National Aeronautics and Space Administration

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Expedition 23 and 24
Science for Six

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Mission Overview

Expeditions 23 and 24

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Backdropped by a blue and white part of Earth, the International Space Station is featured in this image photographed by an STS-130 crew member on space shuttle Endeavour after the station and shuttle began their post-undocking relative separation.

An American and two Russians will restore the International Space Station's Expedition 23 crew to six when they join the Russian, American and Japanese crew members who have been onboard since December. Once united, the first crew to include three Russians at once will continue outfitting the newest modules of the nearly completed outpost, and welcome the last planned shuttle flights and a new docking port.

The Expedition 23 and 24 crews, comprising a total of nine residents over a span of eight months, will continue to usher in a new era of scientific research, with some 130 ongoing experiments in human research, biology and biotechnology, physical and materials sciences, technology development, and Earth and space sciences.

In addition to welcoming Discovery, Atlantis and Endeavour and their cargoes of supplies, the long-duration crew will see the arrival of a Russian docking module, the Alpha Magnetic Spectrometer (AMS) and four Progress resupply ships. Expeditions 23 and 24 also will conduct two spacewalks and may see the first demonstration flights of a commercial resupply ship.

Russian cosmonaut Oleg Kotov accepted command of Expedition 23 on March 17, taking over for NASA's Jeff Williams, who landed with Flight Engineer Max Suraev in Kazakhstan on March 18. NASA's T.J. Creamer and Soichi Noguchi, of the Japan Aerospace Exploration Agency, continue to circle the globe with Kotov until June, maintaining the station and conducting microgravity research in a number of disciplines.

NASA astronaut T.J. Creamer (foreground) and Japan Aerospace Exploration Agency (JAXA) astronaut Soichi Noguchi (left), both Expedition 22/23 flight engineers; along with cosmonaut Oleg Kotov (center background), Expedition 22 flight engineer and Expedition 23 commander, participate in an emergency procedure training session in an International Space Station mock-up/trainer in the Space Vehicle Mock-up Facility at NASA's Johnson Space Center.

The rest of the Expedition 23 crew will launch from the Baikonur Cosmodrome in Kazakhstan on April 2, and dock their Soyuz TMA-18 spacecraft to the station's Poisk docking compartment on April 4. Russian Flight Engineers Alexander Skvortsov and Mikhail Kornienko, and NASA's Tracy Caldwell Dyson will become a part of the Expedition 23 crew when they arrive.

Skvortsov will become Expedition 24 commander when Kotov, Creamer, and Noguchi depart the station after 163 days in space and 161 days aboard the outpost. Dyson and Kornienko will remain as Expedition 24 flight engineers, and the trio will be joined by NASA's Doug Wheelock and Shannon Walker, and Russia's Fyodor Yurchikhin in mid-June.

Creamer, 50, a U.S. Army colonel from Upper Marlboro, Md., is making his first spaceflight. Assigned to NASA's Johnson Space Center in 1995 as a space shuttle vehicle integration test engineer, he supported eight shuttle missions as a vehicle integration test team lead and specialized in coordinating the information technologies for the Astronaut Office. Selected as an astronaut in 1998, Creamer worked with hardware integration and robotics, and was a support astronaut for Expedition 12.

NASA astronaut Tracy Caldwell Dyson (foreground), Expedition 23/24 flight engineer, participates in a training session in an International Space Station mock-up/trainer in the Space Vehicle Mock-up Facility at NASA's Johnson Space Center.

Noguchi, 45, an aeronautical engineer from Chigasaki, Kanagawa, Japan, is making his second spaceflight. He was selected as a National Space Development Agency of Japan (NASDA), now JAXA, astronaut candidate in 1996 and trained at Johnson Space Center. After completing his astronaut training, he supported development and integration of the station's Japanese Kibo experiment module. Noguchi flew on the STS-114 return-to-flight mission of Discovery in 2005. He has logged nearly 14 days in space, including more than 20 hours of spacewalks to test new procedures for shuttle inspection and repair techniques.

Dyson, 40, will be making her second trip to space. Selected for astronaut training by NASA in 1998, she worked in Mission Control as spacecraft communicator for both space shuttle and station operations, and supported shuttle launch and landing operations at NASA's Kennedy Space Center. She flew on STS-118 as a mission specialist, serving as the mission's intravehicular spacewalk coordinator and primary shuttle robotic arm operator.

Houston's first and only native astronaut, Shannon Walker, 44, will be making her first trip into space as a flight engineer on the Soyuz for Expedition 24. In 1995, Walker joined NASA's Johnson Space Center to work with international partners in the design and construction of the space station robotics equipment. Four years later, she moved to Moscow to work with Roscosmos in the areas of avionics integration and integrated problem solving. Upon returning to Houston, she became technical lead for the space station mission evaluation room and the deputy manager of the On-Orbit Engineering Office. Walker spent two years in Russia training to fly the Soyuz from launch through landing, and is fully qualified in both automatic and manual modes.

An Army colonel and West Point graduate, Wheelock, 50, entered flight school in 1984 and graduated at the top of his flight class as an Army aviator. He attended the U.S. Naval Test Pilot School and served as an experimental test pilot with the Army Aviation Technical Test Center. In 2004, Wheelock completed training in the NASA Extreme Environments Mission Operations (NEEMO) program, during a 10-day undersea mission aboard the National Undersea Research Center's Aquarius habitat. During his first space mission, STS-120, he participated in three spacewalks, totaling 20 hours and 41 minutes.

Kotov, 44, a physician and Russian Air Force colonel, is making his second spaceflight and serving his second tour aboard the station. Selected as a cosmonaut in 1996, he trained as a cosmonaut researcher for a flight on the Soyuz and as a backup crew member to the Mir-26 mission. A former lead test doctor at Gagarin Cosmonaut Training Center, he served as a flight engineer and Soyuz commander on the Expedition 15 mission in 2007. He will be a flight engineer for Expedition 22, and assume the duties of Expedition 23 commander when Williams departs in March 2010.

This will be the first spaceflight for both Skvortsov and Kornienko. Skvortsov, 44, is a Russian Air Force colonel and second-generation cosmonaut. He has logged about 1,000 hours of flight time on various Russian aircraft. He began his basic space training in 1998, qualifying as a test cosmonaut in 1999 and starting space station training in 2000. Kornienko worked in the Baikonur Launch Facility as a launch equipment specialist, and as a cosmonaut training engineer for the Russian Space Corp., Energia. Kornienko, 50, was selected as a cosmonaut candidate in 1998.

Yurchikhin, 51, graduated from the S. Ordzhonikidze Moscow Aviation Institute, and worked at Energia. He began working as a controller in the Russian Mission Control Center and held the positions of engineer, senior engineer, and lead engineer, eventually becoming a lead engineer for Space Shuttle-Mir Program. Yurchikhin qualified as a test cosmonaut, and completed his first trip into space aboard the space shuttle Atlantis on STS-112. He also served as commander of Expedition 15 on the space station.

Astronaut Doug Wheelock, Expedition 24 flight engineer and Expedition 25 commander, gets help in the donning of a training version of his Extravehicular Mobility Unit spacesuit in preparation for a spacewalk training session in the waters of the Neutral Buoyancy Laboratory.

The Expedition 23 and 24 crews will work with experiments across a variety of fields, including human life sciences, physical sciences and Earth observation, and conduct technology demonstrations including an additional recycling device known as Sabatier, which will help wring additional oxygen and water from excess hydrogen not yet being reclaimed by the station's Water Recovery System. As with prior expeditions, many experiments are designed to gather information about the effects of long-duration spaceflight on the human body, which will help us understand complicated processes such as immune systems with plan for future exploration missions.

NASA astronaut Doug Wheelock, Expedition 24 flight engineer and Expedition 25 commander; along with NASA astronaut Shannon Walker (left) and Russian cosmonaut Fyodor Yurchikhin (foreground), both Expedition 24/25 flight engineers, participate in an advanced cardiac life support training session in an International Space Station mock-up/trainer.

The STS-131/19A mission of space shuttle Discovery is set to launch from Kennedy Space Center, Florida, the day after Skvortsov, Kornienko, and Dyson arrive on station. With timelines compressed, the new crew members will need to defer some of their normal familiarization time to pitch in for eight full days of joint operations with Discovery's crew. Carrying the Leonardo multipurpose logistics module on its final round-trip to the station before it is refitted to become a Permanent Multipurpose Module, Discovery will launch on April 5 and dock on April 7. Discovery's crew will conduct three spacewalks to replace a depleted ammonia tank for the station's active external cooling system and a rate gyroscope assembly, and retrieve Japanese exposure experiment samples and a Light Weight Adapter Plate Assembly.

A Progress resupply ship is scheduled to launch from Baikonur on April 28 and dock with the station's Pirs module April 30. Progress 37 will deliver food, fuel, water and other supplies for use by the expedition crews.

The next-to-last Russian module – "Rassvet," the Russian word for dawn, or sunrise – scheduled to be added to the station will launch in the payload bay of the space shuttle Atlantis in May. Also known as Mini Research Module 1, it will be installed on the Earth-facing docking port of the Zarya module during the STS-132 mission. Also known as Utilization and Logistics Flight 4, the mission is scheduled to launch from Kennedy Space Center in Florida on May 14, dock with the station on May 16, and conduct seven days of joint operations that will include three spacewalks to install a backup space-to-ground antenna, replace batteries that store electricity generated by the station's solar arrays for use when the station is in darkness, and install an additional station external spare parts cradle.

A few days after Wheelock, Walker and Yurchikhin arrive at the station, they will climb back into their Soyuz and move it from the aft docking port of the Zvezda service module to the newly delivered Rassvet port. That will make room at the aft port of the Zvezda service module for another resupply craft, Progress 38, scheduled to launch from Baikonur on June 28, and dock on June 30.

In July, one of the station's new commercial resupply rockets, built by Space Exploration Technologies Corp. (SpaceX), is set to make its first demonstration flight. The station crew will not be involved in the mission, but it will mark an important milestone in providing additional supply lines for the station.

At the Baikonur Cosmodrome in Kazakhstan, NASA astronaut Tracy Caldwell Dyson (left), Expedition 23 flight engineer, along with Russian cosmonauts Alexander Skvortsov (center), Soyuz commander and flight engineer, and Mikhail Kornienko, flight engineer, pose for pictures in front of their Soyuz TMA-18 spacecraft March 22, 2010, following a fit check dress rehearsal.

