.⁸⁸ The rearrangement placed Kristall in the proper position for the next Atlantis docking, during STS-74 in October. Figure 8 shows the resulting configuration of the complex. Solovyev inspected the air seal at the -Z port and found it intact.⁸⁹

Problems during second Mir 19 EVA. The primary purpose of the second space walk (July 19) was to deploy the Belgian-French MIRAS (Mir infrared spectrometer) on the far end of the Spektr module. But minutes after the EVA began, Solovyev's Orlan-DMA suit cooling system malfunctioned and the TsUP ordered him to stay attached by an umbilical to Kvant 2. The MIRAS deployment had to be postponed, but Budarin was able to do some preparatory work alone. He also retrieved the American cosmic ray detector, TREK, which had been on the Kvant 2 surface since 1991, and switched out cassettes of sample construction materials as part of an ongoing space exposure experiment. His time outside totaled 3 hr, 8 min. But the troubles were not all over: After closing the Kvant 2 EVA hatch, the cosmonauts found a 2-mm gap in the seal through which air was escaping. They had to work with the hatch to get it tightly shut.^{90,91}

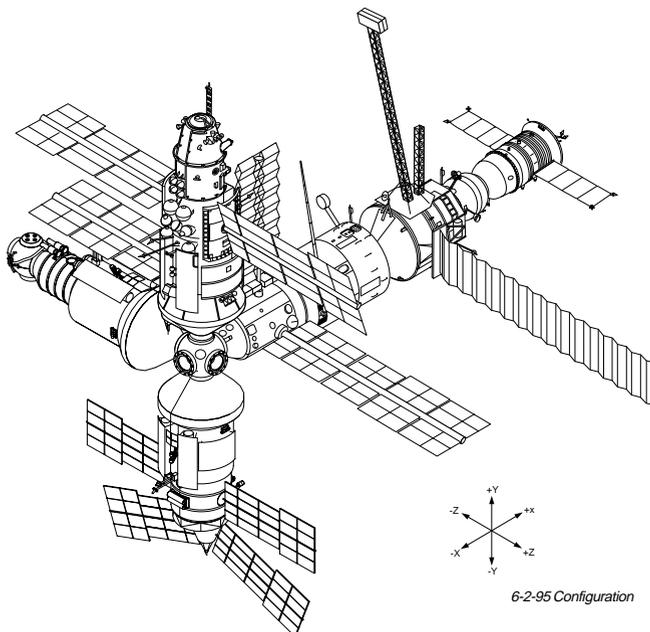
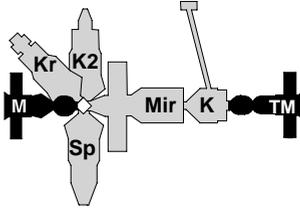


Figure 8. The Mir complex as configured after multiple relocations of Kristall to accommodate Spektr docking and subsequent relocation to the -Y port on June 2, 1995. Spektr is shown at the bottom of the complex in this orientation.

July 22 - September 4, 1995

**Kristall Kvant 2
Progress-M 28 - Mir - Kvant - Soyuz-TM 21
Spektr**



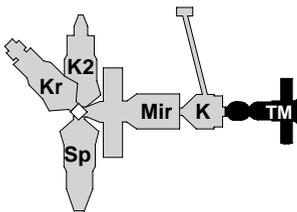
Progress-M 28 arrives. Launched by a Soyuz booster from Baikonur on July 20, Progress-M 28 module bore 2.4 t of food and water, fuel and oxidizer, and science equipment (including about 335 kg for use during Euromir 95). Two days later, using the Kurs system, Progress-M 28 docked at the -X port of the base block.⁹²

Installation of MIRAS during third EVA. On July 21, the cosmonauts opened the Kvant 2 hatch again and retrieved the cooling umbilical left outside in their last EVA. Using the Strela boom, they made their way to the Spektr module, on which they installed the 220-kg MIRAS spectrometer. This final EVA of Mir 19 lasted 5 hr, 35 min.⁹³

Interior work throughout August. With their EVAs completed, the Mir 19 crew turned their attention to experiments in life sciences and astrophysics and smelting experiments in the Gallar furnace. They unloaded the cargo brought by the Progress module and monitored the automatic refueling by Progress of the base block propellant tanks. They also performed station maintenance and repairs, including installation in Kvant 2 of new gyrodynes brought up on Progress. They repaired the seals on other gyrodyne cases with a lute-type sealer called “germetik.”^{94,95,96}

September 4-5, 1995

**Kristall Kvant 2
Mir - Kvant - Soyuz-TM 21
Spektr**



Progress-M 28 undocks. Packed with trash and obsolete equipment, Progress-M 28 left the -X port on September 4 and splashed down into the Pacific, thus clearing the way for Soyuz-TM 22 to dock with the next Mir crew.