ZVEZDA

CORNERSTONE FOR EARLY HUMAN HABITATION OF THE INTERNATIONAL SPACE STATION

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NASA

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Zvezda

Launch Date:	07/12/00
Launch Time:	12:56 AM eastern time
Vehicle:	Proton
Launch Site:	Baikonur Cosmodrome, Kazakhstan
Launch Window:	10:00
Altitude:	240 statute miles
Inclination:	51.6 degrees
Liftoff Weight:	Zvezda - 42,000 lbs; Proton - 1,540,000 lbs.

International Space Station Update

The ISS: Continued Assembly and Performance

When Zvezda reaches the International Space Station in July, the station will have completed more than 9,300 Earth orbits since the first two components were brought together in December 1998 beginning the largest and most complex international project ever undertaken.

Zvezda

Current International Space Station

Quick Look Facts: Zvezda

Length (end-to-end) - 43 feet
Gross launching weight - 42,000 pounds
Launch vehicle - 3-stage Proton rocket
Launch site - Baikonur Cosmodrome, Kazakhstan
Inclination of orbit - 51.6 degrees
Orbit at Rendezvous - 240 statute miles circular
Wingspan - 98 feet
Pressurized compartments - three
Windows - 13

Zvezda

Zvezda Means "Star"

Zvezda (Russian word for Star), the primary Russian contribution to the ISS, is scheduled for launch July 12 from the Baikonur Cosmodrome in Kazakhstan. In addition to serving as the early station living quarters, Zvezda will be the main docking port for Russian Progress cargo resupply vehicles. It also will provide early propulsive attitude control and reboost capabilities for the station. A remote-controlled, unpiloted Progress resupply module will follow on a logistics and reboost mission, with docking to the ISS planned for early August.

Russian Service Module, Zvezda, photographed at RSC-Energia, Moscow

The crew of the most recent logistics mission, STS-101/2A.2a, prepared ISS for Zvezda's arrival. The crew performed life-extension maintenance tasks on the Zarya module, and delivered supplies to the inside and outside of the station for use by future crews.

The next mission to the ISS, STS-106/2A.2b, is scheduled for September and will see astronauts and cosmonauts continue to prepare the station for the arrival of its first houseguests – the Expedition One crew of William Shepherd, Yuri Gidzenko and Sergei Krikalev.

Space Shuttle Discovery will be the platform for a major ISS assembly mission (ISS 3A), scheduled for a late September launch. Its cargo will consist of the Boeing-built "Z1" truss and Pressurized Mating Adapter (PMA-3), four Control Moment Gyros (CMGs), and a Ku-band communication system.

Zvezda

Z1 truss will house four CMGs (above) that will provide ISS attitude control

The Z1 truss will house the four large gyroscopes that later will be activated to provide ISS attitude (orientation) control. It also will serve as an early exterior framework where the first U.S. solar arrays will be temporarily mounted for early power. During the flight, astronauts will install a Ku-band communications system, which eventually will support early science, and U.S. television capability.

Expedition One is scheduled for launch atop a Soyuz rocket from Baikonur in late October. Their capsule will dock at the ISS two days later, connecting to the recently arrived Zvezda. The crew will stay for about four months, performing installation, checkout and flight test duties. They also will assist in continued ISS assembly. Their replacement crew will arrive aboard the shuttle in February 2001. The two crews will swap places, as the Expedition One crew returns on the shuttle, leaving the Soyuz capsule behind as an emergency return vehicle, if needed.

ISS after completion of Mission 2R

Today, 16 countries are members of the International Space Station Team: the United States, Russia, Japan, Canada, Italy, Belgium, The Netherlands, Denmark, Norway, France, Spain, Germany, Sweden, Switzerland, the United Kingdom, and Brazil.

Zvezda Service Module: Cornerstone of Russia's International Space Station Modules

The Zvezda service module is the first fully Russian contribution to the International Space Station and serves as the cornerstone for early human habitation of the station. Named for the Russian word for 'Star,' the service module is scheduled to be launched unpiloted at 12:56:28 AM EDT on July 12 as the third station component, docking by remote control with the already orbiting Zarya and Unity modules at an altitude of about 245 by 230 statute miles (394 x 371 kilometers).

The 42,000-pound module, similar in layout to the core module of Russia's Mir space station, will provide the early station living quarters; life support system; electrical power distribution; data processing system; flight control system; and propulsion system. It also will provide a communications system that includes remote command capabilities from ground flight controllers.

Zvezda provides life support, command and control and early living quarters to the ISS

Although many of these systems will be supplemented or replaced by later U.S. station components, Zvezda always will remain the structural and functional center of the Russian segment of the International Space Station.

The module has a solar array wingspan of 98 feet tip to tip, and is 43 feet long from end to end. Zvezda contains three pressurized compartments: a small, spherical Transfer Compartment at the forward end; the long, cylindrical main Work Compartment; and the small, cylindrical Transfer Chamber at the aft end. An unpressurized Assembly Compartment is wrapped around the exterior of the Transfer Chamber at the aft of the module and holds external equipment such as propellant tanks, thrusters and communications antennas.

The module includes four docking ports, one in the aft Transfer Chamber and three in the spherical forward Transfer Compartment -- one facing forward, one facing up and one facing down. The aft docking port has a probe and cone docking mechanism to allow dockings by Progress resupply spacecraft and Soyuz piloted spacecraft. Zvezda is also outfitted with an automated rendezvous and docking system. The Zarya control module will dock to the forward docking port. Other modules and equipment, including a Russian Science Power Platform and a Russian Universal Docking Module, eventually will occupy the remaining two forward docking ports.

Living accommodations on Zvezda include personal sleeping quarters for the crew; a toilet and hygiene facilities; a kitchen with a refrigerator-freezer; and a table for securing meals while eating. The module will have a total of 13 windows, including three 9-inch diameter windows in the forward Transfer Compartment for viewing docking activities; one large 16-inch diameter window in the Working Compartment; an individual window in each crew compartment. Additional windows are positioned for Earth and intramodule observations.

Exercise equipment will include a NASA-provided treadmill and a stationary bicycle. The crew's wastewater and condensation water will be recycled for use in oxygen-generating devices on the module, but it is not planned to be recycled for use as drinking water. Spacewalks using Russian Orlan-M spacesuits can be performed from Zvezda by using the Transfer Compartment as an airlock. The module also will provide data, voice and television communications with Mission Control Centers in Moscow and in Houston.

Zvezda will be launched on a Russian Proton booster from the Baikonur Cosmodrome, Kazahkstan. At launch, many systems will be in standby mode and will activate via preprogrammed commands onboard. The solar arrays will be deployed as will various communications antennas.

The European Space Agency (ESA) provided the Data Management System, which serves as the "brain" of Zvezda. This computer system not only will control service module functions, but also will provide control of Russian station elements as well as the guidance and navigation for the station until the launch of the U.S. Destiny laboratory on the STS-98 mission. Destiny contains the systems, which will assume management and control of ISS operations.

Control of the orientation of the ISS will be an integrated responsibility of both the U.S. and Russian elements with the service module continuing to provide propulsive capability for the ISS for activities such as the periodic reboost of the station. Zvezda's navigation system will provide data to the motion control system of Destiny for U.S. commanding of ISS maneuvers until U.S. Global Positioning System hardware is delivered to the ISS on a future assembly flight.

The Data Management System is the first European hardware to be delivered to ISS. It was developed and manufactured in Europe by an industrial consortium led by Daimler-Chrysler of Bremen, Germany. ESA is supplying the system to the Russian partner in return for two flight-unit docking systems (no exchange of funds) for use with a later ESA element, the Automated Transfer Vehicle.

Rendezvous and Docking

Once on orbit, Zvezda becomes the passive vehicle for a rendezvous with the already-orbiting International Space Station comprised of the Zarya control module and the Unity module. As the passive "target" vehicle, Zvezda will maintain a station-keeping orbit as Zarya performs the rendezvous and docking under ground control using the Russian automated rendezvous and docking system (Kurs).

Following the docking, Zvezda assumes responsibility for attitude control and reboost. Many of the systems aboard Zarya are deactivated and the station’s first ISS component then serves primarily as a propellant storage facility and provider of pressurized volume for stowage.

Approximately three weeks after ISS docking to Zvezda, the first Progress resupply vehicle will dock automatically to the rear of the service module, which contains a probe and drogue docking assembly. Progress then will assume temporary responsibility for reboost and propulsive maneuvers of the ISS. The Progress will transfer excess propellant to Zarya’s propellant tanks by lines routed through Zvezda.

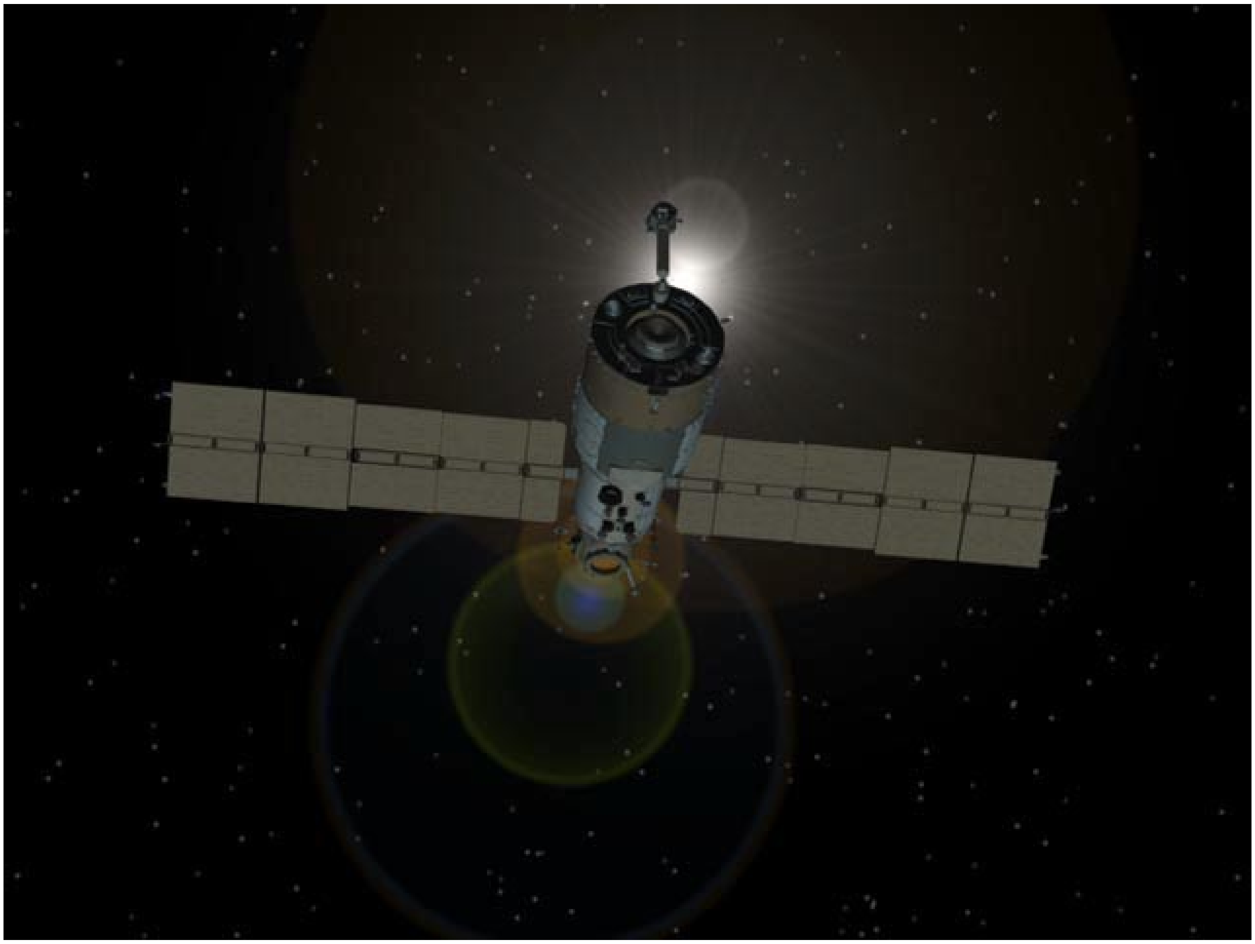
In the event the ISS cannot dock automatically with Zvezda, a two-man Russian cosmonaut crew would be launched on a Soyuz rocket from the Baikonur Cosmodrome about 15 days later on a mission to accomplish the docking manually.