Two more spacewalks are planned between the STS-132 and STS-134 shuttle missions, one using U.S. equipment and the other using Russian equipment. They are planned for July during Expedition 24. During the 15th U.S. stage spacewalk, Dyson and Wheelock will exit the Quest airlock in U.S. spacesuits to install a power, data and grapple fixture on the Zarya module so that the space station's robotic arm can be based there to perform work on the Russian segment of the station. Later that same month, Kornienko and Yurchikhin will exit the Russian Poisk airlock to make the final external connections of the airlock and docking port to the rest of the station.

At the end of July, the STS-134 mission of Endeavour, also known as Utilization and Logistics Flight 6, will deliver the Alpha Magnetic Spectrometer and mount the instrument to the station's truss structure where it will use the power generated by the station's solar arrays to support observations of cosmic rays. Looking at various types of unusual matter found in the universe will allow AMS researchers to study the formation of the universe and search for evidence of dark matter and antimatter. Endeavour is scheduled to launch from Kennedy Space Center on July 29, dock with the station on July 31, and conduct eight days of joint operations with the expedition crew. In addition, STS-134 will deliver EXPRESS Logistics Carrier 3 (ELC-3), which will hold a variety of spare parts. The STS-134 mission will include three spacewalks to lubricate the port Solar Alpha Rotary Joints that allow the arrays to track the sun as they generate electricity, install ammonia jumper hoses for the station's cooling system, stow the Orbiter Boom Sensor System outside the station for future use as an inspection tool, and retrieve a set of materials exposure experiments for return to Earth.

Yet another resupply ship will launch from Baikonur on Aug. 31, and dock to the station's aft docking port Sept. 2. Progress 39 will take the place of Progress 38, which will undock on Aug. 30 full of trash that will burn up during the entry into Earth's atmosphere.

On Sept. 16, Skvortsov, Dyson and Kornienko will climb into their Soyuz spacecraft and depart the station after 167 days in space and 167 days as residents, leaving Wheelock as commander, and Walker and Yurchikhin to maintain the station until the next crew arrives a few weeks later.

While the Expedition 24 crew stands at three, the final space shuttle mission, STS-133, will deliver the modified Leonardo module as a Permanent Multipurpose Module. The venerable Discovery will launch Sept. 16, also carrying EXPRESS Logistics Carrier 4 and its spare parts, and dock to the station on Sept. 18 for four days of joint operations by the shuttle and station crews. There are no spacewalks planned for Utilization and Logistics Flight 5.

Expedition 23 and 24 crew members pose for a photo during a cake-cutting ceremony in the Jake Garn Simulation and Training Facility at NASA's Johnson Space Center. Pictured from the left are Russian cosmonauts Mikhail Kornienko, Expedition 23/24 flight engineer; and Alexander Skvortsov, Expedition 23 flight engineer and Expedition 24 commander; NASA astronauts Tracy Caldwell Dyson, Expedition 23/24 flight engineer; Shannon Walker, Expedition 24/25 flight engineer; and Doug Wheelock, Expedition 24 flight engineer and Expedition 25 commander; along with Russian cosmonaut Fyodor Yurchikhin, Expedition 24/25 flight engineer.

Not quite two weeks later, the next Soyuz spacecraft will launch from Baikonur, carrying Expedition 24 Flight Engineers Scott Kelly, Alexander Kaleri and Oleg Skripochka. Their Soyuz TMA-20 spacecraft is scheduled to launch from Baikonur on Sept. 30, and dock with the station's Poisk module on Oct. 2.

The restored six-person crew will spend approximately two months together, conducting two Russian spacewalks, before Wheelock hands over command of the station to Kelly. Wheelock, Walker and Yurchikhin will then undock their Soyuz TMA-19 spacecraft and head for a landing in Kazakhstan on Nov. 26.

Expedition 23 & 24 Crew

Expedition 23

Expedition 23 Patch

The focal point of the Expedition XXIII emblem illustrates the beautiful planet Earth in the black expanse of space. The International Space Station is shown traveling in its orbit around Earth. The space station orbital path flies through the XXIII to show that this increment is building upon the missions that have gone on before and laying the groundwork for future missions. This illustrates the work being performed aboard the orbiting complex that will lead the way to eventual missions to the moon, Mars and beyond. The mission designation uses roman numerals to illustrate the home nations of the crew, which are also represented by their national flags. The two stars represent the two teams that make up this expedition crew.

Expedition 23 crew members take a break from training at NASA's Johnson Space Center to pose for a crew portrait. From the left are Russian cosmonaut Mikhail Kornienko, NASA astronaut Tracy Caldwell Dyson, Russian cosmonaut Alexander Skvortsov, all flight engineers; Russian cosmonaut Oleg Kotov, commander; NASA astronaut T.J. Creamer and Japan Aerospace Exploration Agency (JAXA) astronaut Soichi Noguchi, both flight engineers.

Expedition 24

Expedition 24 Patch

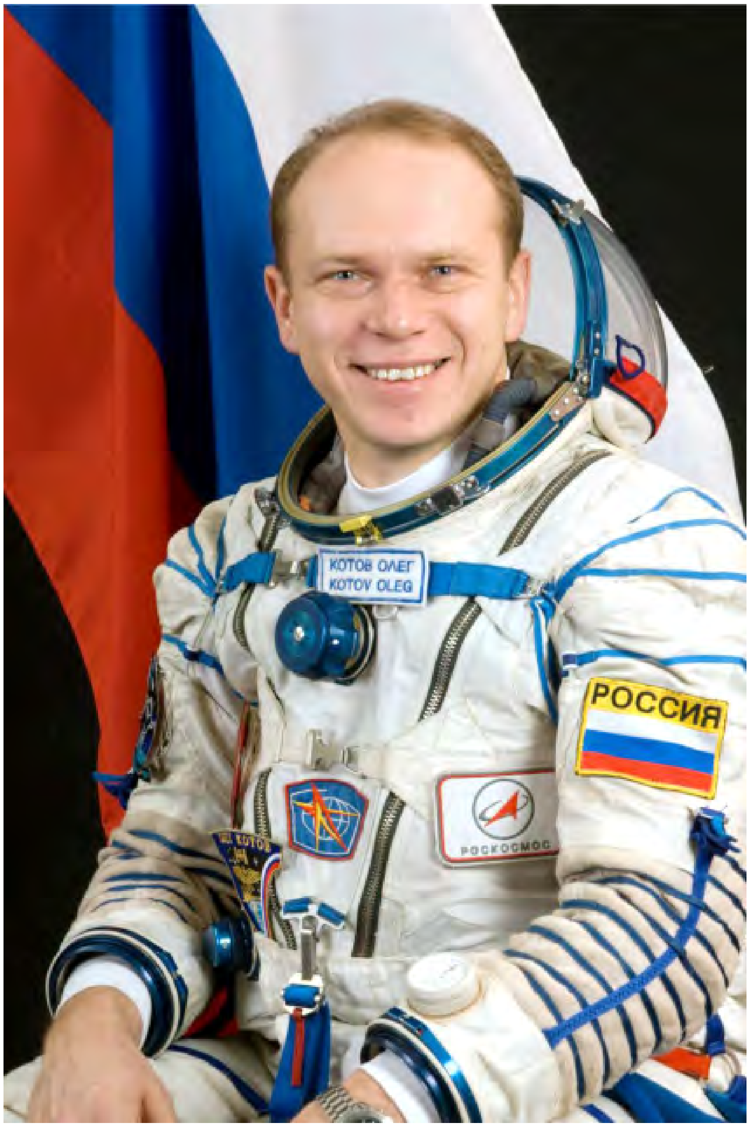
Science and exploration are the cornerstones of NASA's mission onboard the space station. This emblem signifies the dawn of a new era in our program's history. With each new expedition, as we approach assembly complete, our focus shifts toward the research nature of this world-class facility. Prominently placed in the foreground, the station silhouette leads the horizon. Each ray of the sun represents the five international partner organizations that encompass this cooperative program. Expedition 24 is one of the first missions expanding to a crew of six. These crews, symbolized here as stars arranged in two groups of three, will launch on Soyuz vehicles. The unbroken flight track symbolizes our continuous human presence in space, representing all who have and will dedicate themselves as crew and citizens of the space station.

Expedition 24 crew members include, from left,
Col. Doug Wheelock, flight engineer; Tracy Caldwell Dyson, flight engineer;
Alexander Skvortsov, commander; Mikhail Kornienko, flight engineer;
Shannon Walker, flight engineer; and Fyodor Yurchikhin, flight engineer.

Short biographical sketches of the crew follow with detailed background available at:

http://www.jsc.nasa.gov/Bios/

Expedition 23



Oleg Kotov

Oleg Kotov (Col., Russian Air Force) will serve as Expedition 23 commander. Kotov most recently served as a flight engineer and Soyuz commander on the Expedition 15 mission for six months.

He was selected as a cosmonaut candidate by the Gagarin Cosmonaut Training Center in 1996. For the following two years he completed his basic training for spaceflight. In March 1998, he received a test-cosmonaut qualification. Since July 1998, Kotov has been undergoing advanced training for space station flights.

In 2004, he became chief of the CAPCOM Branch in the Cosmonaut Office.

Soichi Noguchi

Japan Aerospace Exploration Agency (JAXA) astronaut Soichi Noguchi will serve as a flight engineer on Expedition 23. He holds degrees in aeronautical engineering from the University of Tokyo. Noguchi was selected by the National Space Development Agency of Japan (NASDA) in 1996 and reported to NASA's Johnson Space Center the same year. He participated in the basic training course for Russian manned space systems at Gagarin Cosmonaut Training Center in Russia in 1998 and then continued mission specialist advanced training at JSC.

Noguchi served as mission specialist-1 and EV-1 on STS-114. This was the return-to-flight mission during which the shuttle docked with the space station and the crew tested and evaluated new procedures for flight safety and shuttle inspection and repair techniques. He also performed three spacewalks, totaling 20 hours and five minutes.

Timothy J. (T.J.) Creamer

Timothy (T.J.) Creamer (Col., USA) will be making his first trip to space. Assigned as NASA's Johnson Space Center in 1995, he served as a space shuttle vehicle integration test engineer and directly supported eight shuttle missions as a vehicle integration test team lead. Creamer was selected by NASA in 1998 and reported for astronaut candidate training the same year.

In November 2000, he became the crew support astronaut for the Expedition 3 crew which was in orbit for four months. Creamer headed the Astronaut Office's hardware integration section in March 2002 and was responsible for ensuring that all hardware configurations were properly integrated. Most recently, he was assigned to the robotics branch and was the real-time support lead for Expedition 12 for robotics operations on the station.

