NASA Facts

National Aeronautics and
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Lyndon B. Johnson Space Center **IS-1999-06-ISS023**
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The International Space Station:
The First Steps to a New Home in Orbit

Overview: The largest and most complex international scientific project in history, the International Space Station will be a move off of the planet Earth of unprecedented scale as on-orbit assembly continues through the year 2004. Led by the United States, the International Space Station draws upon the scientific and technological resources of 16 nations: Canada, Japan, Russia, 11 nations of the European Space Agency and Brazil.

Shuttle-Mir: The first phase of the International Space Station, the Shuttle-Mir Program, began in 1995 and involved more than two years of continuous stays by astronauts aboard the Russian Mir Space Station and nine Shuttle-Mir docking missions. Knowledge was gained in technology, international space operations and scientific research.

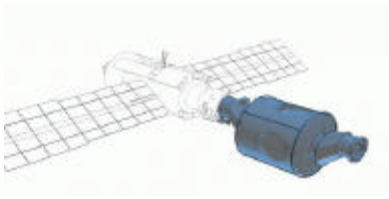
Research: The International Space Station will establish an unprecedented state-of-the-art laboratory complex in orbit, more than four times the size and with almost 60 times the electrical power for experiments ~~-c~~ritical for research capability ~~-of~~ Russia's Mir. Research in the station's six laboratories will lead to discoveries in medicine, materials and fundamental science that will benefit people all over the world. Through its research and technology, the station also will serve as an indispensable step in preparation for future human space exploration.

Assembly: The first two station components, the Zarya and Unity modules, were launched and joined together in orbit in late 1998. Following components are nearing completion at factories and laboratories in the United States and worldwide. Already, more than a half-million pounds of station components have been built and are being prepared for launch at sites around the world. Orbital assembly of the International Space Station begins a new era of hands-on work in space, involving more spacewalks than ever before and a new generation of space robotics. The Space Shuttle and two types of Russian launch vehicles will launch a total of 46 missions to assemble the station, three of which ~~-t~~wo Shuttle missions and one Russian launch ~~-h~~ave been completed. Of the total flights, 37 will be Space Shuttle flights and nine will be Russian rockets. The first crew to live aboard the International Space Station, comprised of a U.S. astronaut as commander accompanied by two Russian cosmonauts, will be launched in March 2000 on a Russian Soyuz spacecraft. They, along with the crews of the next five Space Shuttle missions to assemble the station, are now in training. Assembly is planned to be complete by 2004.

Overview of Early Assembly Flights – Completed Missions

Zarya

1. Space Tugboat: *Zarya control module* – Launched Nov. 20, 1998, by a Russian Proton Rocket from the Baikonur Cosmodrome, Kazakstan, Zarya is essentially an unpiloted space "tugboat" that provides early propulsion, steering and communications for the station's first months in orbit. Later during assembly, Zarya becomes a station passageway, docking port and fuel tank. Zarya was built by Russia under contract to the U.S. and is owned by the U.S.

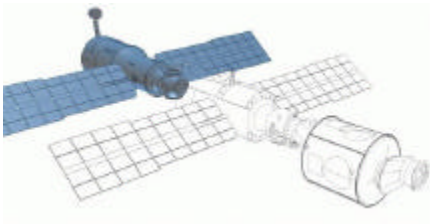


Zarya/Unity

2. Building Block: *Unity connecting module (Shuttle Mission STS-88)* – Launched on Dec. 4, 1998, aboard the Space Shuttle Endeavour from the Kennedy Space Center, FL, the Unity module is a six-sided connector for future station components. This was the first of 37 planned Space Shuttle flights to assemble the station. Endeavour's crew rendezvoused with the already orbiting Zarya module and attached it to Unity on Dec. 6, 1998. The crew then finished the connections during three spacewalks. They also entered the interior of Unity and Zarya to install communications equipment and complete other assembly work. Unity provides six attachment ports, one on each side, to which all future U.S. modules will join. Unity and Zarya are in an orbit 250 miles above Earth, monitored continuously by flight controllers in Houston and Moscow. Together, the two modules form the new, 70,000 pound, 76-foot long International Space Station.

3. Cargo Flight: *Space Shuttle Logistics Flight (Shuttle Mission STS-96)* – The Shuttle Discovery was launched on May 27, 1999, and performed the first docking with the International Space Station on May 29, 1999. This was the second of 37 Space Shuttle flights planned for station assembly. Discovery's crew unloaded almost two tons of supplies and equipment for the station, ranging from clothing, laptop computers and water for the first resident station crew to spare parts. The crew also performed one spacewalk to install a U.S. developed spacewalkers' "crane," the base of a Russian-developed "crane," and other spacewalking tools on the station's exterior to await use by future station assembly crews. Discovery also fired its thrusters to reboost the station's orbit and then undocked on June 3, 1999. Discovery landed on June 6, 1999.