The cosmonaut crew would dock its Soyuz capsule to the rear of Zvezda two days after launch, board the new module, and assemble a teleoperated rendezvous control system (TORU) in Zvezda. Two days later, they would use the TORU system to guide the ISS toward Zvezda for a linkup.

The flight plan calls for the cosmonauts to activate a number of service module systems before departing, in preparation for the arrival of a Progress resupply craft and the Shuttle Atlantis to outfit Zvezda during the STS-106 mission.

An automatic sequence of computer commands on Zvezda will order deployment of antennas for its Kurs rendezvous and docking system, and for the Lira communications system

At about the same time, Zvezda's solar arrays are to deploy and immediately begin following the sun; meanwhile, automatic commands will order the activation of the module's major systems



One orbit later, as the module flies high over Russian communications stations on the ground, Mission Controllers will verify the proper activation of the major systems; then they will command the drifting Zvezda into an orientation designed to minimize propellant usage while allowing the solar arrays to gather sunlight

Zvezda

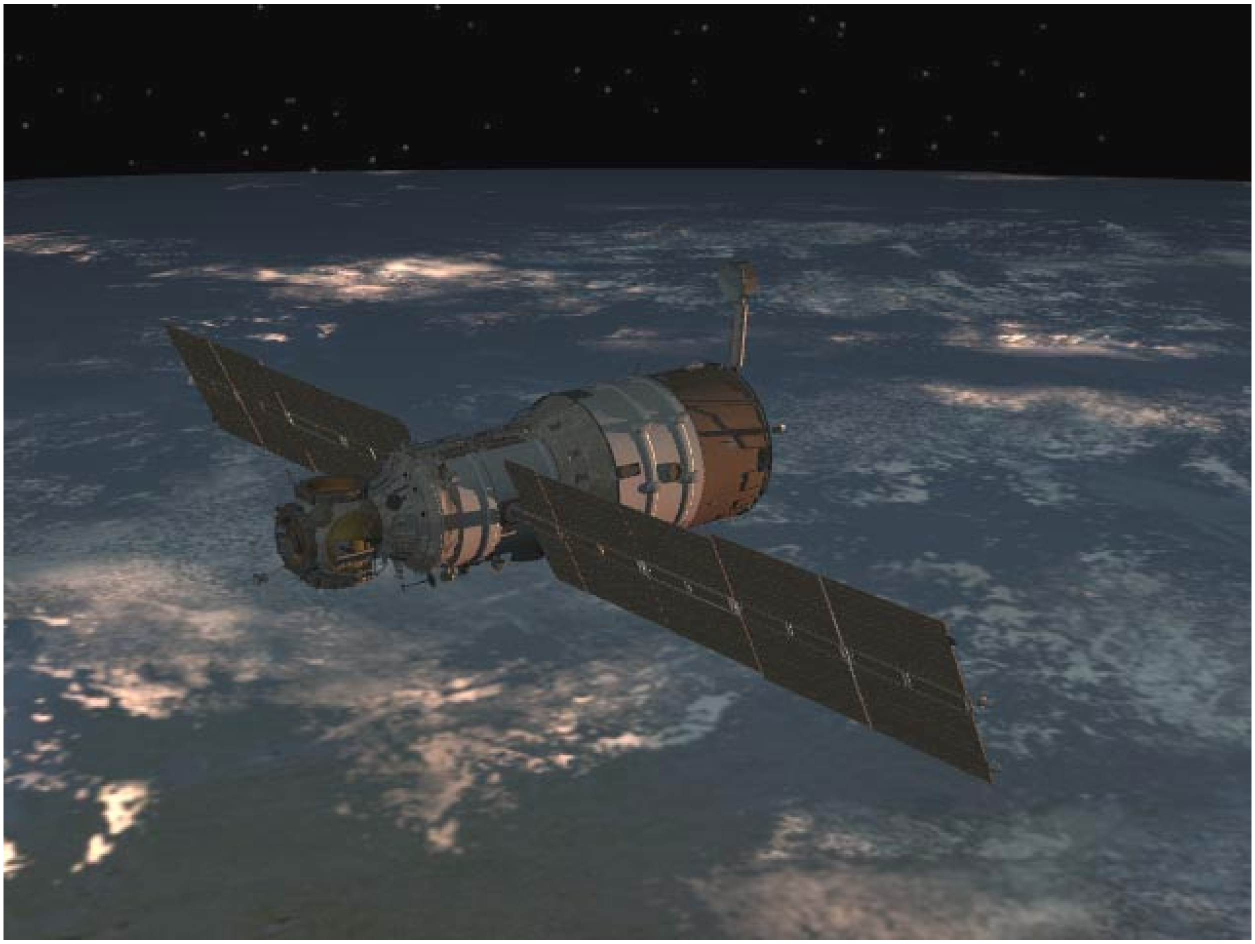
On the next ground station pass, controllers will reconfigure the module's on-board attitude sensors, activate it star tracker, and test the ability of a new communications system to relay information to Russian ground controllers

Next day, when Zvezda again comes into the range of Russian ground stations, Flight Controllers will first command it to a different attitude, and later will test-fire its maneuvering engines

Zvezda

That will set the stage for the following day's two firings of the module's main engines, raising Zvezda's orbit to approximately the altitude of the International Space Station

Zvezda



Over the course of the next several days, controllers will first test the ability of the module's motion control system to orient the solar arrays while flying in darkness, and then test the efficiency of the solar arrays themselves. They will also verify telemetry to and from the motion control system computer to ensure that Zvezda is ready to meet ISS

A day prior to docking, Zvezda will be maneuvered to its docking orientation and its solar arrays moved into the proper docking position, to verify any impact that orientation will have on battery charging

Zvezda

The next day the Kurs rendezvous system will be activated, and Zvezda will become the passive partner to the International Space Station as it moves toward a docking with its newest member

Zvezda

With the Zarya module controlling, the station will chase and catch up to Zvezda. Ground commands through Zarya's automated rendezvous system, will slowly pull the station next to the module, and then capture Zvezda

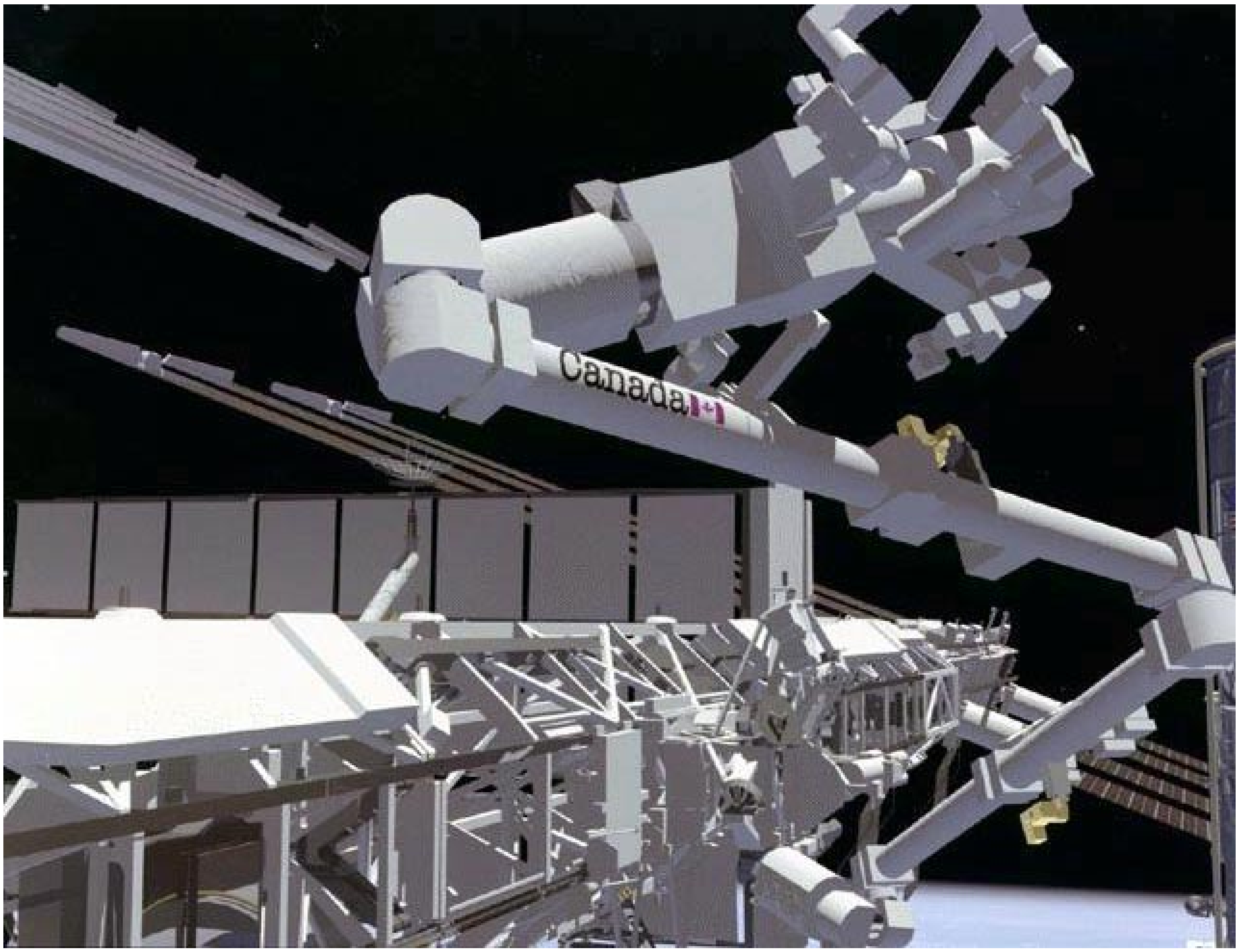
Zvezda

It will take approximately 25 minutes for the hooks and latches on the two modules to fully close, achieving a hard mate and adding a third module to the International Space Station. Over the following 16 to 24 hours, Flight Controllers will closely monitor pressure between the newly-joined modules to ensure an airtight seal, and then they'll begin work to turn control of most station functions over from Zarya, its first component, to Zvezda, the future home of the permanent crews on the International Space Station