Alexander Skvortsov

This will be the first spaceflight for Alexander Skvortsov (Col., Russian Air Force) who will serve as a flight engineer. He will also serve as Expedition 24 commander. Skvortsov has flown L-39, MiG-23 and Su-27 aircraft and has logged around 1,000 hours of flight time. He is also a Class 1 Air Force pilot.

Skvortsov began his basic space training in 1998 and was qualified as a test cosmonaut in 1999. He started space station advanced training in 2000.

Tracy Caldwell Dyson

In her second trip to space, Tracy Caldwell Dyson will serve as a flight engineer.

Dyson was selected by NASA in 1998. In 2000, she was assigned prime crew support astronaut for the 5th space station Expedition crew. She has worked in Mission Control as spacecraft communicator (CAPCOM) for both space shuttle and station operations, serving also as the lead CAPCOM for station Increment 11. Other technical assignments have included flight software verification in the Shuttle Avionics Integration Laboratory and supporting shuttle launch and landing operations at NASA's Kennedy Space Center.

She flew on STS-118 as mission specialist-1 and served as the intravehicular crew member, directing the four space-walks, as well as the rendezvous mission specialist and primary operator of the shuttle's robotic arm.

Mikhail Kornienko

This is the first mission for cosmonaut Mikhail Kornienko, who will serve as flight engineer.

From 1986 to 1991 he worked in the Baikonur Launch Facility as a launch equipment specialist. In 1995, he started working at Russian Space Corporation Energia as an engineer and was assigned with developing technical documentation for cosmonaut primary and backup crew tests and training. He took part in spacewalk tests in simulated zero-gravity at the Hydrolab and at the Selen dynamic stand. In the process of this work he gained experience in organizing extravehicular repair/refurbishment and assembly activities on the Mir orbital station.

Kornienko was selected as a test-cosmonaut candidate in 1998. He completed his basic training at Gagarin Cosmonaut Training Center and was qualified as a test cosmonaut in 1991.

Expedition 24

Shannon Walker

Houston's first and only native astronaut, Shannon Walker, will be making her first trip into space as a flight engineer on the Soyuz for Expedition 24.

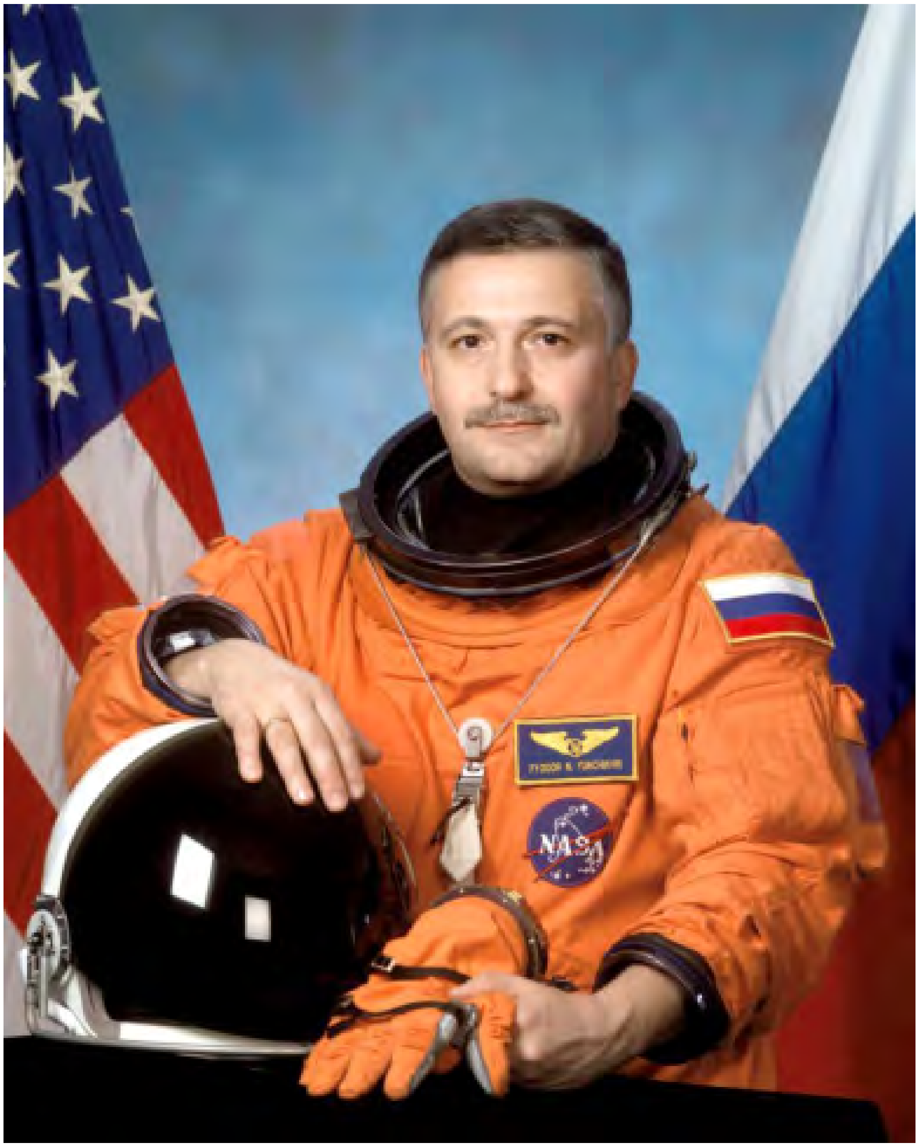
In 1995, Walker joined the NASA civil service at Johnson Space Center working with the space station International Partners in the design and construction of the robotics hardware for the space station. Four years later she moved to Moscow, Russia, to work with Roscosmos in the areas of avionics integration and integrated problem solving for the station. After a year in Russia she returned to Johnson Space Center and became the technical lead for the space station Mission Evaluation Room and the deputy manager of the On-Orbit Engineering Office.

Walker is fully trained to fly the Soyuz from launch through landing in both automatic modes and manually.

Doug Wheelock

A graduate of West Point, Doug Wheelock (Col., USA) entered flight school in 1984 and graduated at the top of his flight class and was designated as an Army Aviator. He was selected as a member of Class 104 at the U.S. Naval Test Pilot School and upon completion was assigned as an experimental test pilot with the Army Aviation Technical Test Center (ATTC).

In 2004, Wheelock completed training in the NASA Extreme Environments Mission Operations (NEEMO) program, during a 10-day undersea mission aboard the National Undersea Research Center's Aquarius habitat. Three years later he completed his first mission into space. Wheelock served as a mission specialist on STS-120. He participated in three spacewalks, totaling 20 hours and 41 minutes.



Fyodor Yurchikhin

Fyodor Yurchikhin will serve as flight engineer on Expedition 24/25.

Upon graduation from the S. Ordzhonikidze Moscow Aviation Institute, Yurchikhin has worked at the Russian Space Corporation Energia. He began working as a controller in the Russian Mission Control Center and held the positions of engineer, senior engineer, and lead engineer, eventually becoming a lead engineer for Shuttle-Mir and NASA-Mir Programs. Yurchikhin qualified as a test cosmonaut and two months later he started training in the test-cosmonaut group for the space station program.

Yurchikhin's first trip into space was aboard STS-112. He also served as commander of Expedition 15.

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Expedition 23/24 Major Milestones

(Dates are subject to change)

2010:

April 2	Launch of the Expedition 23/24 crew (Skvortsov, Kornienko, Caldwell Dyson) from the Baikonur Cosmodrome, Kazakhstan, on Soyuz TMA-18
April 4	Expedition 23/24 docks to the Poisk module in Soyuz TMA-18
April 5	Launch of Discovery on the STS-131/19A mission
April 7	Docking of Discovery to Pressurized Mating Adapter-2
April 15	Undocking of Discovery from Pressurized Mating Adapter-2
April 27	Undocking of the ISS Progress 35 cargo ship from the Pirs Docking Compartment
April 28	Launch of the ISS Progress 37 cargo ship from the Baikonur Cosmodrome, Kazakhstan
April 30	Docking of the ISS Progress 37 cargo ship to the Pirs Docking Compartment
May 10	Undocking of the ISS Progress 36 cargo ship from the Zvezda Service Module’s aft port
May 12	Relocation of the Soyuz TMA-17 (Kotov, Creamer, Noguchi) from the Zarya module’s nadir port to the aft end of the Zvezda Service module to clear the Zarya port for the installation of the Rassvet Mini-Research Module-1
May 14	Launch of Atlantis on its final flight on the STS-132/ULF-4 mission
May 16	Docking of Atlantis to Pressurized Mating Adapter-2 (Rassvet is installed on the nadir port of the Zarya module on Flight Day 5 of the STS-132/ULF-4 mission)
May 24	Undocking of Atlantis from Pressurized Mating Adapter-2
June 2	Undocking of the Expedition 23 crew (Kotov, Creamer, Noguchi) in the Soyuz TMA-17 craft from the aft port of the Zvezda Service Module and landing
June 16	Launch of the Expedition 24/25 crew (Yurchikhin, Wheelock, Walker) in the Soyuz TMA-19 craft from the Baikonur Cosmodrome in Kazakhstan

June 18	Expedition 24/25 docks to the aft port of the Zvezda Service Module in Soyuz TMA-19
June 22	Relocation of the Soyuz TMA-19 craft (Yurchikhin, Wheelock, Walker) from the aft port of the Zvezda Service Module to the Rassvet module
June 28	Launch of the ISS Progress 38 cargo ship from the Baikonur Cosmodrome in Kazakshtan
June 30	Docking of the ISS Progress 38 cargo ship to the aft end of the Zvezda Service Module
July 8	Spacewalk by Wheelock and Caldwell Dyson in U.S. spacesuits out of the Quest airlock
July 15	35th anniversary of the start of the Apollo-Soyuz Test Project mission
July 23	Spacewalk by Yurchikhin and Kornienko in Russian Orlan spacesuits out of the Pirs Docking Compartment
July 29	Launch of Endeavour on its final flight on the STS-134/ULF-6 mission
July 31	Docking of Endeavour to Pressurized Mating Adapter-2
Aug. 7	Undocking of Endeavour from Pressurized Mating Adapter-2
Aug. 30	Undocking of the ISS Progress 38 cargo ship from the aft port of the Zvezda Service Module
Aug. 31	Launch of the ISS Progress 39 cargo craft from the Baikonur Cosmodrome in Kazakhstan
Sept. 2	Docking of the ISS Progress 39 cargo craft to the aft port of the Zvezda Service Module
Sept. 16	Undocking of the Expedition 24 crew (Skvortsov, Kornienko, Caldwell Dyson) in the Soyuz TMA-18 craft from the Poisk module and landing

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Launch of Discovery on the final shuttle mission, STS-133/ULF-5

Expedition 23/24 Spacewalks

Astronaut Doug Wheelock, STS-120 mission specialist, participates in the mission's fourth session of Extravehicular Activity (EVA) while space shuttle Discovery is docked with the International Space Station.

