

## The Amazing Story of Sergei Krikalev “The last Soviet Cosmonaut”

Sergei Krikalev, the last “Soviet cosmonaut” wrote history by being the only cosmonaut who started his journey with a different citizenship (Soviet) than he ended up with at his return from space. (Russian). He was described as the “lost man in space” by most publications as can be seen from quotations of a recent article:

“After blasting off from Baikonur on 18th May 1998, Krikalev wouldn’t inhale earthly air for 308 days. In that time, the soft-spoken cosmonaut would watch his country crumble from 400 km up. Presidents would change. His hometown of Leningrad would become St. Petersburg. And one communist superpower would splinter into 15 nations. By the time he returned, Krikalev would be, in essence, the last remaining citizen of the once-mighty Soviet Union.” [1]

By his late 20s, he was already an impressive pilot and a member of the Soviet Union’s national aerobatics team. When the Soviets lost contact with their Salyut 7 space station in 1985, Krikalev was part of the ground control team that planned the audacious in-orbit rescue mission.

That role helped the young pilot to become a cosmonaut in the following years: after switching to the Mir program Krikalev was assigned to his first space flight with the Soyuz TM -7 on 26 November 1988 to the space station Mir. Together with his commander Alexander Volkov, he was responsible for the mission Mir EO-4, which overlapped with the Mir stays of the Soviet cosmonauts Vladimir Lyakhov and Valeriy Polyakov, as well as Jean-Loup Chrétien from France and Abdul Ahad Mohmand from Afghanistan. Krikalev landed after 151 days in space on 27 April 1989 with Soyuz TM -7 [1].

During Krikalev’s second, unexpectedly prolonged stay on Mir as station commander were periods of very high and critical activities punctuated by the “coming and going” participation of national and international cosmonauts/astronauts, interlaced with his worries about his uncertain future and safe return to his family. The flight turned out to be an unplanned “endurance flight requiring all his discipline, skills, patience and mental stability to fulfill all the required tasks. The following is an extract from the “Ezyklopädie Raumfahrt” [2] and shall illustrate the tenacity, professionalism and dedication of Sergei Krikalev demanding the admiration and respect of every “space –operations” insider.



*A view of the Russian space station Mir on 3 July 1993 as seen from the approaching Soyuz TM-17, carrying the new crew. The image is unusual in that it shows ongoing docking operations; Progress M-17 can be seen docked to the Kvant-1 module and Soyuz TM-16 (crew rescue vehicle) to the Kristall module, with Progress M-18 (left, detached) in the process of vacating the core module's forward port to allow Soyuz TM-17 crew (not seen in the picture) to dock there.*

### Krikalev’s “Endurance” Flight (May 18, 1991 – March 25, 1992)

#### ***The Begin of Krikalev’s Mir endurance flight: Soyuz-TM 12, (Juno-Mission) May 18, 1991***

Helen Sharman, the first Briton in space, launched with Artsebarsky and Krikalev from Baikonur on May 18, 1991. She remembers the cosmonaut as cool under pressure, during the critical docking process Krikalev’s aim was flawless even without the rendezvous guidance, and they boarded Mir without issue, joining the existing crew, Afanasjev and Manarow. [1]

He loved the feeling of weightlessness and learned to glide like a diver from one side of the space

station to the other without touching anything. Krikalev and his crew spent any free minute looking out the tiny Kvant porthole watching the Earth passing under them. “Every spare moment, we tried to look at the Earth,” Krikalev told the media.

After only eight days in orbit Sharman returned with the two-member crew already on board, Viktor Afanasjew and Musa Manarow, leaving Krikalev and Artsebarsky alone on Mir. The Soyuz TM-11 return capsule landed on Sunday, 26 May 1991 in Kazakhstan.

The two remaining cosmonauts Krikalev and Artebarsky had a five-month mission packed with six EVA's for station upgrades and repairs ahead of them, supported by two Progress supply flights on May 30th 1991 (Progress M8) and August 20th 1991 (Progress M9). With the six EVA's, the two cosmonauts worked 32 hours and 23 minutes in space repairing the antenna of the “Kurs” rendezvous and docking system. Experiments on astronomy, biology, chemistry, earth exploration, space technology, materials science and medicine were also conducted by them.