International Partner Contribution

The international partners, Canada, Japan, the European Space Agency, and Russia, will contribute the following key elements to the ISS:

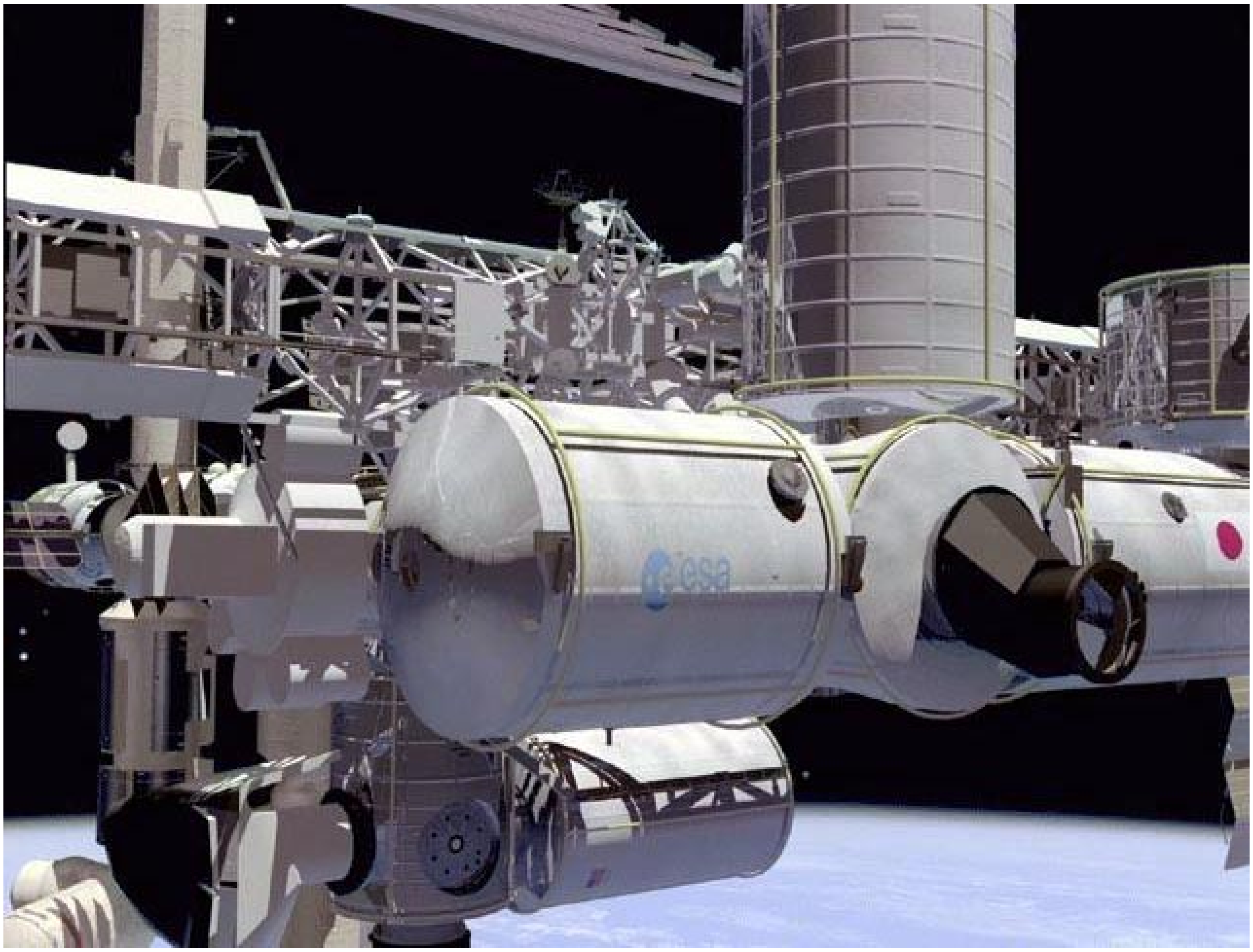
Canada is providing a 55-foot-long robotic arm to be used for assembly and maintenance tasks on the Space Station.



Canadian Robotics

Zvezda

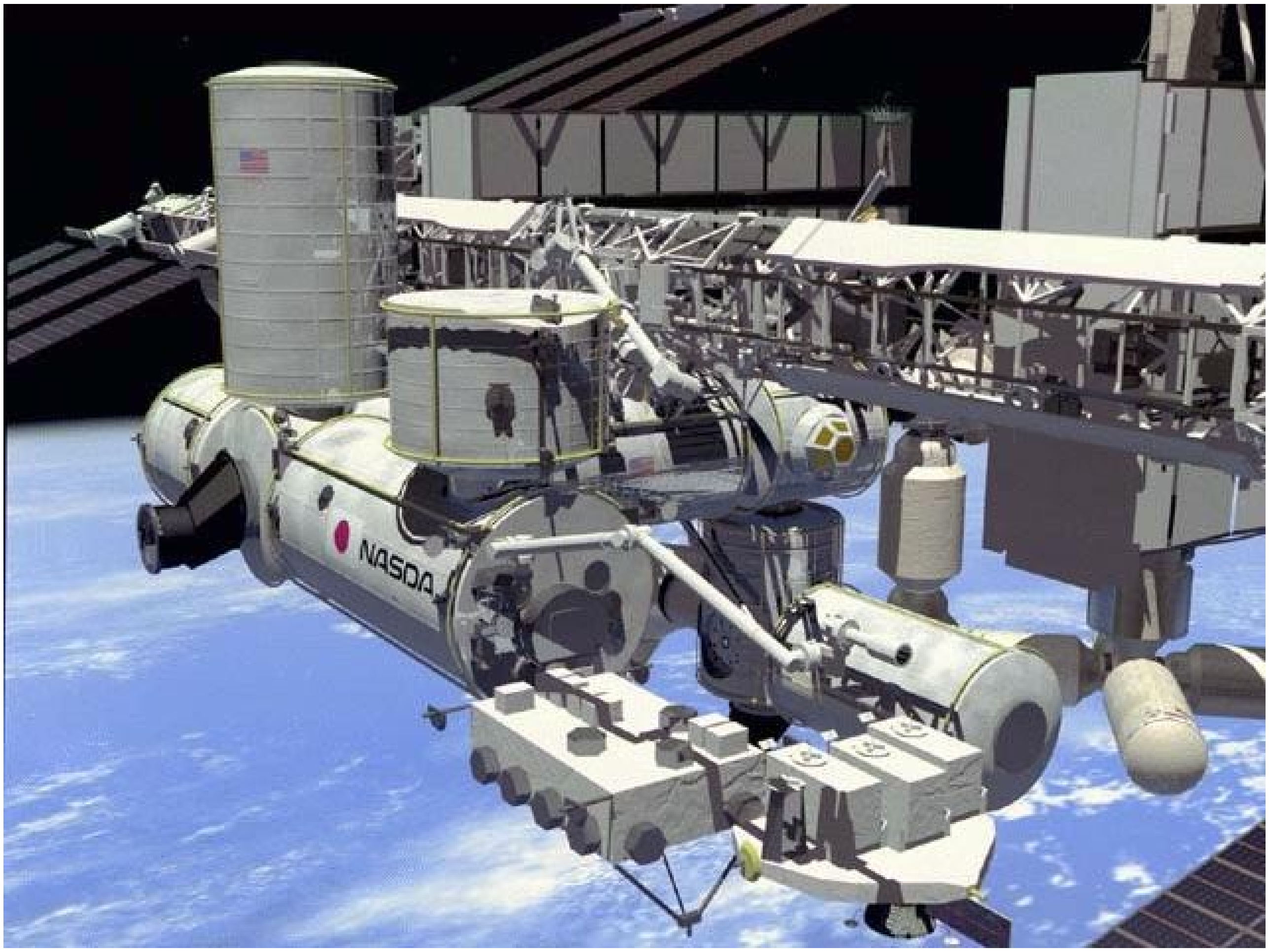
The European Space Agency is building a pressurized laboratory to be launched on the Space Shuttle and logistics transport vehicles to be launched on the Ariane 5 launch vehicle.