Two spacewalks to be performed by four spacewalkers are planned for the July timeframe during Expedition 23/24.

U.S. Flight Engineers Doug Wheelock and Tracy Caldwell Dyson will perform a 6.5-hour spacewalk from the Quest airlock, and Russian Flight Engineers Mikhail Kornienko and Fyodor Yurchikhin will exit the station from the Pirs docking compartment for their spacewalk, which is scheduled to last a little over six hours.

Dyson and Kornienko will be performing their first spacewalks, though Dyson acted as the intravehicular officer during the four spacewalks of the STS-118 mission. The others are all experienced spacewalkers. Wheelock performed three spacewalks in 2007 during the STS-120, and Yurchikhin took part in two during his stint as Expedition 15 commander, also in 2007.

The U.S. Spacewalk

The first spacewalk, also known as an extravehicular activity or EVA, is slated for July 8, and is designated U.S. EVA 15. Wheelock will be the lead spacewalker and wear a suit marked with a red stripe, while Dyson wears an all-white suit. The primary task for the crew will be to install a power and data grapple fixture – or PDGF – on the exterior of the Zarya module. The fixture will provide a handhold for the space station's robotic arm on the Russian side of the station, extending its reach for activities in that area.

The installation of the PDGF is divided into four sections. First, Wheelock and Dyson will spend 45 minutes actually securing the hardware to Zarya. It will be held in place by three feet arranged in a triangle, each of which can be screwed into spots on the station's exterior.

Once the PDGF is in place, Wheelock and Dyson will begin connecting it to the necessary support systems. They will split up for about two hours while Wheelock installs a video signal converter nearby and Dyson plugs it into power for the robotic arm to use when it is attached to the PDGF. Installing the converter will require Wheelock to tighten one bolt, connect three cables and cover the equipment with insulation. Dyson will meanwhile connect six cables and use wire ties to secure them to handrails.

The two spacewalkers will then come together again for the final task of installing a data cable. The four connections should take about an hour and 15 minutes to complete.

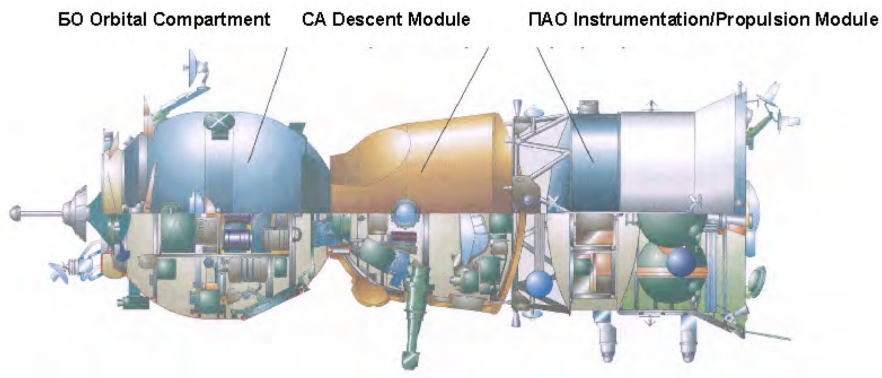
The Russian Spacewalk

Yurchikhin and Kornienko are currently scheduled to perform their spacewalk – Russian EVA 25 – on July 23. They will wear Russian Orlan spacesuits; Yurchikhin, the lead spacewalker, will wear one marked with a red stripe, while Kornienko will wear a blue-striped suit. They will conduct four tasks aimed at getting the new Rassvet mini research module, which will have arrived on STS-132, set up for permanent operations in space.

Their first tasks will be to hook the module up to the rest of the station. They will run three data cables between Rassvet and the Zvezda module, routing them along the Zarya module. They will then install cables between Rassvet and Zarya.

The spacewalkers' last two tasks will focus on Rassvet's television capabilities. They will first relocate a camera already on Rassvet's exterior from the zenith or space-facing side to the nadir or Earth-facing side. And then, as their final tasks, Yurchikhin and Kornienko will replace a camera used for docking European Automated Transfer Vehicles to the station.

Russian Soyuz TMA



The Soyuz space capsule transported the first crew to the International Space Station in November 2000. Since then, at least one Soyuz always has been docked to the station, serving as a lifeboat in the event an emergency would cause the crew to leave the station. Following the Columbia accident in February 2003, the Soyuz became the only method of transportation for crews launching to or returning from the space station. A new trio of station crew members arrives aboard a new Soyuz capsule about every six months, and then returns to Earth aboard the same Soyuz capsule in which they arrived. More than 1,500 launch vehicles by the same name have taken humans, as well as satellites for telecommunications, Earth observation, weather and scientific missions, into orbit. Soyuz rockets and capsules already serve as the primary crew transport vehicle to the station, anticipating the space shuttle's retirement in September 2010.

Aboard a Soyuz rocket, the Soyuz capsule and crew are launched to the space station from the Baikonur Cosmodrome in Kazakhstan and land in central Asia. The Soyuz spacecraft consists of an Orbital Module, a Descent Module and an Instrumentation/Propulsion Module. The Orbital Module is used by the crew while on orbit during free-flight. On the front end it has a docking mechanism that is used to dock to the space station and a hatch that allows entry into the station. It also has rendezvous antennas that are used by the automated docking system to move toward the station for docking. All the necessary controls and displays of the Soyuz are located in the Descent Module, which also is where the cosmonauts and astronauts sit for launch, re-entry and landing. The Instrumentation/Propulsion Module contains three compartments: intermediate, instrumentation and propulsion. The intermediate compartment is where the module connects to the Descent Module. The primary guidance, navigation, control and computer systems of the Soyuz are in the instrumentation compartment. The propulsion compartment contains the system that is used to perform any maneuvers while in orbit, including rendezvous and docking with the space station and the deorbit burns necessary to return to Earth.

It takes about two days after launch for the Soyuz to reach the space station and less than three and a half hours to return to Earth. Though the rendezvous and docking are both automated, once the spacecraft is within 492 feet of the station, the Russian Mission Control Center monitors the approach and docking. The crew is well trained and has the capability to manually intervene or execute these operations. Up to three crew members can launch and return to Earth from the station aboard a Soyuz spacecraft.

Training to be a crew member on the Soyuz takes nearly two and a half years to complete. The training consists of lectures in a classroom, simulations where the crew members get direct hands-on experience and two phases of survival training. At the beginning of training the crew members typically are not proficient in Russian, so they are given an interpreter and receive about six to eight hours of language training each week. The commander, left seat and right seat all do the exact same training but depending on which seat they are, the amount of training time varies. Soyuz commander training is probably the most challenging because of the responsibilities and expectations the position holds.

The commander sits in the center seat of the Soyuz, does all manual flying when necessary, talks directly to ground control while in flight and has complete control of the vehicle. The left seat serves as the commander's backup and is basically the co-pilot. The left seat completes almost exactly as much training as the commander in case of an emergency where the crew has to return to Earth unexpectedly and the commander cannot fulfill his duties. The right seat has the fewest responsibilities. While the commander and left seat have all the hands-on responsibilities in the Soyuz, the right seat maintains situational awareness with everything that is going on and also monitors displays.

Even though there is so much technical systems training, teamwork is perhaps the most critical aspect of training to be a Soyuz crew member. While the commander is flying the vehicle, he needs to be able to have faith in his left seat and right seat that they know what they are supposed to be doing. Likewise, the left seat and right seat have to have the same confidence in the commander that he knows what exactly to do and when to do it. Overall trust among the crew may come later than normal with the language and cultural barriers that are in place.

Orbital Module

This portion of the Soyuz spacecraft is used by the crew while on orbit during free-flight. It has a volume of 6.5 cubic meters (230 cubic feet), with a docking mechanism, hatch and rendezvous antennas located at the front end. The docking mechanism is used to dock with the space station and the hatch allows entry into the station. The rendezvous antennas are used by the automated docking system – a radar-based system – to maneuver towards the station for docking. There is also a window in the module.

The opposite end of the orbital module connects to the descent module via a pressurized hatch. Before returning to Earth, the orbital module separates from the descent module – after the deorbit maneuver – and burns up upon re-entry into the atmosphere.

Descent Module

The descent module is where the cosmonauts and astronauts sit for launch, re-entry and landing. All the necessary controls and displays of the Soyuz are here. The module also contains life support supplies and batteries used during descent, as well as the primary and backup parachutes and landing rockets. It also contains custom-fitted seat liners for each crew member, individually molded to fit each person's body – this ensures a tight, comfortable fit when the module lands on the Earth. When crew members are brought to the station aboard the space shuttle, their seat liners are brought with them and transferred to the Soyuz spacecraft as part of crew handover activities.

The module has a periscope, which allows the crew to view the docking target on the station or the Earth below. The eight hydrogen peroxide thrusters located on the module are used to control the spacecraft's orientation, or attitude, during the descent until parachute deployment. It also has a guidance, navigation and control system to maneuver the vehicle during the descent phase of the mission.

This module weighs 2,900 kilograms (6,393 pounds), with a habitable volume of 4 cubic meters (141 cubic feet). Approximately 50 kilograms (110 pounds) of payload can be returned to Earth in this module and up to 150 kilograms (331 pounds) if only two crew members are present. The Descent Module is the only portion of the Soyuz that survives the return to Earth.

Instrumentation/Propulsion Module

This module contains three compartments: intermediate, instrumentation and propulsion.

The intermediate compartment is where the module connects to the descent module. It also contains oxygen storage tanks and the attitude control thrusters, as well as electronics, communications and control equipment. The primary guidance, navigation, control and computer systems of the Soyuz are in the instrumentation compartment, which is a sealed container filled with circulating nitrogen gas to cool the avionics equipment. The propulsion compartment contains the primary thermal control system and the Soyuz radiator, with a cooling area of 8 square meters (86 square feet). The propulsion system, batteries, solar arrays, radiator and structural connection to the Soyuz launch rocket are located in this compartment.