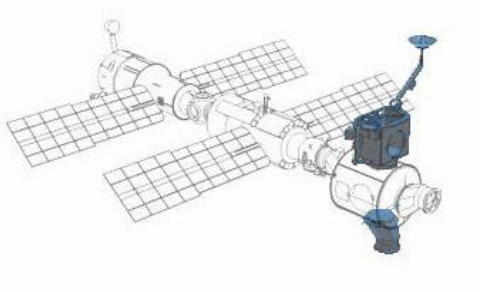
Overview of Early Assembly Flights – Upcoming Missions



Zvezda Service Module attached

4. Living Quarters: *Zvezda Service Module* – The next assembly flight for the station is targeted for launch in November 1999 on a Russian Proton Rocket from the Baikonur Cosmodrome, Kazakstan, carrying the Zvezda service module, an early living quarters. The Zvezda Module is the first fully Russian station contribution and the core of the Russian station segment. Launched without people aboard, it will dock with the orbiting Zarya and Unity by remote control. The Zvezda Module provides living quarters, life support, navigation, propulsion, communications and other functions for the early station. Its guidance and propulsion systems take over those functions from the Zarya module, which now becomes a passageway from Unity to the Zvezda Module.

5. Second Cargo Flight: *Space Shuttle Logistics Flight (Shuttle Mission STS-101)* – To be launched in December 1999 from the Kennedy Space Center, FL, the Space Shuttle Atlantis will dock with the station carrying supplies to be transferred to the interior. This will be the third Shuttle mission for station assembly. Atlantis' crew will be the first people to ever enter the orbiting Zvezda Module as the astronauts transfer supplies from the docked Shuttle to the space station and begin orbital checkout and setup of the new living quarters. Altantis' crew also will perform a spacewalk to attach a telescoping boom to the Russian spacewalker's crane left on the station's exterior during mission STS-96, as well as to conduct other assembly tasks. The station will remain unpiloted after Atlantis undocks.

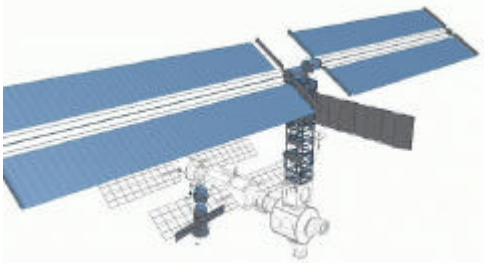


Framework, docking adapter added

6. Gyroscopes: *First Exterior Framework (Shuttle Mission STS-92)* – To be launched in February 2000 from the Kennedy Space Center, FL, the Space Shuttle Discovery will carry the first exterior framework for the station, a piece of the girder-like station truss, and an additional, conical station docking adapter. This will be the fourth Shuttle mission for assembly of the station. The framework houses critical electronic equipment, including gyroscope systems that eventually will replace thrusters to maintain the station's stability as well as communications equipment. Although attached on this flight, these systems will not be usable until later in the station's assembly. The shuttle's robotic arm will be used to attach the framework, called a Z-1 Truss, and docking adapter. Afterward, astronauts will perform four days of spacewalks to finish connections. Discovery will leave the station uninhabited.

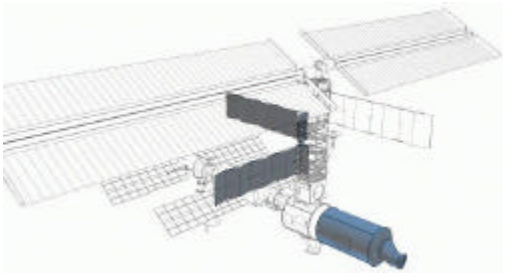
7. First International Space Station Crew – To be launched in March 2000, the first International Space Station crew will travel to the station aboard a Russian Soyuz spacecraft from the Baikonur Cosmodrome, Kazakstan. The three-person crew is commanded by U.S. Astronaut Bill Shepherd, and includes two Russian cosmonauts, Soyuz Commander Yuri Gidzenko and Flight Engineer Sergei Krikalev. They will dock with the station two days after launch and begin a stay of about four months. Their mission, designated Expedition 1, is a test flight and checkout of the new station, assisting with the continuing assembly. During their stay, the crew will conduct two spacewalks, using a Zvezda compartment as an airlock, to continue outfitting. The crew will return to Earth on Space Shuttle flight STS-102 in June 2000, but the Soyuz that launched them will remain at the station for six months to be used as an emergency "lifeboat."

8. Solar Power: *First U.S. Solar Panels (Shuttle Mission STS-97)* – To be launched in March 2000 from the Kennedy Space Center, FL, the Space Shuttle Atlantis will carry the first giant solar arrays and batteries for the station. This will be the fifth Shuttle flight to assemble the station. Eventually, four such sets of solar panels will be on the station with over a half-acre of surface area. The arrays will supply 60 times as much power for research work than was available on Russia's Mir space station. Endeavour's crew will conduct two spacewalks to complete connections of the solar arrays. Power from this first set of arrays sets the stage for a major expansion, arrival of the first laboratory.