ESA Columbus Lab

Zvezda

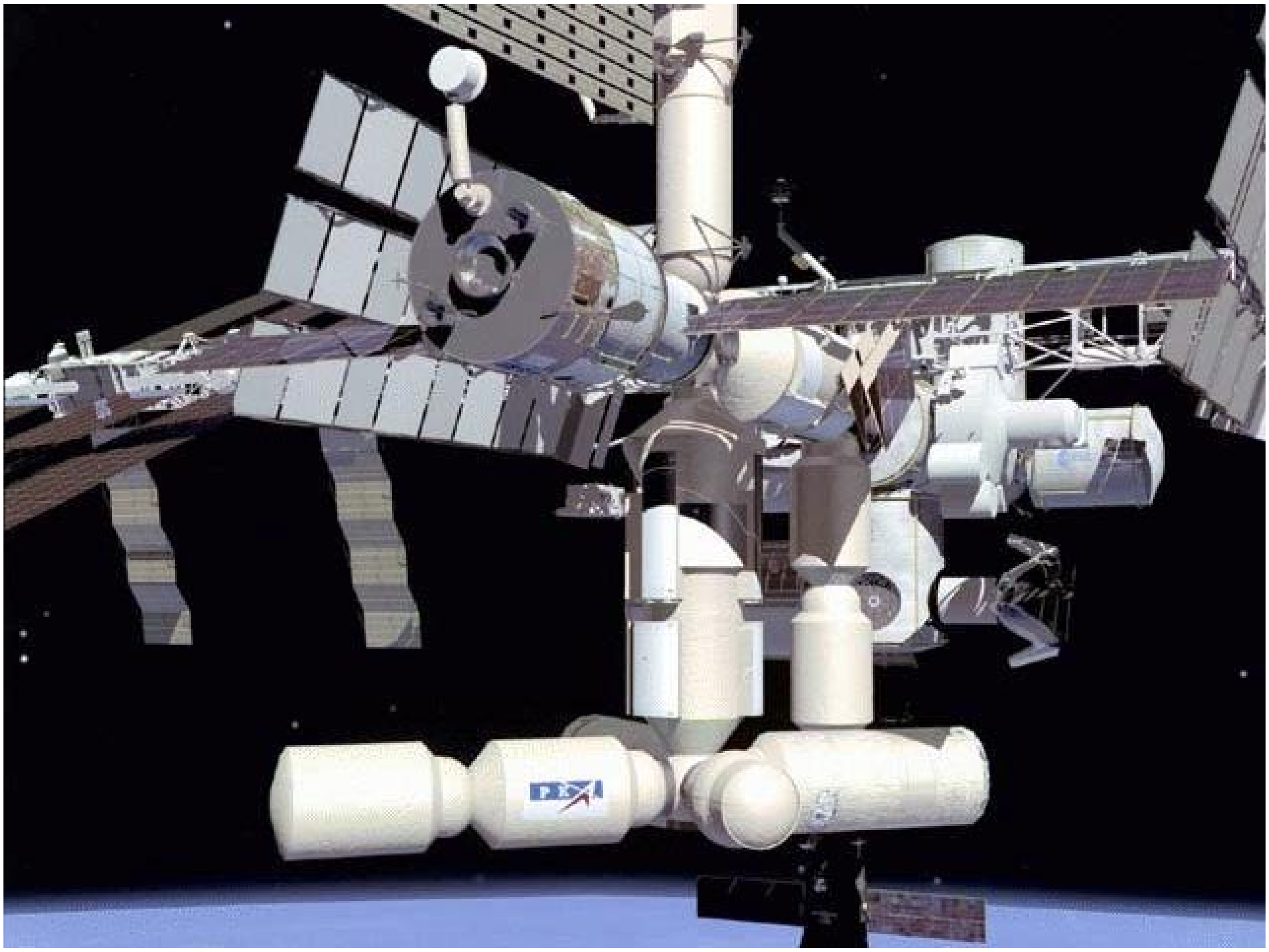
Japan is building a laboratory with an attached exposed exterior platform for experiments, as well as logistics transport vehicles.



Japan's Kibo Lab

Zvezda

Russia is providing two research modules; the Service Module with its own life support and habitation systems; a science power platform of solar arrays that can supply about 20 kilowatts of electrical power; logistics transport vehicles, and Soyuz spacecraft for crew return and transfer.



Russian Segment

In addition, Brazil and Italy are contributing some equipment to the ISS through agreements with the United States.

Research on the International Space Station

The ISS will become 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 of Russia's Mir space station. Research in the six ISS 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 ISS also will serve as an indispensable step in preparation for future human space exploration.

Examples of the types of U.S. research that will be performed aboard the station include:

Protein crystal studies: More pure protein crystals may be grown in space than on Earth. Analysis of these crystals helps scientists better understand the nature of proteins, enzymes and viruses, perhaps leading to the development of new drugs and a better understanding of the fundamental building blocks of life. Similar experiments have been conducted on the Space Shuttle, although they are limited by the short duration of Shuttle flights. This type of research could lead to the study of possible treatments for cancer, diabetes, emphysema and immune system disorders, among other research.

Tissue culture: Living cells can be grown in a laboratory environment in space where they are not distorted by gravity. NASA already has developed a Bioreactor device that is used on Earth to simulate, for such cultures, the effect of reduced gravity. Still, these devices are limited by gravity. Growing cultures for long periods aboard the station will further advance this research. Such cultures can be used to test new treatments for cancer without risking harm to patients, among other uses.

Life in low gravity: The effects of long-term exposure to reduced gravity on humans – weakening muscles; changes in how the heart, arteries and veins work; and the loss of bone density, among others – will be studied aboard the ISS. Studies of these effects may lead to a better understanding of the body’s systems and similar ailments on Earth. A thorough understanding of such effects and possible methods of counteracting them is needed to prepare for future long-term human exploration of the solar system. In addition, studies of gravity's effects on plants, animals and the function of living cells will be conducted aboard the station. A centrifuge, in the Centrifuge Accommodation Module, will use centrifugal force to generate simulated gravity ranging from almost zero to twice that of Earth. This facility will imitate Earth’s gravity for comparison purposes; eliminate variables in experiments; and simulate the gravity on the moon or Mars for experiments that can provide information useful for future space travels.

Flames, fluids and metal in space: Fluids, flames, molten metal and other materials will be the subjects of basic research on the station. Flames burn differently without gravity. Reduced gravity reduces convection currents, the currents that cause warm air or fluid to rise and cool air or fluid to sink on Earth. This absence of convection alters the flame shape in orbit and allows studies of the combustion process that are impossible on Earth, a research field called combustion science. The absence of convection allows molten metals or other materials to be mixed more thoroughly in orbit than on Earth. Scientists plan to study this field, called materials science, to create better metal alloys and more perfect materials for applications such as computer chips. The study of all of these areas may lead to developments that can add value to many industries on Earth.

The nature of space: Some experiments aboard the station will take place on the exterior of the station modules. Such exterior experiments can study the space environment and how long-term exposure to space, the vacuum and the debris, affects materials. This research can provide future spacecraft designers and scientists a better understanding of the nature of space and enhance spacecraft design. Some experiments will study the basic forces of nature, a field called fundamental physics, where experiments take advantage of weightlessness to study forces that are weak and difficult to study when subject to gravity on Earth. Experiments in this field may help explain how the universe developed. Investigations that use lasers to cool atoms to near absolute zero may help us understand gravity itself. In addition to investigating basic questions about nature, this research could lead to down-to-Earth developments that may include clocks a thousand times more accurate than today's atomic clocks; better weather forecasting; and stronger materials.

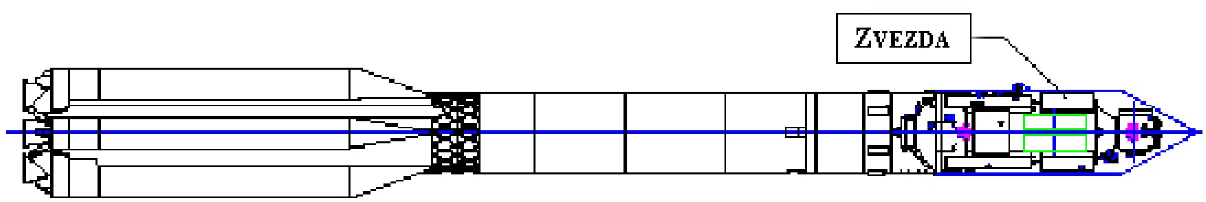
Watching the Earth: Observations of the Earth from orbit help the study of large-scale, long-term changes in the environment. Studies in this field can increase understanding of the forests, oceans and mountains. The effects of volcanoes, ancient meteorite impacts, hurricanes and typhoons can be studied. In addition, changes to the Earth that are caused by the human race can be observed. The effects of air pollution, such as smog over cities; of deforestation, the cutting and burning of forests; and of water pollution, such as oil spills, are visible from space and can be captured in images that provide a global perspective unavailable from the ground.

Commercialization: As part of the commercialization of space research on the station, industries will participate in research by conducting experiments and studies aimed at developing new products and services. The results may benefit those on Earth not only by providing innovative new products as a result, but also by creating new jobs to make the products.

The Proton Rocket: A Russian Booster for Early Station Components

The three-stage Russian Proton rocket that will be used to launch the first fully Russian contribution – the Zvezda service module – has successfully flown more than 200 times.

The Proton originally was introduced in 1965 as a booster for heavy military payloads and for space stations. It was designed by the Salyut Design Bureau and is manufactured by the Khrunichev State Research and Production Space Center in Moscow. The Proton is among the most reliable heavy-lift launch vehicles in operation, with a reliability rating of about 98 percent. In addition to Zvezda, the three-stage Proton was used to boost the first component of the International Space Station known as Zarya, or Sunrise, into orbit Nov. 20, 1998.



The Zvezda service module atop the Proton booster

With the Zvezda module, launch fairing and adapter in place atop the booster, the Proton measures about 180 feet tall, 24 feet in diameter at its widest point and weighs about 1,540,000 pounds when fully fueled for launch. The engines use nitrogen tetroxide, an oxidizer, and unsymmetrical dimethyl hydrazine, a fuel, as propellants. The first stage includes six engines that are fed propellants from a single, center oxidizer tank surrounded by six outboard fuel tanks. At launch, the first stage engines combine to provide about 1.9 million pounds of thrust. The first stage, which measures about 68 feet long by 24 feet in diameter, burns out and is jettisoned two minutes, six seconds after launch at an altitude of 27 statute miles and traveling more than 3,700 miles per hour.

Four engines creating 475,000 pounds of thrust power the Proton's second stage, which measures 56 feet long by 13.5 feet in diameter. While the second stage is in operation, the protective fairing covering Zvezda for liftoff is jettisoned at three minutes, three seconds into the flight. The second stage burns for a total of about three minutes, 28 seconds and is jettisoned at about five and half minutes after launch. When the second stage is jettisoned, the spacecraft is at an altitude of about 86 miles, traveling more than 9,900 miles per hour.

Zvezda

The Proton's third and final stage measures 13.5 feet long by 13 feet in diameter, and is powered by a single engine that creates 125,000 pounds of thrust. The third stage is jettisoned nine minutes, 47 seconds into the flight, at an altitude of 115 statute miles and traveling about 16,900 miles per hour. Zvezda then will be in an elliptical orbit with a high point of 220 statute miles and a low point of 115 statute miles. Firings of Zvezda's engines during the following days will raise the orbit to an altitude of about 240 statute miles for the rendezvous and capture by the orbiting station under control of Zarya.