The propulsion compartment contains the system that is used to perform any maneuvers while in orbit, including rendezvous and docking with the space station and the deorbit burns necessary to return to Earth. The propellants are nitrogen tetroxide and unsymmetric-dimethylhydrazine. The main propulsion system and the smaller reaction control system, used for attitude changes while in space, share the same propellant tanks.

The two Soyuz solar arrays are attached to either side of the rear section of the instrumentation/propulsion module and are linked to rechargeable batteries. Like the orbital module, the intermediate section of the instrumentation/propulsion module separates from the descent module after the final deorbit maneuver and burns up in atmosphere upon re-entry.

TMA Improvements and Testing

The Soyuz TMA spacecraft is a replacement for the Soyuz TM, which was used from 1986 to 2002 to take astronauts and cosmonauts to Mir and then to the International Space Station.

The TMA increases safety, especially in descent and landing. It has smaller and more efficient computers and improved displays. In addition, the Soyuz TMA accommodates individuals as large as 1.9 meters (6 feet, 3 inches) tall and 95 kilograms (209 pounds), compared to 1.8 meters (6 feet) and 85 kilograms (187 pounds) in the earlier TM. Minimum crew member size for the TMA is 1.5 meters (4 feet, 11 inches) and 50 kilograms (110 pounds), compared to 1.6 meters (5 feet, 4 inches) and 56 kilograms (123 pounds) for the TM.

Two new engines reduce landing speed and forces felt by crew members by 15 to 30 percent and a new entry control system and three-axis accelerometer increase landing accuracy. Instrumentation improvements include a color “glass cockpit,” which is easier to use and gives the crew more information, with hand controllers that can be secured under an instrument panel. All the new components in the Soyuz TMA can spend up to one year in space.

New components and the entire TMA were rigorously tested on the ground, in hangar-drop tests, in airdrop tests and in space before the spacecraft was declared flight-ready. For example, the accelerometer and associated software, as well as modified boosters (incorporated to cope with the TMA's additional mass), were tested on flights of Progress unpiloted supply spacecraft, while the new cooling system was tested on two Soyuz TM flights.

Descent module structural modifications, seats and seat shock absorbers were tested in hangar drop tests. Landing system modifications, including associated software upgrades, were tested in a series of airdrop tests. Additionally, extensive tests of systems and components were conducted on the ground.

Soyuz Launcher

Throughout history, more than 1,500 launches have been made with Soyuz launchers to orbit satellites for telecommunications, Earth observation, weather, and scientific missions, as well as for human flights.

The basic Soyuz vehicle is considered a three-stage launcher in Russian terms and is composed of:

- A lower portion consisting of four boosters (first stage) and a central core (second stage).
- An upper portion, consisting of the third stage, payload adapter and payload fairing.
- Liquid oxygen and kerosene are used as propellants in all three Soyuz stages.

First Stage Boosters

The first stage's four boosters are assembled around the second stage central core. The boosters are identical and cylindrical-conic in shape with the oxygen tank in the cone-shaped portion and the kerosene tank in the cylindrical portion.

An NPO Energomash RD 107 engine with four main chambers and two gimbaled vernier thrusters is used in each booster. The vernier thrusters provide three-axis flight control.

Ignition of the first stage boosters and the second stage central core occur simultaneously on the ground. When the boosters have completed their powered flight during ascent, they are separated and the core second stage continues to function.

First stage separation occurs when the pre-defined velocity is reached, which is about 118 seconds after liftoff.

A Soyuz launches from the Baikonur Cosmodrome, Kazakhstan.

Second Stage

An NPO Energomash RD 108 engine powers the Soyuz second stage. This engine has four vernier thrusters, necessary for three-axis flight control after the first stage boosters have separated.

An equipment bay located atop the second stage operates during the entire flight of the first and second stages.

Third Stage

The third stage is linked to the Soyuz second stage by a latticework structure. When the second stage's powered flight is complete, the third stage engine is ignited. Separation occurs by the direct ignition forces of the third stage engine.

A single-turbopump RD 0110 engine from KB KhA powers the Soyuz third stage.

The third stage engine is fired for about 240 seconds. Cutoff occurs at a calculated velocity. After cutoff and separation, the third stage performs an avoidance maneuver by opening an outgassing valve in the liquid oxygen tank.

Launcher Telemetry Tracking & Flight Safety Systems

Soyuz launcher tracking and telemetry is provided through systems in the second and third stages. These two stages have their own radar transponders for ground tracking. Individual telemetry transmitters are in each stage. Launcher health status is downlinked to ground stations along the flight path. Telemetry and tracking data are transmitted to the mission control center, where the incoming data flow is recorded. Partial real-time data processing and plotting is performed for flight following and initial performance assessment. All flight data is analyzed and documented within a few hours after launch.

Baikonur Cosmodrome Launch Operations

Soyuz missions use the Baikonur Cosmodrome's proven infrastructure, and launches are performed by trained personnel with extensive operational experience.

Baikonur Cosmodrome is in the Republic of Kazakhstan in Central Asia between 45 degrees and 46 degrees north latitude and 63 degrees east longitude. Two launch pads are dedicated to Soyuz missions.

Final Launch Preparations

The assembled launch vehicle is moved to the launch pad on a railcar. Transfer to the launch zone occurs two days before launch. The vehicle is erected and a launch rehearsal is performed that includes activation of all electrical and mechanical equipment.

On launch day, the vehicle is loaded with propellant and the final countdown sequence is started at three hours before the liftoff time.

Rendezvous to Docking

A Soyuz spacecraft generally takes two days to reach the space station. The rendezvous and docking are both automated, though once the spacecraft is within 150 meters (492 feet) of the station, the Russian Mission Control Center just outside Moscow monitors the approach and docking. The Soyuz crew has the capability to manually intervene or execute these operations.

Soyuz Booster Rocket Characteristics

First Stage Data - Blocks B, V, G, D	
Engine	RD-107
Propellants	LOX/Kerosene
Thrust (tons)	102
Burn time (sec)	122
Specific impulse	314
Length (meters)	19.8
Diameter (meters)	2.68
Dry mass (tons)	3.45
Propellant mass (tons)	39.63
Second Stage Data, Block A	
Engine	RD-108
Propellants	LOX/Kerosene
Thrust (tons)	96
Burn time (sec)	314
Specific impulse	315
Length (meters)	28.75
Diameter (meters)	2.95
Dry mass (tons)	6.51
Propellant mass (tons)	95.7
Third Stage Data, Block I	
Engine	RD-461
Propellants	LOX/Kerosene
Thrust (tons)	30
Burn time (sec)	240
Specific impulse	330
Length (meters)	8.1
Diameter (meters)	2.66
Dry mass (tons)	2.4
Propellant mass (tons)	21.3
PAYLOAD MASS (tons)	6.8
SHROUD MASS (tons)	4.5
LAUNCH MASS (tons)	309.53
TOTAL LENGTH (meters)	49.3

Prelaunch Countdown Timeline

T- 34 Hours	Booster is prepared for fuel loading
T- 6:00:00	Batteries are installed in booster
T- 5:30:00	State commission gives go to take launch vehicle
T- 5:15:00	Crew arrives at site 254
T- 5:00:00	Tanking begins
T- 4:20:00	Spacesuit donning
T- 4:00:00	Booster is loaded with liquid oxygen
T- 3:40:00	Crew meets delegations
T- 3:10:00	Reports to the State commission
T- 3:05:00	Transfer to the launch pad
T- 3:00:00	Vehicle 1st and 2nd stage oxidizer fueling complete
T- 2:35:00	Crew arrives at launch vehicle
T- 2:30:00	Crew ingress through orbital module side hatch
T- 2:00:00	Crew in re-entry vehicle
T- 1:45:00	Re-entry vehicle hardware tested; suits are ventilated
T- 1:30:00	Launch command monitoring and supply unit prepared
	Orbital compartment hatch tested for sealing
T- 1:00:00	Launch vehicle control system prepared for use; gyro instruments activated
T - :45:00	Launch pad service structure halves are lowered
T- :40:00	Re-entry vehicle hardware testing complete; leak checks performed on suits
T- :30:00	Emergency escape system armed; launch command supply unit activated
T- :25:00	Service towers withdrawn
T- :15:00	Suit leak tests complete; crew engages personal escape hardware auto mode
T- :10:00	Launch gyro instruments uncaged; crew activates on-board recorders
T- 7:00	All prelaunch operations are complete
T- 6:15	Key to launch command given at the launch site
	Automatic program of final launch operations is activated
T- 6:00	All launch complex and vehicle systems ready for launch
T- 5:00	Onboard systems switched to onboard control
	Ground measurement system activated by RUN 1 command
	Commander's controls activated
	Crew switches to suit air by closing helmets
	Launch key inserted in launch bunker
T- 3:15	Combustion chambers of side and central engine pods purged with nitrogen

Prelaunch Countdown Timeline (concluded)

T- 2:30	Booster propellant tank pressurization starts
	Onboard measurement system activated by RUN 2 command
	Prelaunch pressurization of all tanks with nitrogen begins
T- 2:15	Oxidizer and fuel drain and safety valves of launch vehicle are closed
	Ground filling of oxidizer and nitrogen to the launch vehicle is terminated
T- 1:00	Vehicle on internal power
	Automatic sequencer on
	First umbilical tower separates from booster
T- :40	Ground power supply umbilical to third stage is disconnected
T- :20	Launch command given at the launch position
	Central and side pod engines are turned on
T- :15	Second umbilical tower separates from booster
T- :10	Engine turbopumps at flight speed
T- :05	First stage engines at maximum thrust
T- :00	Fueling tower separates
	Lift off

Ascent/Insertion Timeline

T- :00	Lift off
T+ 1:10	Booster velocity is 1,640 ft/sec
T+ 1:58	Stage 1 (strap-on boosters) separation
T+ 2:00	Booster velocity is 4,921 ft/sec
T+ 2:40	Escape tower and launch shroud jettison
T+ 4:58	Core booster separates at 105.65 statute miles
	Third stage ignites
T+ 7:30	Velocity is 19,685 ft/sec
T+ 9:00	Third stage cut-off
	Soyuz separates
	Antennas and solar panels deploy
	Flight control switches to Mission Control, Korolev