First solar arrays attached to station

9. Research Lab: *U.S. Destiny Laboratory Module (Shuttle Mission STS-98)* – To be launched in April 2000 from the Kennedy Space Center, FL, the Shuttle Endeavour will carry the first station laboratory, built by the U.S. and the centerpiece of future research activity on the International Space Station. This will be the sixth Shuttle flight to assemble the station. Discovery will use its robotic arm to maneuver the new laboratory into position on the station. Discovery's crew will then perform three spacewalks to finish the installation.



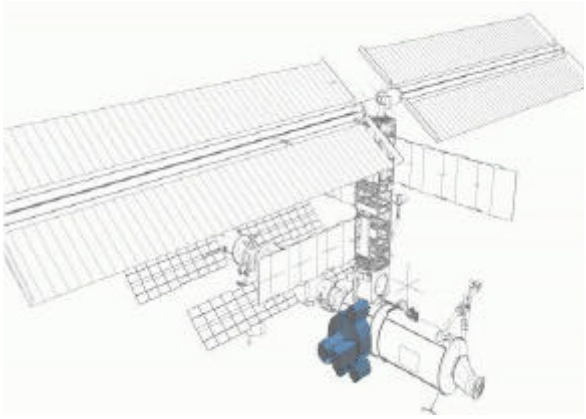
U.S. Laboratory attached

10. Third Cargo Flight: *Space Shuttle Leonardo Module Logistics Flight (Shuttle Mission STS-102)* – To be launched in June 2000 from the Kennedy Space Center, FL, the Space Shuttle Discovery will dock with the station carrying interior supplies and equipment racks housed in an Italian-built logistics module. This will be the seventh Space Shuttle flight to assemble the station. The reusable Leonardo logistics module will carry equipment racks

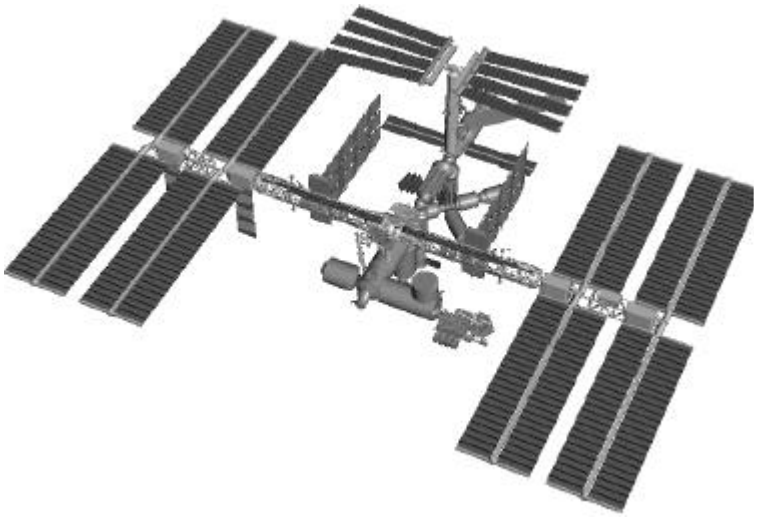
to outfit the U.S. Laboratory. Also, a second resident crew for the station will launch on this mission and the first station crew will return home.

11. Robot Arm: *Lab Equipment and Canadian Robotic Arm (Shuttle Mission STS-100)* – To be launched in July 2000 from the Kennedy Space Center, FL, the Shuttle Atlantis will carry two foreign-built station components aloft: a new station robotic arm built by Canada and the Italian Raffaello logistics module. This will be the eighth Shuttle mission to assemble the station. The new station arm will be attached during the mission. The logistics carrier will be attached to the station, unloaded and then returned to Earth on Atlantis. The logistics carrier will bring equipment to finish the interior construction of the U.S. laboratory. The Canadian robotic arm will assist with most future assembly activities.

12. Station Airlock: *Early Assembly Phase Completed (Shuttle mission STS-104)* – Launched from the Kennedy Space Center, FL, in August 2000, the Space Shuttle Endeavour will carry aloft the U.S.-built International Space Station airlock on the ninth Shuttle assembly mission. After it is attached, the airlock will enable the station crew to conduct spacewalks on their own, without a Shuttle present, using either U.S. or Russian spacesuits. The addition of the airlock signals the completion of the early phase of station assembly in orbit, and means that the orbiting station has taken on a degree of self-sufficiency and capabilities for full-fledged research in the attached laboratory module. The final phase of assembly will continue until 2004. The station crew size will expand to seven. Other elements that will be added to complete assembly are a Japanese Laboratory, European Laboratory, Centrifuge Module and a U.S. X-38 Crew Return Vehicle.



Station airlock attached



Assembly in orbit completed, 2004:

Wingspan – 360 feet
Length – 290 feet
Mass – 1 million lbs.
Crew size – up to 7
Laboratories – 6

INTERNATIONAL SPACE STATION