Zvezda Proton Launch Profile

Time	Event	Altitude	Speed
T-0	Liftoff	n/a	n/a
T+2:06	1st state jettison	27 miles	3,700 mph
T+3:03	Zvezda fairing jettison	48 miles	4,700 mph
T+5:30	2nd stage jettison	86 miles	9,900 mph
T+9:47	3rd stage jettison	115 miles	16,900 mph

Orbit at 3rd stage jettison: approximately 115 x 220 statute miles
Orbit at ISS rendezvous: 240 statute miles

Zvezda Launch Countdown

MET	GMT	Eastern Time	EVENT
T-8 hrs	2056:28	4:56:28 p.m.	-- Power up Proton booster avionics & verify condition of main avionics systems
T-7 hrs, 20 min	2136:28	4:36:28 p.m.	-- Power up 'Zvezda' command & control system heaters
T-7 hrs	2156:28	5:56:28 p.m.	-- Power up 'Zvezda' telemetry to verify onboard systems -- Start data recorders
T-6 hrs, 30 min	2126:28	5:26:28 p.m.	-- Turn off telemetry system and power down electric buses
T-6 hrs	22:56:28	6:56:28 p.m.	-- Begin loading Proton oxidizer (2 hrs, 40 min duration)
T-4 hrs, 20 min	0036:28	8:36:28 p.m.	-- Begin loading Proton propellant (1 hr, 10 min duration)
T-2 hrs, 40 min	0216:28	10:16:28 p.m.	-- Thermal conditioning of Proton and 'Zvezda'
T-1 hr, 10 min	0346:28	11:46:28 p.m.	-- Retract service umbilical -- Ventilate & purge gas cavities of Proton propellant tanks -- Activate ground system electrical bus -- Set start time for launch sequence mechanism and synchronize it with the universal time system
T-1 hr, 5 min	0351:28	11:51:28 p.m.	-- Adjust Proton booster trajectory
T-1 hr	0356:28	11:56:28 p.m.	-- Power up ground station data handling complex -- Power up 'Zvezda' electrical buses and telemetry systems
T-45 min	0411:28	12:11:28 a.m.	-- 'Zvezda' launch sequence initiated
T-40 min	0416:28	12:16:28 a.m.	-- Radiotelemetry sy stem activated
T-35 min	0421:28	12:21:28 a.m.	-- Thermal control system activated
T- 33 min	0423:28	12:23:28 a.m.	-- Motion Control System activated in pre-launch mode
T- 32 min	0424:28	12:24:28 a.m.	-- Final alignment of gyroscopes for required liftoff azimuth
T-30 min	0426:28	12:26:28 a.m.	-- Command and control system activated
T-25 min	0431:28	12:31:28 a.m.	-- Fine tuning of gyro-stabilized launch platform of the Proton's trajectory control system in the horizon plane and line of the azimuth
T-20 min	0436:28	12:36:28 a.m.	-- Trajectory measurement system activated
T-18 min	0438:28	12:38:28 a.m.	-- 'Zvezda' telemetry system activated

MET	GMT	Eastern Time	EVENT
T-15 min	0441:28	12:41:28 a.m.	-- Onboard telemetry monitoring system activated -- Thermal monitoring of Proton booster engines
T-12 min	0444:28	12:44:28 a.m.	-- Initiate rotation of gyro-stabilized platform of Proton trajectory control system
T-10 min	0446:28	12:46:28 a.m.	-- Ground systems ready
T-9 min	0447:28	12:47:28 a.m.	-- Power switched from ground to 'Zvezda' onboard batteries
T-8 min	0448:28	12:48:28 a.m.	-- Steering jets of all booster stages confirmed in 'zero position' -- Ground command receives 'control systems ready' message -- Ground command receives 'auxiliary systems read' message
T-5 min	0451:28	12:51:28 a.m.	-- Final launch operation program initiated
T-4 min	0452:28	12:52:28 a.m.	-- Telemetry monitoring system switched to onboard power supply
T-3 min, 30 sec	0452:58	12:52:58 a.m.	-- 'Zvezda' telemetry system recording activated
T-3 min	0453:28	12:53:28 a.m.	-- Power up of ground station recorders
T-2 min	0454:28	12:54:28 a.m.	-- Ground command receives 'main block ready' command
T-1 min	0455:28	12:55:28 a.m.	-- Ground station recorders activated
T-2.5 sec	0456:25.5	12:56:25.5 a.m.	-- Time launch sequence mechanism issues ignition command for first stage engines -- Proton control system switched to onboard power supply
T-1.6 sec	0456:26.4	12:56:26.4 a.m.	-- Onboard system issues full-thrust command to engines
T Zero	0456:28	12:56:28 a.m.	-- LAUNCH
+2 min, 6 sec	0458:34	12:58:34 a.m.	-- First stage separation (27.1 miles, 43.6 kilometers)
+3 min, 3 sec	0459:31	12:59:31 a.m.	-- Launch shroud jettison (48.6 miles, 78.2 km - removal of Proton nose fairing) -- Shroud panels deploy two folded command and control antennae and the telemetry system antenna on 'Zvezda'
+5 min	0501:28	1:01:28 a.m.	-- Begin telemetry recording of 'Zvezda' module
+5 min, 34 sec	0502:02	1:02:02 a.m.	-- Second stage separation (85.9 miles, 138.3 km)
+5 min, 50 sec	0502:18	1:02:18 a.m.	-- Prepare 'Zvezda' propulsion system for operations (30 seconds in duration)

MET	GMT	Eastern Time	EVENT
+9 min, 37 sec	0506:05	1:06:05 a.m.	-- Third stage main engine shutdown command initiated
+9 min, 47 sec	0506:15	1:06:15 a.m.	-- Third stage separation command (114.9 miles, 185 km) -- Third stage steering jet is deactivated -- Pyro locks securing 'Zvezda' to booster are released -- Third stage solid body fuel jets fire to separate booster from 'Zvezda'
+9 min, 49 sec	0506:17	1:06:17 a.m.	-- 'Zvezda' command and control system activated -- External elements deployment program initiated
+10 min, 5 sec	0506:33	1:06:33 a.m.	-- Fire pyro pins to deploy 'Kurs' docking system antennae
+10 min, 9 sec	0506:37	1:06:37 a.m.	-- Deactivate telemetry system used during ascent
+10 min, 11 sec	0506:39	1:06:39 a.m.	-- Start spin-up of control system gyro motors
+10 min, 37 sec	0507:05	1:07:05 a.m.	-- Initiate 'Kurs' rendezvous antennae deployment -- 'Lira' telemetry antenna deployment
+12 min, 20 sec	0508:48	1:08:48 a.m.	-- Initiate trim of residual angular rates (27 seconds in duration)
+13 min, 20 sec	0509:48	1:09:48 a.m.	-- Solar array deployment (two minutes in duration)

Zvezda Orbital Events Summary

Launch reference date is July 12, 2000

FLIGHT DAY	DATE	EVENT
1	07/12/00	-- Launch, ascent, orbit insertion -- Antennae/solar array deploy -- Motion Control System activation -- Systems activation -- Propulsion system preparation -- Star tracker activation and test -- External black and white television camera test
2	07/13/00	-- Verification burn #1 (approx. one meter per second) -- Verification burn #2 (approx. one m/s) - Preparations for flight day three orbit raising burns -- Solar array test (first set of drive motors) - verifies accuracy of solar array positioning -- Inertial navigation system telemetry test -- Star tracker navigation system test
3	07/14/00	-- Maneuver to attitude for raising burns -- Perform two orbit raising burns (approx. 16 m/s and 26 m/s) -- Solar array test (second set of drive motors) - verifies accuracy of solar array positioning
4	07/15/00	-- Maneuver to burn attitude -- Perform one orbit correction burn (approx. four m/s) -- 'Regul' telemetry system test
6	07/17/00	-- Motion Control System test -- Inertial navigation system test -- Battery cycling test -- External black and white television camera test
8	07/19/00	-- Zvezda maneuvered to inertial docking attitude -- Zvezda, 'Kurs' and 'Regul' systems tests
9	07/20/00	-- Telemetry analysis -- Zvezda battery current measurements -- Solar array system test -- Zarya's Motion Control System activated
11	07/22/00	-- ISS maneuvered to initial docking attitude

FLIGHT DAY	DATE	EVENT
13	07/24/00	-- Two Zvezda rendezvous burns -- Zarya Motion Control System activated -- Zarya docking mechanism extended -- Unity systems powered down -- ISS orbital correction burn -- Unity systems reactivated -- Zarya Motion Control System deactivated
14	07/25/00	-- One Zvezda orbit correction burn -- Zarya Motion Control System activated -- Final Zvezda maneuver to docking attitude -- ISS orbital correction burn -- Zvezda automatic rendezvous system (Kurs) activated -- Solar arrays locked for docking -- ISS (Zarya) automatic rendezvous system (Kurs) activated -- ISS DOCKING TO ZVEZDA -- Solar arrays resume Sun tracking -- Zarya Motion Control System deactivated -- Hooks between Zarya and Zvezda closed for hard mate -- Zvezda assumes attitude control of the ISS complex

ISS Missions Accomplished - Four Flights Completed

The International Space Station is in good shape without any significant problems as it hurtles at a speed of more than 17,000 mph (27,300 kph), circling Earth about every 92 minutes in an orbit of 245 by 230 statute miles (394 x 371 kilometers). The Station currently weighs about 74,000 pounds and will weigh about 1 million pounds when completed.

The first module, Zarya, was launched by Russia's Proton rocket from the Baikonur Cosmodrome in Kazakhstan on Nov. 20, 1998 (ISS flight 1A/R). Two weeks later, on Dec. 4, Space Shuttle Endeavour carried America's Unity module into orbit (ISS flight 2A).

Two astronauts completed the linkup of the first two modules during three spacewalks totaling 21 hours, 22 minutes and prepared the ISS for future assembly missions. Endeavour returned home Dec. 15.

On May 27, 1999, the first logistics mission (ISS 2A.1) got under way with the launch of Space Shuttle Discovery. More than 2,000 pounds of supplies and hardware was loaded aboard the ISS to await future crews that would live on the station.

During the mission's only spacewalk, the initial pieces of a Russian cargo crane Strela ("Arrow") and a U.S. crane were attached to the outside of the station during a seven hour, 55 minute spacewalk. Discovery returned home June 6, 1999.