Orbital Insertion to Docking Timeline

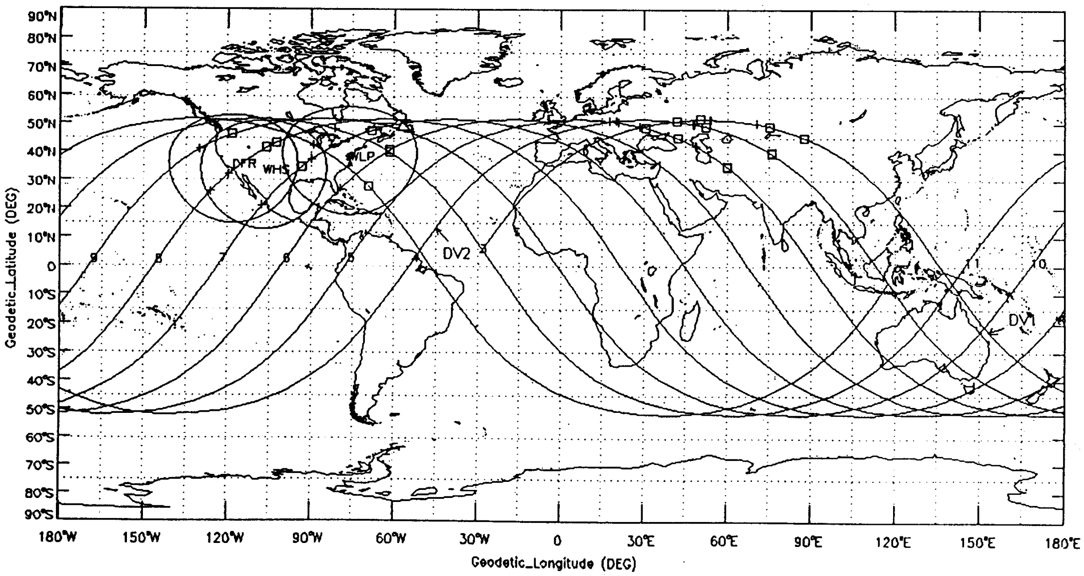
FLIGHT DAY 1 OVERVIEW	
Orbit 1	**Post insertion: Deployment of solar panels, antennas and docking probe**
	- Crew monitors all deployments
	- Crew reports on pressurization of OMS/RCS and ECLSS systems and crew health. Entry thermal sensors are manually deactivated
	- Ground provides initial orbital insertion data from tracking
Orbit 2	**Systems Checkout: IR Att Sensors, Kurs, Angular Accels, "Display" TV Downlink System, OMS engine control system, Manual Attitude Control Test**
	- Crew monitors all systems tests and confirms onboard indications
	- Crew performs manual RHC stick inputs for attitude control test
	- Ingress into HM, activate HM CO2 scrubber and doff Sokols
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
	Manual maneuver to +Y to Sun and initiate a 2 deg/sec yaw rotation. MCS is deactivated after rate is established.
Orbit 3	**Terminate +Y solar rotation, reactivate MCS and establish LVLH attitude reference (auto maneuver sequence)**
	- Crew monitors LVLH attitude reference build up
	- Burn data command upload for DV1 and DV2 (attitude, TIG Delta V's)
	- Form 14 preburn emergency deorbit pad read up
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
	Auto maneuver to DV1 burn attitude (TIG - 8 minutes) while LOS
	- Crew monitor only, no manual action nominally required
	DV1 phasing burn while LOS
	- Crew monitor only, no manual action nominally required
Orbit 4	**Auto maneuver to DV2 burn attitude (TIG - 8 minutes) while LOS**
	- Crew monitor only, no manual action nominally required
	DV2 phasing burn while LOS
	- Crew monitor only, no manual action nominally required

FLIGHT DAY 1 OVERVIEW (CONTINUED)	
Orbit 4 (continued)	**Crew report on burn performance upon AOS**
	- HM and DM pressure checks read down
	- Post burn Form 23 (AOS/LOS pad), Form 14 and "Globe" corrections voiced up
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
	Manual maneuver to +Y to Sun and initiate a 2 deg/sec yaw rotation. MCS is deactivated after rate is established.
	External boresight TV camera ops check (while LOS)
	Meal
Orbit 5	**Last pass on Russian tracking range for Flight Day 1**
	Report on TV camera test and crew health
	Sokol suit clean up
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 6-12	**Crew Sleep, off of Russian tracking range**
	- Emergency VHF2 comm available through NASA VHF Network
FLIGHT DAY 2 OVERVIEW	
Orbit 13	**Post sleep activity, report on HM/DM Pressures**
	Form 14 revisions voiced up
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 14	**Configuration of RHC-2/THC-2 work station in the HM**
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 15	**THC-2 (HM) manual control test**
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 16	**Lunch**
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 17 (1)	**Terminate +Y solar rotation, reactivate MCS and establish LVLH attitude reference (auto maneuver sequence)**
	RHC-2 (HM) Test
	- Burn data uplink (TIG, attitude, delta V)
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
	Auto maneuver to burn attitude (TIG - 8 min) while LOS
	Rendezvous burn while LOS
	Manual maneuver to +Y to Sun and initiate a 2 deg/sec yaw rotation. MCS is deactivated after rate is established.

FLIGHT DAY 2 OVERVIEW (CONTINUED)	
Orbit 18 (2)	**Post burn and manual maneuver to +Y Sun report when AOS**
	- HM/DM pressures read down
	- Post burn Form 23, Form 14 and Form 2 (Globe correction) voiced up
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 19 (3)	**CO2 scrubber cartridge change out**
	Free time
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 20 (4)	**Free time**
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 21 (5)	**Last pass on Russian tracking range for Flight Day 2**
	Free time
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 22 (6) - 27 (11)	**Crew sleep, off of Russian tracking range**
	- Emergency VHF2 comm available through NASA VHF Network
FLIGHT DAY 3 OVERVIEW	
Orbit 28 (12)	**Post sleep activity**
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 29 (13)	**Free time, report on HM/DM pressures**
	- Read up of predicted post burn Form 23 and Form 14
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
Orbit 30 (14)	**Free time, read up of Form 2 "Globe Correction," lunch**
	- Uplink of auto rendezvous command timeline
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radar and radio transponder tracking
FLIGHT DAY 3 AUTO RENDEZVOUS SEQUENCE	
Orbit 31 (15)	**Don Sokol spacesuits, ingress DM, close DM/HM hatch**
	- Active and passive vehicle state vector uplinks
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radio transponder tracking

FLIGHT DAY 3 AUTO RENDEZVOUS SEQUENCE (CONCLUDED)	
Orbit 32 (16)	**Terminate +Y solar rotation, reactivate MCS and establish LVLH attitude reference (auto maneuver sequence)**
	Begin auto rendezvous sequence
	- Crew monitoring of LVLH reference build and auto rendezvous timeline execution
	- A/G, R/T and Recorded TLM and Display TV downlink
	- Radio transponder tracking
FLIGHT DAY 3 FINAL APPROACH AND DOCKING	
Orbit 33 (1)	**Auto Rendezvous sequence continues, flyaround and station keeping**
	- Crew monitor
	- Comm relays via SM through Altair established
	- Form 23 and Form 14 updates
	- Fly around and station keeping initiated near end of orbit
	- A/G (gnd stations and Altair), R/T TLM (gnd stations), Display TV downlink (gnd stations and Altair)
	- Radio transponder tracking
Orbit 34 (2)	**Final Approach and docking**
	- Capture to “docking sequence complete” 20 minutes, typically
	- Monitor docking interface pressure seal
	- Transfer to HM, doff Sokol suits
	- A/G (gnd stations and Altair), R/T TLM (gnd stations), Display TV downlink (gnd stations and Altair)
	- Radio transponder tracking
FLIGHT DAY 3 STATION INGRESS	
Orbit 35 (3)	**Station/Soyuz pressure equalization**
	- Report all pressures
	- Open transfer hatch, ingress station
	- A/G, R/T and playback telemetry
	- Radio transponder tracking

Typical Soyuz Ground Track



Key Times for Expedition 23 Launch Events

<u>Expedition 23 Launch on Soyuz TMA-18</u>

11:04:34 p.m. CT on Thursday, April 1

4:04:34 GMT on Thursday, April 2

8:04:34 a.m. Moscow daylight time on Thursday, April 2

10:04:34 a.m. Kazakhstan time on Thursday, April 2

<u>Expedition 23 docking to station on Soyuz TMA-18 (Poisk Module)</u>

12:28 a.m. CT on Sunday, April 4

5:28 GMT on Sunday, April 4

9:28 a.m. Moscow daylight time on Sunday, April 4

<u>Expedition 23 hatch opening to station</u>

~3:30 a.m. CT on Sunday, April 4

~8:30 GMT on Sunday, April 4

~12:30 p.m. Moscow daylight time on Sunday, April 4 (three hours after docking)

Soyuz Landing

After about six months in space, the departing crew members from the International Space Station will board their Soyuz spacecraft capsule for undocking and a one-hour descent back to Earth.

About three hours before undocking, the crew will bid farewell to the other three crew members who will remain on the station awaiting the launch of a new trio of astronauts and cosmonauts from the Baikonur Cosmodrome in Kazakhstan about 17 days later.

The departing crew will climb into its Soyuz vehicle and close the hatch between Soyuz and its docking port. The Soyuz commander will be seated in the center seat of the Soyuz' descent module, flanked by his two crewmates.

After activating Soyuz systems and getting approval from flight controllers at the Russian Mission Control Center outside Moscow, the Soyuz commander will send commands to open hooks and latches between Soyuz and the docking port.

He will then fire the Soyuz thrusters to back away from the docking port. Six minutes after undocking, with the Soyuz about 66 feet away from the station, the Soyuz commander will conduct a separation maneuver, firing the Soyuz jets for about 15 seconds to begin to depart the vicinity of the complex.

About 2.5 hours after undocking, at a distance of about 12 miles from the station, Soyuz computers will initiate a deorbit burn braking maneuver. The 4.5-minute maneuver to slow the spacecraft will enable it to drop out of orbit and begin its reentry to Earth.

About 30 minutes later, just above the first traces of the Earth's atmosphere, computers will command the pyrotechnic separation of the three modules of the Soyuz vehicle. With the crew strapped in the centermost descent module, the uppermost orbital module, containing the docking mechanism and rendezvous antennas, and the lower Instrumentation and propulsion module at the rear, which houses the engines and avionics, will separate and burn up in the atmosphere.

The descent module's computers will orient the capsule with its ablative heat shield pointing forward to repel the buildup of heat as it plunges into the atmosphere. The crew will feel the first effects of gravity about three minutes after module separation at the point called entry interface, when the module is about 400,000 feet above the Earth.

About eight minutes later, at an altitude of about 33,000 feet, traveling at about 722 feet per second, the Soyuz will begin a computer-commanded sequence for the deployment of the capsule's parachutes. First, two "pilot" parachutes will be deployed, extracting a larger drogue parachute, which stretches out over an area of 79 square feet. Within 16 seconds, the Soyuz' descent will slow to about 262 feet per second.