### ***Political Turmoil in Russia: August 19, 1991 to December 1991***



*Yeltsin stands on a tank to defy the August coup in 1991.*

[https://commons.wikimedia.org/wiki/File:Boris\\_Yeltsin\\_in\\_19\\_August\\_1991-1.jpg](https://commons.wikimedia.org/wiki/File:Boris_Yeltsin_in_19_August_1991-1.jpg)

As dawn broke on the 19th August 1991, tanks rolled into Moscow's Red Square and in an official announcement claimed Gorbachev had stepped aside voluntarily for health reasons. “For us, it was totally unexpected,” Krikalev later said. “We didn't understand what happened. When we discussed all this, we tried to grasp how it would affect the space program.” Gorbachev recovered power within days, but the country's fate was sealed. Over the coming weeks and months, the Soviet states declared independence one at a time and after thrilling months Boris Yeltsin declared the dissolution of the Soviet Union and became the new president of the independent Russian states in December 1991. [1]

During that time, Krikalev got semi-regular calls from his wife, Elena, who worked in mission control. The pair had gotten to know each other over the radio on his first mission to Mir in 1988. This time, they had a 9-month-old daughter. As the political upheaval caused prices to surge, Krikalev wondered how his family was surviving with his meager pay of just a few dollars.[1]

The dissolution of the Soviet Union into individual nation states extended Krikalev's stay in space by half a year. In October 1991, instead of the planned replacement of Krikalev by an experienced Russian cosmonaut, the Kazakh Toktar Aubarikov was sent to Mir, a cosmonaut with no long-term experience and who returned to Earth after only eight days onboard. The Russians thus met an political demand from the soon independent Republic of Kazakhstan, on whose territory the Baikonur Cosmodrome is located [1]. Now, Sergei Krikalev had to remain in space additional six months longer than planned, because the next two planned missions were merged for lack of funds and thus only one member of the regular crew could be exchanged.

### ***Sojuz-TMI3, (Austro MIR) October 2, 1991***

That space mission was of high international interest because for the first time an Austrian research cosmonaut, Franz Viehboeck, could be on board the Mir station. He and his colleague Clemens Lothaller had been training in Star City since January 1990. Austrian scientists had prepared a

multitude of medical-biological and material-science experiments. The appropriate equipment was transported to Mir earlier with Progress M-9 (20 Aug. 1991).



*Crew of Soyuz flight TM-13: Franz Viehboeck, Alexander Volkov and Toktar Aubkirov (from left)*  
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On 30th of September 1991 a Soviet space commission appointed Alexander Volkov, the Kazatch science specialist Toktar Aubarikov and Franz Viehboeck for the Austro-Mir mission. Soyuz TM-13 lifted off on 2nd of October 1991 and after a prolonged two day rendezvous and docking maneuver the new passengers were greeted by Kirkalev and Artsebarski after hatch opening with a Viennese waltz. After a short welcome ceremony the five cosmonauts started working right away on the 15 Austrian experiments. among other new experiments, Datamir (data collection enabling “realtime” data exchange with the ground) and Video-Mir (enabling realtime video conferences with the crew) were improvements and “firsts” on Mir

On October 10th Viehboeck, Artsebarski (now over four months in orbit) and Tahktar entered the return capsule Syouz TM-12 and de-docked from Mir leaving Volkov and Krikalev behind. Soyuz TM-12 landed on 10th October safely in the Kazakh steppe.

The longer Krikalev and Volkov stayed in orbit, the more scarce Russia’s cash became. The collapsing country sold off more space station guest flights to Western governments (approx.. \$20 Mio per seat) to raise funds. There were even discussions about selling whole Mir complex itself, which made the crew wonder about their status as tenants. “A human race sent its son off to the stars to fulfill a concrete set of tasks,” reported the Komsomolskaya Pravda. “But hardly had he left Earth than it lost interest in those tasks, for worldly and completely explicable reasons. And it started to forget about its cosmonaut. It did not even fetch him back at the appointed time, again for completely worldly reasons.”[1]

There was always a Soyuz capsule Krikalev and Volkov could use for an emergency escape, but if they would take the easy way out and left Mir, it could mean the end of the space station. And so they stayed.

The Cold War and the Soviet Union ended on Christmas Day 1991.

The lonely crew aboard the Mir station consisted now of Alexander Volkov (since 2nd October 1991) and Krikalev (since 18th May 1991) and the main focus of Volkov and Krikalev of course was on the operation of the space station and their fitness exercises to strengthen the body and stay healthy. Nevertheless the continuation of the scientific experiments was an obligation, at the end of 1991 a series of material experiments with the crystallization melting oven contributed by the CSSR, in which the behavior of different molten materials in the weightlessness was examined, could be conducted successfully.