Astronaut James Newman performs EVA on STS-88

Zvezda

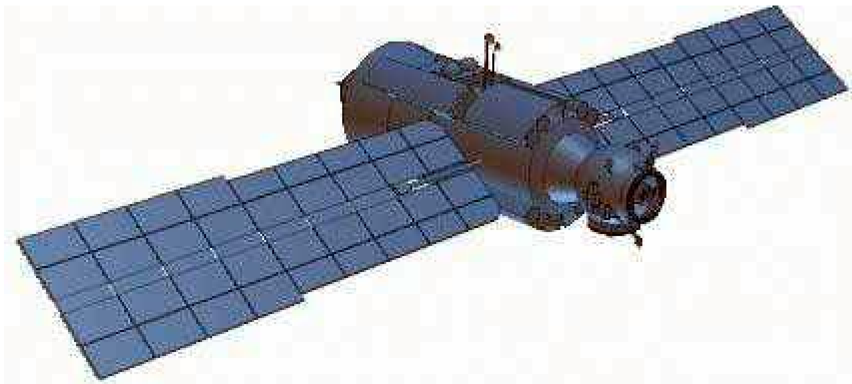
Atlantis launched a crew of seven on May 19, 2000, carrying more supplies and maintenance equipment to ISS. This fourth mission dedicated to the ISS Program (ISS 2A.2a) was designed to prepare the station for the next station module, the Russian-built Zvezda service module, scheduled for launch in mid July from Baikonur. The crew spent five days docked to the ISS delivering more supplies, while conducting maintenance tasks to restore the station's electrical power system back to full redundancy. More than 2,000 pounds of supplies were left onboard for use by astronauts and cosmonauts scheduled to begin permanent residence by the late fall of this year.

Two crewmembers spent more than six and a half hours outside Atlantis completing a variety of planned assembly and maintenance tasks on ISS. The EVA marked the fifth spacewalk conducted for construction of ISS.

The launch was Atlantis' first since September 1997 following major modifications, including installation of a state-of-the-art, glass cockpit filled with computer displays to replace the old cockpit dials and switches.

Early Assembly Flights Overview

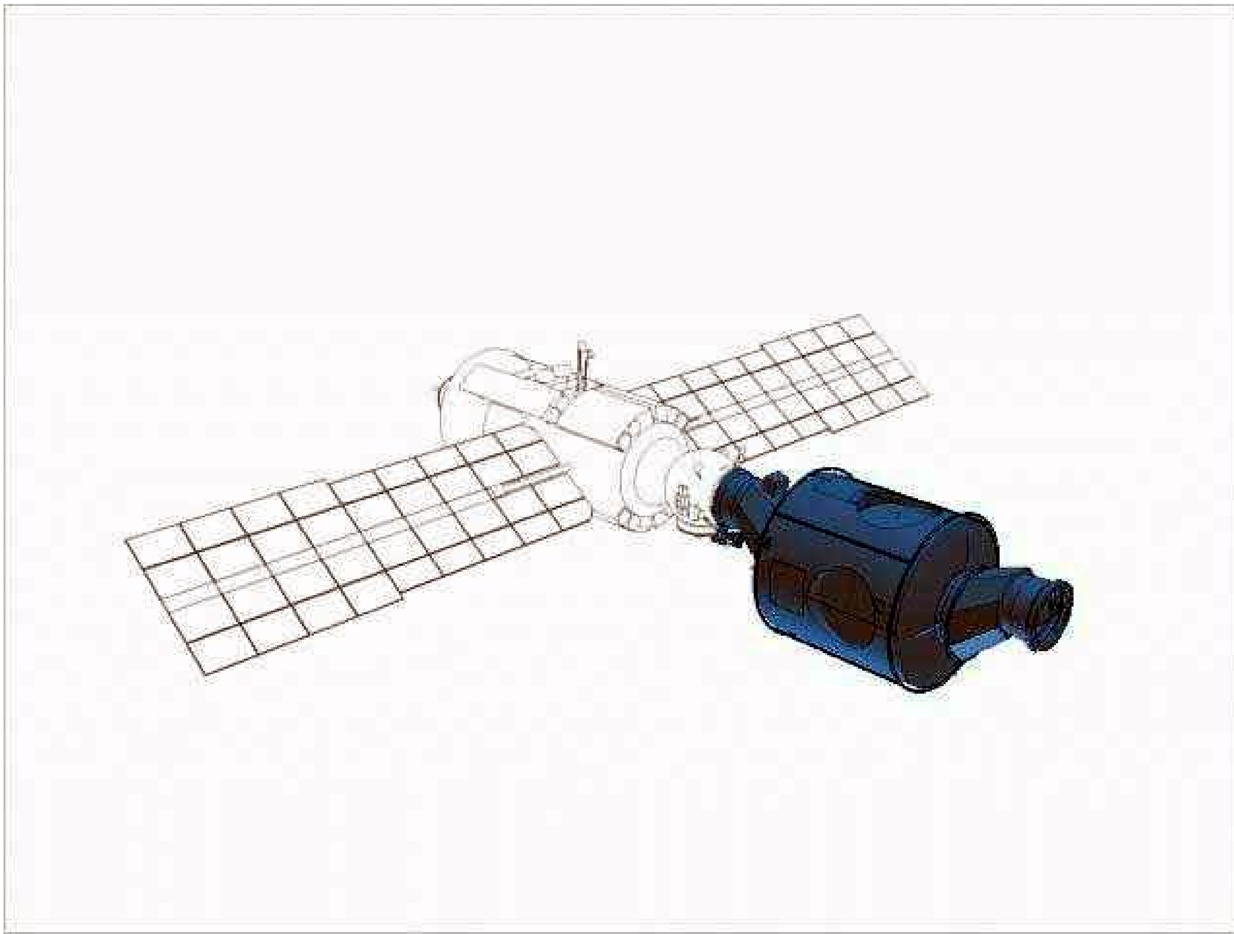
Zarya control module



Zarya

Launched Nov. 20, 1998, from the Baikonur Cosmodrome, Kazakhstan, Zarya is providing the early propulsion, steering and communications for the station until Zvezda arrives. Afterward, Zarya is used as a passageway, stowage facility, docking port and fuel tank.

Unity Node
(Shuttle Mission STS-88)



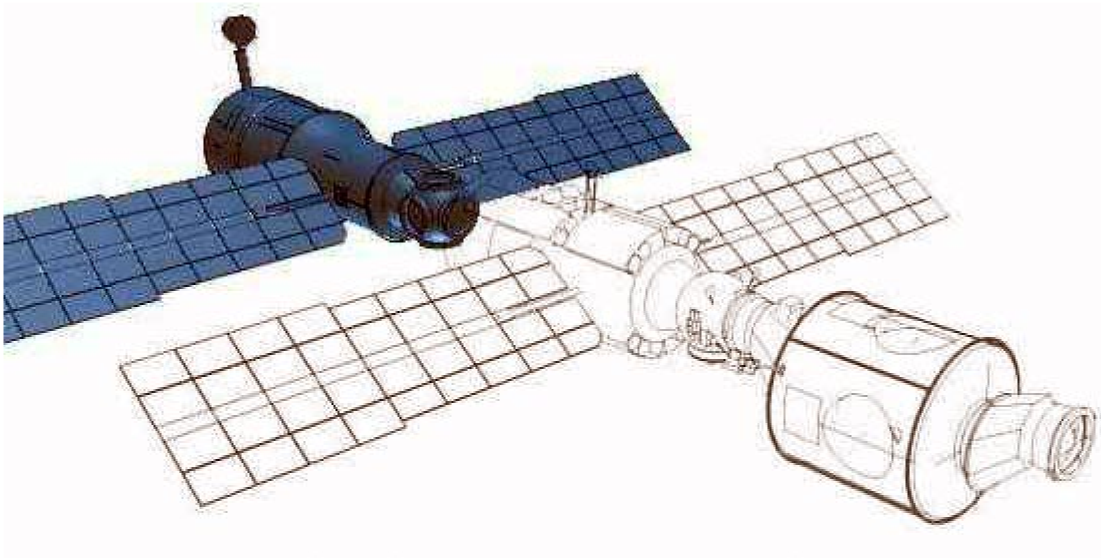
Zarya/Unity

The first wholly U.S. component was launched Dec. 4, 1998, aboard Space Shuttle Endeavour. Unity provides six docking ports, one on each side. With Zarya permanently attached to one of those, the remaining five will serve as attach points, to which all future U.S. modules will be joined.

Logistics Flight
(Shuttle Mission STS-96)
Discovery launched May 27, 1999 and docked with the ISS two days later. Aboard was 2,000 pounds of supplies and logistics to prepare the orbiting facility with equipment that eventually will be used by crews that live aboard for long durations. It was the second shuttle mission dedicated to the assembly and outfitting of the station.

Maintenance/Logistics Flight
(Shuttle Mission STS-101)
Atlantis returned to space on May 19, 2000, following two years of upgrades, including a newly designed, state-of-the-art forward cockpit. It's cargo included more than 2,000 pounds of supplies and equipment to extend the lifetime of the Zarya module. During the mission, four of six batteries and associated electrical components were swapped to restore the electrical power system to full redundancy. This was the third shuttle flight for station assembly.

Zvezda service module

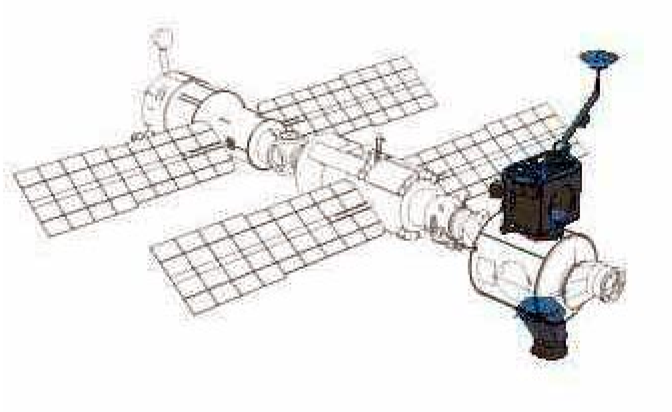


Service Module attached

Zvezda will be the core of the Russian segment when launched in July 2000. The ISS performs an automatic rendezvous and docking with Zvezda, which provides living area, life support, navigation, propulsion and communications through the early assembly phases. It then will assume most of Zarya's functions.

Logistics Flight
(Shuttle Mission STS-106)
Atlantis returns to the ISS after the arrival of the Zvezda to provide additional supplies and serve as the first opportunity for astronauts and cosmonauts to enter the newest module after it becomes a permanent part of the station. Crewmembers not only will unload supplies from the shuttle, but also from a recently docked Progress vehicle. The mission currently is targeted for launch in September 2000.