The initiation of the parachute deployment will create a gentle spin for the Soyuz as it dangles underneath the drogue chute, assisting in the capsule's stability in the final minutes prior to touchdown.

A few minutes before touchdown, the drogue chute will be jettisoned, allowing the main parachute to be deployed. Connected to the descent module by two harnesses, the main parachute covers an area of about 3,281 feet. The deployment of the main parachute slows the descent module to a velocity of about

23 feet per second. Initially, the descent module will hang underneath the main parachute at a 30 degree angle with respect to the horizon for aerodynamic stability. The bottommost harness will be severed a few minutes before landing, allowing the descent module to right itself to a vertical position through touchdown.

At an altitude of a little more than 16,000 feet, the crew will monitor the jettison of the descent module's heat shield, which will be followed by the termination of the aerodynamic spin cycle and the dissipation of any residual propellant from the Soyuz. Computers also will arm the module's seat shock absorbers in preparation for landing.

When the capsule's heat shield is jettisoned, the Soyuz altimeter is exposed to the surface of the Earth. Signals are bounced to the ground from the Soyuz and reflected back, providing the capsule's computers updated information on altitude and rate of descent.

At an altitude of about 39 feet, cockpit displays will tell the commander to prepare for the soft landing engine firing. Just 3 feet above the surface, and just seconds before touchdown, the six solid propellant engines will be fired in a final braking maneuver. This will enable the Soyuz to settle down to a velocity of about five feet per second and land, completing its mission.

As always is the case, teams of Russian engineers, flight surgeons and technicians in fleets of MI-8 helicopters will be poised near the normal and "ballistic" landing zones, and midway in between, to enact the swift recovery of the crew once the capsule touches down.

A portable medical tent will be set up near the capsule in which the crew can change out of its launch and entry suits. Russian technicians will open the module's hatch and begin to remove the crew members. The crew will be seated in special reclining chairs near the capsule for initial medical tests and to begin readapting to Earth's gravity.

About two hours after landing, the crew will be assisted to the recovery helicopters for a flight back to a staging site in northern Kazakhstan, where local officials will welcome them. The crew then will board a Russian military plane and be flown to the Chkalovsky Airfield adjacent to the Gagarin Cosmonaut Training Center in Star City, Russia, where their families will meet them. In all, it will take around seven hours between landing and the return to Star City.

International Space Station: Expedition 23/24 Science Overview

The Expedition 23 and 24 mission will finish the laboratory, delivering the final facilities to enable full use of the International Space Station for research, technology development, and education, putting the potential of space to work for the people of Earth.

With nearly 130 integrated investigations – the work of nearly 400 scientists around the globe, scientific throughput has quadrupled during the transition from assembly to the era of utilization.

Forty-five of the experiments that will be performed are new to the station, eight are associated with the station's role as an official U.S. National Laboratory, and 55 are sponsored by NASA's international partner agencies – the Canadian Space Agency (CSA), the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA). Another 40 experiments are sponsored by the station's fifth partner, the Russian Federal Space Agency (RSA). All station partners cooperate and coordinate their research investigations, and many investigations include international teams of scientists.

The investigations cover human research; biological and physical sciences; technology development; Earth observation, and education. In the past, assembly and maintenance activities have dominated the available time for crew work. But as completion of the orbiting laboratory nears, additional facilities and the crew members to operate them is enabling a measured increase in time devoted to research as a national and multinational laboratory.

The STS-131 mission of space shuttle Discovery will deliver the final set of laboratory facilities to the station, the Window Observational Research Facility (WORF), which will enable full scientific use of the optical-quality window in the Destiny Laboratory; the third and final Minus Eighty-Degree Laboratory Freezer for ISS (MELFI), a European Space Agency-built, NASA-operated freezer for science sample storage; the final EXpedite the PRocessing of Experiments to Space Station Rack 7 (EXPRESS Rack 7), a multipurpose payload rack system that supports experiments in any discipline by providing structural interfaces, power, data, cooling and water; and the Muscle Atrophy Research and Exercise System (MARES), another NASA/ESA collaboration that will be used to better understand the effects of microgravity on the human muscular system.

New experiments on the Expedition 23 and 24 crew's "to-do list" will look at long-duration spaceflight effects on the human immune, balance, oxygen distribution, digestion and central nervous systems. They will carry on research into how plant bark and roots develop in microgravity, and how liquid systems function in complex geometries known as capillaries. Also on tap are investigations into how gravity affects the transition of fluids from liquid to gas, the movement of molecules within fluids and how metals solidify and semiconductor crystals grow.

Technology demonstration projects during Expedition 23 and 24 will test the use of the venerable Sabatier system for the first time in space, attempting to wring additional oxygen and water out of hydrogen and carbon dioxide that are currently vented overboard by the station's recycling systems; a new cabin atmosphere monitor to identify trace contaminants in the air the station's crew breathes; and a new dosimeter that measures radiation exposure in space, a key concern for scientists and engineers working on sending explorers to distant destinations in our solar system, where cosmic rays are a human health hazard.

An educational experiment platform known as Cube Lab will set the stage for cost-effective, student-developed experiments that weigh two-and-a-half pounds (1 kilogram) or less.

Managing the international laboratory's scientific assets, as well as the time and space required to accommodate experiments and programs from a host of private, commercial, industry and government agencies nationwide, makes the job of coordinating space station research critical.

Teams of controllers and scientists on the ground continuously plan, monitor and remotely operate experiments from control centers around the globe. Controllers staff payload operations centers around the world, effectively providing for researchers and the station crew around the clock, seven days a week.

State-of-the-art computers and communications equipment deliver up-to-the-minute reports about experiment facilities and investigations between science outposts across the United States and around the world. The payload operations team also synchronizes the payload time lines among international partners, ensuring the best use of valuable resources and crew time.

The control centers of NASA and its partners are:

- NASA Payload Operations Center, Marshall Space Flight Center in Huntsville, Ala.
- RSA Center for Control of Spaceflights ("TsUP" in Russian) in Korolev, Russia
- JAXA Space Station Integration and Promotion Center (SSIPC) in Tskuba, Japan
- ESA Columbus Control Center (Col-CC) in Oberpfaffenhofen, Germany
- CSA Payloads Operations Telesciences Center, St. Hubert, Quebec, Canada

NASA's Payload Operations Center serves as a hub for coordinating much of the work related to delivery of research facilities and experiments to the space station as they are rotated in and out periodically when space shuttles or other vehicles make deliveries and return completed experiments and samples to Earth.

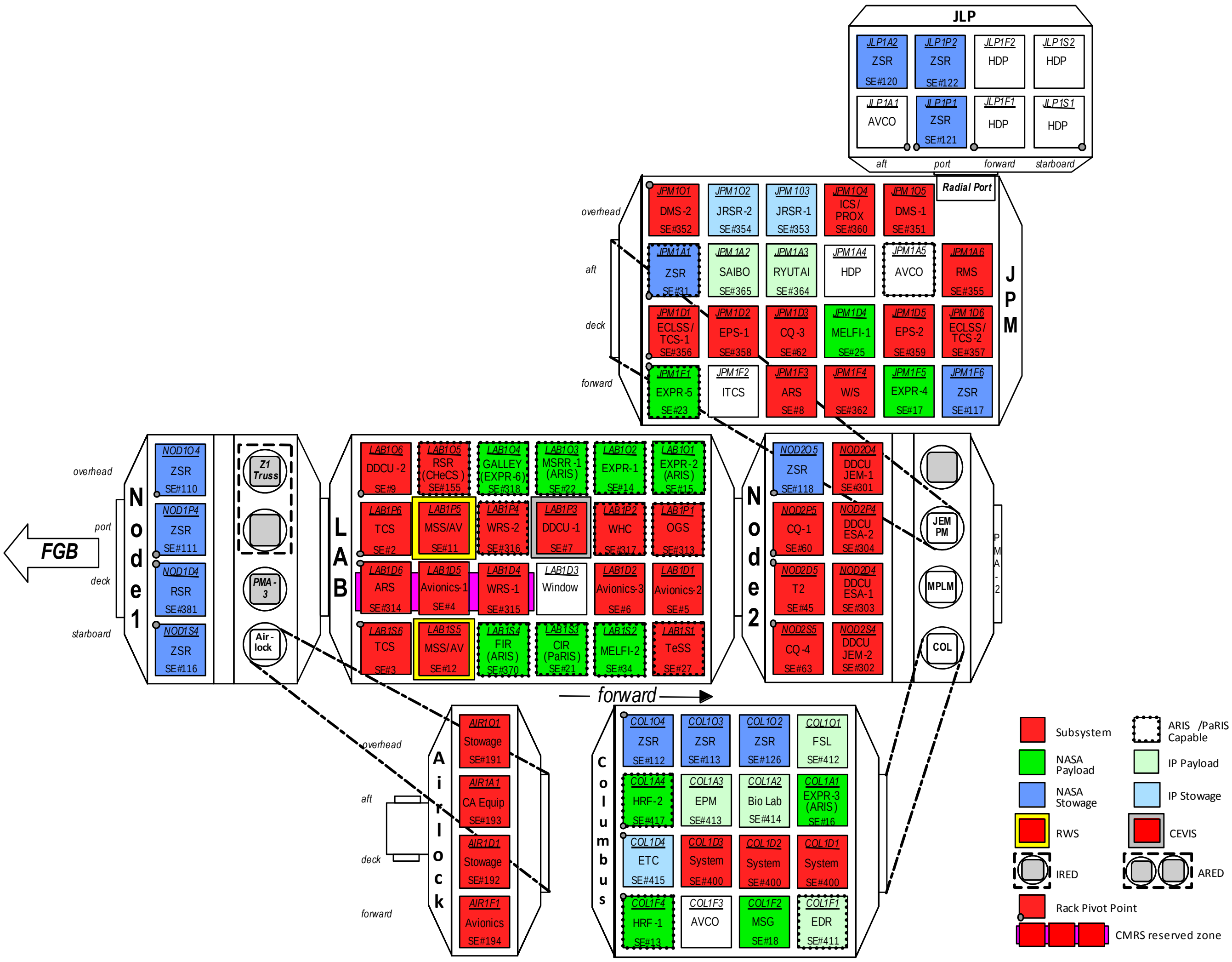
The payload operations director leads the POC's main flight control team, known as the "cadre," and approves all science plans in coordination with Mission Control at NASA's Johnson Space Center in Houston, the international partner control centers and the station crew.