On January 13rd, 1992, the supply transporter Progress M-10 docked at the Mir space station and brought new supplies for the cosmonauts (oxygen, water, food and mail for the cosmonauts) as well as replenishing fuel supply for the attitude control system, running low by now.

A short time later, Volkov and Krikalev loaded the Progress capsule landing capsule with results from their experiments e.g., with exposed high resolution photo films and material samples produced during the weeks and months before. However, the separation of the Progress spaceship from Mir was

delayed because of problems with the attitude control system of the station, defective gyroscopes gave wrong orientation signals. But the cosmonauts soon found a makeshift solution, so that the Progress could decouple on January 20th, 1992, and soon thereafter burned up in the atmosphere as planned, except for the small re-entry capsule, which parachuted with its valuable contents safely down in the steppe of Kazakhstan.

This was just one of many problems the cosmonauts had to cope with. One of the most common causes of faults were broken cable lines, which the cosmonauts had to repair with great skill and improvisation talents, but various other defects often kept the crew from their actual tasks also. On January 25th, 1992, Baikonur launched the next supply spacecraft Progress M-11, which docked already two days later to the Mir station.

This maneuver in particular was critically monitored by international observers, because in those days the ground control personnel in Moscow went on strike and protested against the low salaries, in fact the salaries were so low that some ground operators had to hold down a taxi driving jobs after their 12 hr work shift. Shortly after, the technicians salaries were raised a little.

In the next few days, the two men then prepared intensively for their long-planned outboard maneuver (EVA). Volkov and Krikalev carefully donned their bulky Orlan-DMA spacesuits and tools for their planned work and the Kvant airlock was finally opened on February 20th. With their portable life-support system strapped to their shoulders, the men left the safe pressurized station and inspected the individual modules and various test objects from the outside. Soon, problems with Volkov's spacesuit developed, so that he had to go inside behind the hatch, while Krikalev had to solve all the tasks by himself. Among other repairs he had to take a bulky, protective cover from the Sofora experiment (assembly and deployment of a 12 m truss structure), so that it could be deployed and put into operation. After 4 hrs 12 minutes, the two men returned inside to the safety of space station. For Krikalev it was the seventh EVA maneuver within the year and with a total of 36.5 hours EVA activities he set a new record.

Finally, Krikalev got word that he would be replaced and could return to Earth.

### ***Soyuz – TM 14 (Mir 1992, first German Mir Mission) 17 March 1992***



*Sergei Krikalev, K.D. Flade and Alexander Volkov in the Mir basis module (from left) during the TM-14 German mission.*

After having taken the traditional leak against the rear tire of the transport bus, Flade and his co-travelers boarded the Soyuz space ship having absolved the official farewell ceremony by Russian officials.

With remarkable punctuality the 310-ton Soyuz rocket lifted off from the Cosmodrome in Baikonur on March 17th, 1992 at 16:00 hrs local time. Watching the launch, the German research Minister Riesenhuber also crossed his fingers for K. D. Flade and his two Russian comrades Alexander Viktorenko and Alexander Kaleri.

All three rocket stages ignited "on the dot", and after nine minutes the Soyuz capsule had reached its planned Earth orbit.

Still in the capsule K.D. Flade started with his medical data collection activities already after he reported a very smooth lift off. During the 34th orbit, the Soyuz capsule approached the Mir station, and ground control at Moscow (ZUP) and by visitors at GSOC, Oberpfaffenhofen could monitor the docking in real-time thanks to the previously installed Datamir and Video-Mir systems. The docking took place on 19th March at 16:00 hrs Moscow time and an orbit later the hatches were opened and the newcomers warmly welcomed by the cosmonauts Volkov and Krikalev. Then Flade took up his extensive program of experiments, which he continued in close cooperation with the scientists on the ground and his back-up crew member Reinhold Ewald assisting in the ZUP control center. Several small problems that arose could quickly be remedied thanks to Flade's extensive knowledge and skills.

Flade worked up to 16 hours a day and rarely could enjoy the fantastic view of the earth's surface, instead he devoted himself intensively to his biomedical experiments, in which he was mostly acting as test object also, supported by a tireless Krikalev with his intimate knowledge of the station subtleties. He repeatedly tested his physical and mental condition. Since then, the experiments developed by German scientists are successfully applied in terrestrial hospitals also.