Gyroscopes and Framework
(Shuttle Mission STS-92)

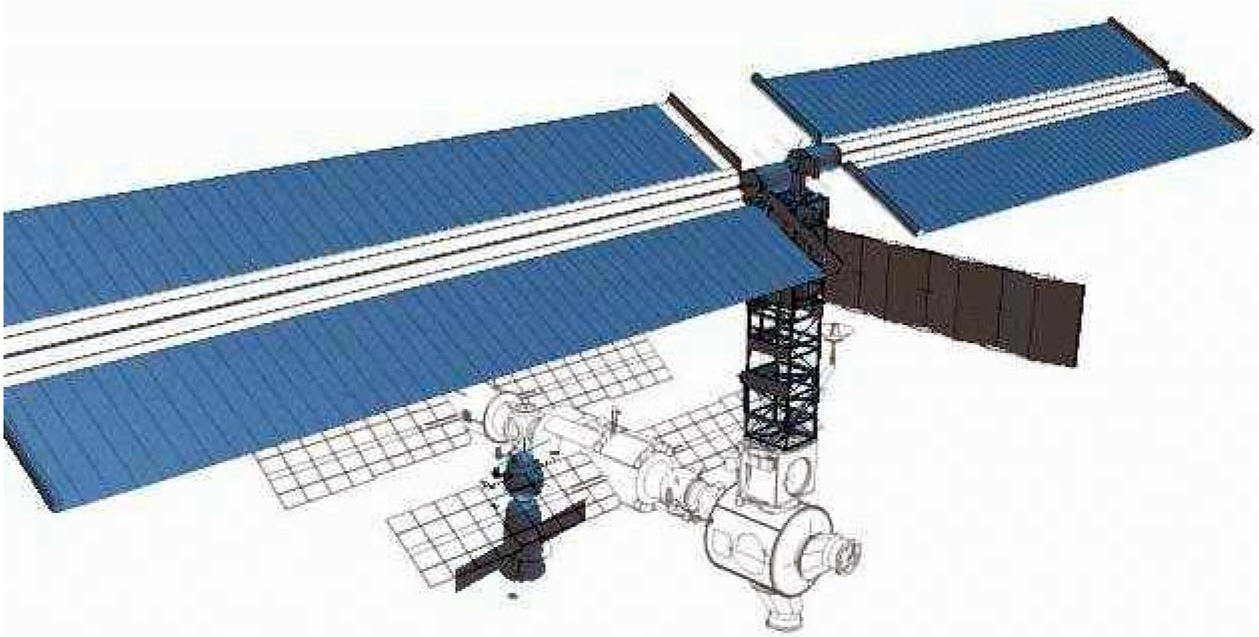


Framework, docking adapter added

Launch of Discovery carrying the first small piece of truss structure and the station's gyroscopes is scheduled for late September 2000. The Z1 truss (a piece of the girder-like truss), four Control Moment Gyros, and an additional conical docking adapter will make up the cargo for this second major shuttle assembly mission. The framework houses critical electronics and communications equipment, and the gyroscope systems that eventually will replace thrusters to maintain the station's stability. The shuttle's robot arm will be used to attach the framework and docking adapter. Next, astronauts will perform several spacewalks to make final connections.

First Crew
The Expedition One crew heads to the ISS in late October or early November to begin the permanent human presence on the station. Astronaut William Shepherd, and cosmonauts Yuri Gidzenko and Sergei Krikalev will travel to the station aboard a Russian Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan. Shepherd serves as the Expedition Commander, Gidzenko is the Soyuz Commander and Krikalev the Flight Engineer. They will dock with the station two days after launch and begin a stay of about four months. Their mission will be to activate life support systems and experiments, while continuing stowage and checkout of the new station. They also will assist with the continuing assembly and conduct the first station-based spacewalks from Zvezda's forward airlock. The first crew will return to Earth on a shuttle, leaving the Soyuz that launched them docked at the station as an emergency "lifeboat" for the next crew.

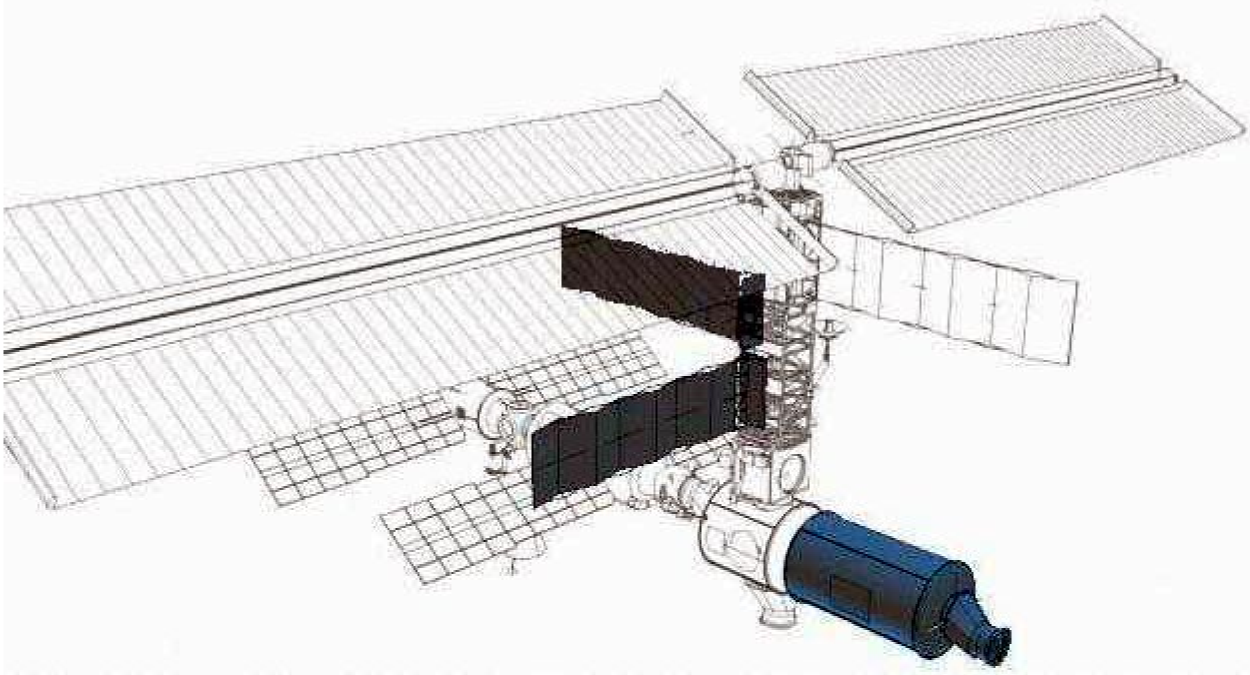
Solar Power
(Shuttle Mission STS-97)



First solar arrays attached to ISS

The focus of Endeavour's mission is to add the first pair of giant solar arrays and batteries to the station. Scheduled for launch in November 2000, the shuttle will deliver this first of four pairs of solar energy grabbing arrays to dramatically increase the electricity available for use by future components and modules. This pair of solar arrays sets the stage for a major expansion of the station: arrival of the U.S. Destiny laboratory. The shuttle crew will conduct a pair of spacewalks to complete connections of the solar arrays.

U.S. Destiny Laboratory
(Shuttle Mission STS-98)



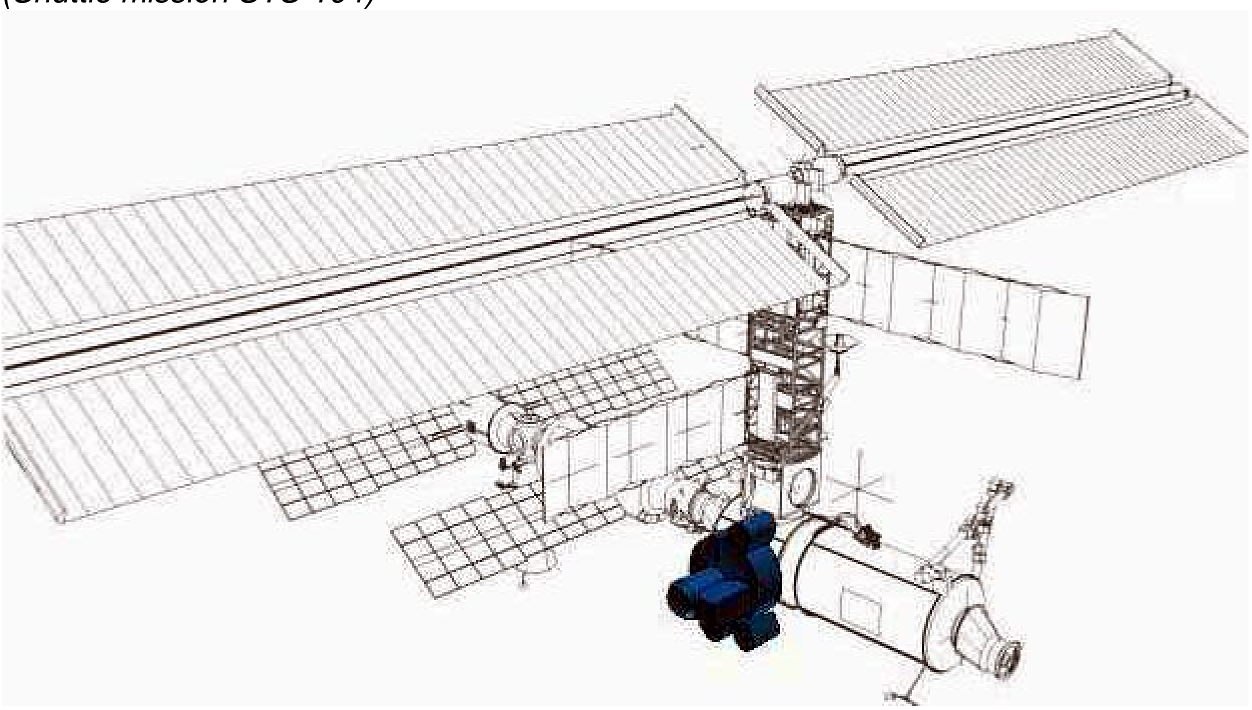
U.S. Laboratory attached

Atlantis' flight to the ISS is set for January 2001, to deliver the first scientific research laboratory. The U.S. Destiny laboratory is the centerpiece of future research activity on the International Space Station. Astronauts will use the shuttle's robot arm to maneuver the new laboratory into position on the station. The installation will be completed during three spacewalks to finish the installation.

Lab Outfitting/Crew Exchange Flight
(Shuttle Mission STS-102)
Discovery's launch in February 2001 will see the orbiter dock with the station carrying interior supplies and equipment racks housed in a reusable Italian-built logistics module named Leonardo. The mission will highlight the first exchange of crews on the ISS with the Expedition One crew being replaced by the Expedition Two crew of Yuriy Usachev, Susan Helms and Jim Voss.

Canadian Robot Arm
(Shuttle Mission STS-100)
Endeavour heads to the ISS again in April 2001 carrying Canada's Space Station Remote Manipulator System (SSRMS) and the second of three reusable multi-purpose logistics modules supplied by Italy named Rafaello. The new station arm will be attached during the mission while the Multipurpose Logistics Module (MPLM) is attached to the station, unloaded and then returned to Earth. Rafaello will hold equipment to finish the interior construction of the Destiny laboratory. The Canadian robotic arm will assist with most future assembly activities.

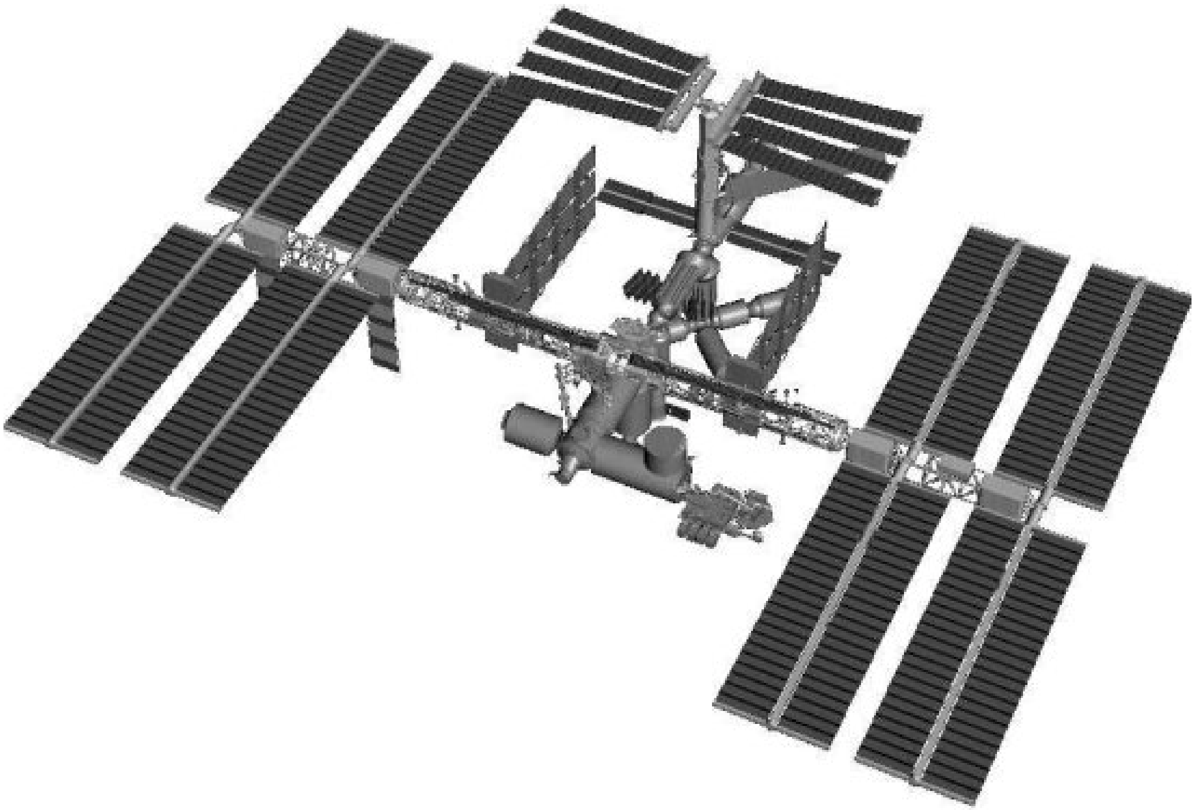
Spacewalking Airlock
(Shuttle mission STS-104)



Station airlock attached

Atlantis will launch in May 2001 to deliver the joint airlock to the International Space Station, which will enable station-based extravehicular activity (EVA) using both U.S. and Russian spacesuits. The addition of the airlock signals the completion of the early phase of station assembly in orbit, meaning 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 into 2005 when the crew size will expand to seven. Other elements that will be added to complete assembly are the Japanese Laboratory, Kibo (meaning Hope); the European Attached Pressurized Module; a Centrifuge; and a crew habitation module.

Zvezda



ISS Assembly complete 2005
Wingspan - 365 feet, 108 meters
Length - 262 feet, 80 meters
Mass - one million pounds, 454,000 kilograms
Crew size - up to seven
Laboratories - six

International Space Station Video Products

Video Resource Reels: Loosely edited comprehensive materials created for use by News Media as B-roll:

International Space Station Animation Resource Reel – June 2000
Reference Master # 618324 JSC # 1834
Cut sheet available
This video resource reel contains the latest animation of the International Space Station, including the just released animation of the Zvezda service module. The tape begins with a sequence illustrating a space shuttle docking with the complete station, then continues with station fly-around views, scenes showing the construction of the station – from early supply missions to assembly missions, in which the giant pieces of the station are maneuvered into place by the shuttle robot arm. There is animation of the first station crew's Soyuz arriving, the space station robot arm, solar arrays tracking the sun and close-up views of modules representing the different participating countries. The video concludes with a step-by-step animation depicting the latest approved assembly plan of the station.

International Space Station General Resource Reel – July 2000
Reference Master # 618326 JSC # 1833
Cut sheet available
This comprehensive reel includes all major recent station video, including new animation of the complete station, actual footage of the Zarya (first element) launch, STS-88 Highlights of the first station assembly mission to join the Zarya and Unity modules in space, STS-96 and STS-101 mission highlights, Zvezda service module, STS-92 Animation of Z-1 and PMA installation, Z-1 truss video, STS-97 animation of P6 Solar array installation and deploy, Solar panel at KSC, Long Spacer at KSC, new Expedition One crew training with Orlan and American suits training underwater at JSC, the Expedition One crew training in Russia, U.S. Lab footage at KSC and Marshall, Multi Purpose Logistics Module at KSC, new footage of the Canadian robot arm, the U.S. Airlock , ISS Solar array, Japanese Experiment module, Animation of the Columbus Attached Pressurized Module, new TransHab animation and real video of testing at JSC, U.S. Hab video from Marshall, X-38 free flight test from March 5, 1999, and finally, animation of the REV E assembly sequence.

ISS Zvezda Service Module Resource Reel – June 2000
Ref. Master# 618325 JSC # 1832
The Zvezda Service Module Resource Reel includes animation of the Zvezda in orbit; and animation of the ISS (Zarya/Unity) rendezvousing and docking with Zvezda. It also includes Zvezda under construction at the Khrunichev State Research and Production Space Center in Moscow, Russia, Oct. 1997, then earlier in 1996 and 1995. Also includes future space station crews touring the Service Module.

Narrated productions:

International Space Station Video Progress Report – July 1999: A Home in Space
Ref. Master # 617401 JSC # 1799
This complete video gives the viewer a glance at all the important achievements accomplished so far with the International Space Station. The program begins with an illustration of the "Brick Moon," a man-made structure that appeared in a magazine article at the turn of the century. Dreams become reality as a real home in space orbits the earth…The International Space Station. The video includes highlights from the first assembly mission to unite the modules Zarya and Unity, highlights from STS-96 (2A.1) and their supply transfer and EVA on the station, updates on future station crews, focusing on Bill Shepherd and Expedition One, updates on hardware, including: the Service Module Zvezda, Z-1 truss, the Lab, the Canadian robot arm, Solar arrays, Leonardo, the U.S. Airlock, the S-0 Truss, the Japanese Kibo module and the Columbus Attached Pressurized Module. Also featured is the MEIT…where station components are hooked together by cable to verify how well they work together at the Space Station Processing Facility at KSC. The video closes with views of the complete station in orbit, reminding the viewer that an age-old dream of a home in space has come true.

Go for Assembly: Building the International Space Station – September 1997
Reference Master # 614249 JSC # 1674
This video presentation explores the assembly of the International Space Station and what NASA has done to prepare for this new era of space walks, or EVA. The video looks back at past EVA Flight Development Tests to trace the evolution of space suits and EVA tools and hardware. The viewer gets a behind the scenes look at the underwater training taking place for the space walks in the Neutral Buoyancy Lab. Also, the program takes a look at robots and the role they will play in station assembly. Animation illustrates the future Station robot arm, and the AERCAM robot. Finally, the video looks ahead to the benefits that can be derived from learning how to build a station, as humankind prepares to once again leave Earth orbit and explore other planets.

Media Assistance Information

NASA Television Transmission
NASA Television is available through the GE2 satellite system, which is located on Transponder 9C, at 85 degrees west longitude, frequency 3880.0 MHz, audio 6.8 MHz.

Status Reports
NASA's Johnson Space Center will issue status reports on countdown, launch and on-orbit activities.

Briefings
Press briefings will be held prior to launch and during the free-flight portion of Zvezda's mission. These briefings will be announced as far in advance as possible.

Internet Information
Information is available through several sources on the Internet. The primary source for mission information is the NASA Human Spaceflight Home Page. This site contains information on virtually all aspects of the International Space Station and Space Shuttle Programs. The site is updated regularly with status reports, photos and video clips throughout the flight. The address is:

http://spaceflight.nasa.gov

If that address is busy or unavailable, information is available through the Office of Space Flight Home Page:

http://www.hq.nasa.gov/osf/

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

http://www.nasa.gov

or

http://www.nasa.gov/newsinfo/index.html

Information on other NASA activities is available through the Today at NASA page:

http://www.nasa.gov/today.html

The daily NASA Television schedule is available at:

http://www.nasa.gov/ntv

During Space Shuttle missions, the NTV schedule is available at:

http://spaceflight.nasa.gov/realdata/nasatv

Status reports, TV schedules and other information also are available from the NASA Headquarters FTP (File Transfer Protocol) server, ftp.hq.nasa.gov. Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure:

NASA Spacelink, a resource for educators, also provides mission information via the Internet. Spacelink may be accessed at the following address:

http://spacelink.nasa.gov

Access by Compuserve
Users with Compuserve accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

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