On the morning of March 25, Flade and the two Russians Volkov and Krikalev climbed into the capsule Soyuz TM-13, with about half a year earlier the Austrian Viehboeck had flown to the Mir Station. The descent and re-entry phase lasted only about 3 hours, and at 11:50 hrs Moscow time the capsule landed safely in northern Kazakhstan. K.D. Flade had been in space for nearly 8 days or exactly 7 days, 21 hours and 57 minutes, and the first medical test certified him good health.

The German and Russian space managers and scientists were highly satisfied with the course of the joint flight. Thanks to the smooth technical process of the mission and the professional support by Sergei Krikalev, the German payload cosmonaut Klaus-Dietrich Flade was able to successfully complete all 14 planned experiments in weightlessness.

### ***End of Krikalev's Mir endurance flight SOYUZ-TM 13, March 25, 1992***

So, Krikalev, the "last Soviet citizen" landed near the city of Arkalyk on March 25th, 1992 – without a valid passport - in the now-independent Republic of Kazakhstan. Krikalev had circled the Earth some 5.000 times, and seen as many sunrises and sunsets. In the decades to come, he would log 803 total days in orbit.

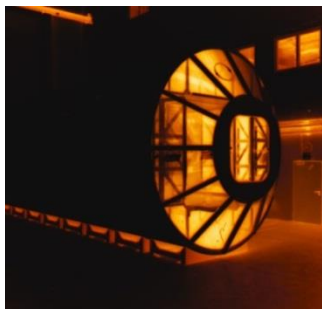
Once back on Earth a recovery team helped Krikalev out and down from the Soyuz capsule. He was pale but in fair condition. Fresh air and bright sunlight was a long missed experience and he was quickly covered with thick fur coat. A blanket of fresh snow greeted the returning crew. It would take several long weeks for Krikalev to feel normal back on the ground and months to recover fully. An Astronauts' rule was, that you would need the same time for recovery as you stayed in orbit, however Krikalev made his recovery astonishingly faster.

"It was very pleasant in spite of the gravity we had to face," Krikalev recalled years later for a documentary crew. "But psychologically, the load was lifted. There was a moment. You couldn't call it euphoria, but it was very good." The enormous responsibility of managing the Mir station complex was no longer his. "What surprises me most was, that at first, the Earth was dark, and now it's white. Winter has come, and before it was summer. Now, it's beginning to bloom again. That's the most impressive change you can see from space." [1]

During a visit at the German Space Operations Center (GSOC) in the early 1990's we could present our preparations for ISS-Columbus operations at the German Aerospace Center (DLR) Oberpfaffenhofen. Among other things we could also show him our Columbus OMSS (Operations Mission Simulator System) which had - for PR reasons - an acrylic nosecone. Seeing this, Krikalev got excited and said: "You have to fly Columbus with this look-out port!" - "This was one of my very view attractions I had during my stay at the Mir station." Indeed they only had one 43 cm porthole in the Kvant module. Compared with the "luxurious" ISS Cupola – the 43 cm on Mir was only the beginning and inspiration for implementing the Cupola - possibly promoted also by Krikalev's experience.



*The 43 cm porthole in the Kvant module of the Mir station. Polyakov looking out watching a Space shuttle approach and dock*



*Columbus "Operations Mission Simulator System" (OMSS) at DLR/GSOC nose cone (2.5 m diameter).*



### *Sergei Krikalev*

Hardly anyone else is so familiar with the two space stations that are still the most successful space projects of all time: Sergei Krikalev lived on the space station Mir (Russian for "peace"), which circled the earth from 1986 until its controlled deorbiting in 2001, and on the International space station (ISS), which has been growing bit by bit since 1998 and is now in orbit since 20 years. The cosmonaut was appointed as flight engineer between November 2000 and March 2001 to the first regular crew of the ISS. He is a veteran of six space flights and ranks third to Gennady Padalka and Yuri Malenchenko for the amount of time in space: a total of 803 days, 9 hours, and 38 minutes [1]. He retired from spaceflight in 2007 and is currently working as vice president of Space Corporation Energia. [4] He is the bearer of several international honorary titles, including "Hero of the Russian Federation" and "Officer of the French Legion of Honor". [5] With Krikalev's total time spent in orbit of 803 days 9 hours and 39 minutes – he has actually time-traveled into his own future by 0.02 seconds using Einstein's time dilation factor according to his general relativity predictions.[6]

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