On the Internet

For fact sheets, imagery and more on Expedition 23/24 experiments and payload operations, visit

http://www.nasa.gov/mission_pages/station/science/

Location of International Space Station Experiment Facilities



International Space Station Experiment Facilities

Name	Title	Agency	Category	Summary	Location
BioLab	Biological Experiment Laboratory	ESA	Facilities	Biological Experiment Laboratory in Columbus (BioLab) is a multi-user research facility located in the European Columbus Laboratory. It will be used to perform space biology experiments on microorganisms, cells, tissue cultures, small plants and small invertebrates. BioLab will allow a better understanding of the effects of microgravity and space radiation on biological organisms	Columbus
EDR	European Drawer Rack	ESA	Facilities	European Drawer Rack (EDR) is a multidiscipline facility to support up to seven modular Experiment Modules (EM). Each payload may be composed of several EMs. Each payload will have its own cooling, power, and data communications, as well as vacuum, venting and nitrogen supply if required	Columbus
EPM	European Physiology Module	ESA	Facilities	European Physiology Module (EPM) is designed to investigate the effects of short-term and long-duration space flights on the human body. It includes equipment for studies in neuroscience, cardiovascular, bone and muscle physiology	Columbus
ETC	European Transportation Carrier	ESA	Facilities	The European Transportation Carrier (ETC) will provide on-orbit stowage for payload items and support of additional European facilities. After the first use of the rack, it will be used primarily as a transport rack in conjunction with the Multi-Purpose Logistics Module (MPLM)	Columbus
FSL	Fluid Science Laboratory	ESA	Facilities	Fluid Science Laboratory (FSL) is a multiuser facility, designed by the European Space Agency (ESA) for conducting fluid physics research in microgravity conditions. It can be operated in fully or in semi-automatic mode and can be controlled onboard by the International Space Station (ISS) crewmembers, or from the ground in telescience mode	Columbus

International Space Station Experiment Facilities (continued)

Name	Title	Agency	Category	Summary	Location
Solar	Sun Monitoring on the External Payload Facility of Columbus	ESA	Facilities	Sun Monitoring on the External Payload Facility of Columbus (Solar) is a monitoring observatory that will measure the solar spectral irradiance. Apart from scientific contributions for solar and stellar physics, the knowledge of the solar energy irradiance into the Earth's atmosphere and its variations is of great importance for atmospheric modeling, atmospheric chemistry and climatology	External
Ryutai	Ryutai Experiment Rack	JAXA	Facilities	Ryutai Experiment Rack (Ryutai) which means "fluid," is a multipurpose payload rack system that includes a Fluid Physics Experiment Facility, Solution Crystallization Observation Facility, Protein Crystallization Research Facility, and image processing	Kibo
Saibo	Saibo Experiment Rack	JAXA	Facilities	Saibo Experiment Rack (Saibo), which means "living cell," includes a Clean Bench glovebox with microscope that isolates the organisms being studied, and Cell Biology Experiment Facility that includes incubator and centrifuges	Kibo
CIR	Combustion Integrated Rack	NASA	Facilities	The Combustion Integrated Rack (CIR) includes an optics bench, combustion chamber, fuel and oxidizer control, and five different cameras for performing combustion experiments in microgravity	Destiny
EMCS	European Modular Cultivation System	NASA	Facilities	European Modular Cultivation System (EMCS) allows for cultivation, stimulation and crew-assisted operation of biological experiments under well-controlled conditions (e.g., temperature, atmospheric composition, water supply and illumination). It includes two centrifuges that can provide artificial gravity from 0 to 2G	

International Space Station Experiment Facilities (continued)

Name	Title	Agency	Category	Summary	Location
EXPRESS Rack-1	EXpedite the PRocessing of Experiments to Space Station Rack-1	NASA	Facilities	EXpedite the PRocessing of Experiments to Space Station Rack-1 (EXPRESS Rack-1) is a multipurpose payload rack system that stores and supports experiments aboard the International Space Station. The EXPRESS Rack system supports science experiments in any discipline by providing structural interfaces, power, data, cooling, water and other items needed to operate science experiments in space	Destiny
EXPRESS Rack-2A	EXpedite the PRocessing of Experiments to Space Station Rack-2 Active Rack Isolation System	NASA	Facilities	EXpedite the PRocessing of Experiments to Space Station Rack-2 Active Rack Isolation System (EXPRESS Rack-2A) is a modified EXPRESS Rack (ER) that house experiments aboard the International Space Station. The ARIS component of the ER reduces external vibration disturbances at selected experiment locations inside the ER, allowing the payloads to operate in an environment of greatly reduced vibrational disturbances	Destiny
EXPRESS Rack-3A	EXpedite the PRocessing of Experiments to Space Station Rack-3 Active Rack Isolation System	NASA	Facilities	EXpedite the PRocessing of Experiments to Space Station Rack-3 Active Rack Isolation System (EXPRESS Rack-3A) is a modified EXPRESS Rack (ER) that house experiments aboard the International Space Station. The ARIS component of the ER reduces external vibration disturbances at selected experiment locations inside the ER, allowing the payloads to operate in an environment of greatly reduced vibrational disturbances	Columbus

International Space Station Experiment Facilities (continued)

Name	Title	Agency	Category	Summary	Location
EXPRESS Rack-4	EXpedite the PRocessing of Experiments to Space Station Rack-4	NASA	Facilities	The EXPRESS Rack is a multipurpose payload rack system that transports, stores and supports experiments aboard the International Space Station. The EXPRESS Rack system supports science payloads in any discipline by providing structural interfaces, power, data, cooling, water and other items needed to operate science experiments in space	Kibo
EXPRESS Rack-5	EXpedite the PRocessing of Experiments to Space Station Rack-5	NASA	Facilities	The EXPRESS Rack are multipurpose payload rack systems that store and supports experiments aboard the International Space Station. The EXPRESS Rack system supports science payloads in any discipline by providing structural interfaces, power, data, cooling, water and other items needed to operate science experiments in space	Kibo
EXPRESS Rack-6	EXpedite the PRocessing of Experiments to Space Station Rack-6	NASA	Facilities	EXpedite the PRocessing of Experiments to Space Station Rack-6 (EXPRESS Rack-6) are multipurpose payload rack systems that store and support experiments aboard the International Space Station. The EXPRESS Rack system supports science experiments in any discipline by providing structural interfaces, power, data, cooling, water and other items needed to operate science	
FIR	Fluids Integrated Rack	NASA	Facilities	The Fluids Integrated Rack (FIR) is a complementary fluid physics research facility designed to host investigations in areas such as colloids, gels, bubbles, wetting and capillary action, and phase changes including, boiling and cooling	Destiny
HRF-1	Human Research Facility-1	NASA	Facilities	The Human Research Facility-1 (HRF-1) enables study of the effects of long-duration space flight on the human body. Equipment in the HRF-1 includes a clinical ultrasound and a device for measuring mass	Columbus

International Space Station Experiment Facilities (continued)

Name	Title	Agency	Category	Summary	Location
HRF-2	Human Research Facility-2	NASA	Facilities	The Human Research Facility-2 (HRF-2) enables study of the effects of long-duration space flight on the human body. HRF-2 equipment includes a refrigerated centrifuge; devices for measuring blood pressure, and heart function; and the Pulmonary Function System for measuring lung function	Columbus
MELFI	Minus Eighty-Degree Laboratory Freezer for ISS	NASA	Facilities	Minus Eighty-Degree Laboratory Freezer for ISS (MELFI) is a European Space Agency built, National Aeronautics and Space Administration operated freezers will store samples on ISS at temperatures as low as -80 degrees C	Kibo
MELFI-2	Minus Eighty-Degree Laboratory Freezer for ISS -2	NASA	Facilities	Minus Eighty-Degree Laboratory Freezer for ISS (MELFI) is a European Space Agency built, National Aeronautics and Space Administration operated freezers will store samples on ISS at temperatures as low as -80 degrees C	
MSG	Microgravity Science Glovebox	NASA	Facilities	Microgravity Science Glovebox (MSG) provides a safe contained environment for research with liquids, combustion and hazardous materials aboard the International Space Station (ISS). Without the MSG, many types of hands-on investigations would be impossible or severely limited onboard the Station	Columbus
MSRR	Materials Science Research Rack-1	NASA	Facilities	The Materials Science Research Rack-1 (MSRR-1) will be used for basic materials research in the microgravity environment of the ISS. MSRR-1 can accommodate and support diverse Experiment Modules (EMs). In this way many material types, such as metals, alloys, polymers, semiconductors, ceramics, crystals, and glasses, can be studied to discover new applications for existing materials and new or improved materials	Destiny

International Space Station Experiment Facilities (concluded)

Name	Title	Agency	Category	Summary	Location
UMS	Urine Monitoring System	NASA	Facilities	The Urine Monitoring System (UMS) is a system designed to collect an individual crewmember's void, gently separate urine from air, accurately measure void volume, allow for void sample acquisition, and discharge remaining urine into the Waste and Hygiene Compartment (WHC) onboard the International Space Station (ISS)	

International Space Station Experiments – Expedition 23 and 24

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/Sortie	Ops Location
APEX-CSA2	Advanced Plant Experiment-CSA2	CSA	Biological Sciences in Microgravity	APEX-CSA2 will compare the gene expression and tissue organization of the white spruce (*Picea glauca)* in microgravity and on Earth.	Advanced Biological Research Facility (ABRS)/ Express Rack (ER)	Jean Beaulieu, Ph.D., Natural Resources Canada (Canadian Wood Fibre Centre), Quebec City, Quebec, Canada	ISS	Destiny
BISE	Bodies in the Space Environment	CSA	Human Research and Countermeasures Development	Bodies in the Space Environment (BISE) will evaluate adaptation to, the effect of, and recovery from long-duration microgravity exposure on the perception of orientation using the OCHART protocol.	No facility	Laurence R. Harris, Ph.D., York University, North York, Ontario, Canada	ISS	Destiny
HYPERSOLE	Cutaneous Hypersensitivity and Balance Control in Humans	CSA	Human Research and Countermeasures Development	HYPERSOLE will determine the change in skin sensitivity post spaceflight for the application to balance control , specifically changes in skin sensitivity of the sole of the foot and which receptors may be influenced following a period of nonloading.	No facility	Leah R. Bent, Ph.D., University of Guelph, Guelph, Ontario, Canada	Pre and Post-flight (Shuttle)	None
VASCULAR	Health consequences of Long-Duration Flight	CSA	Human Research and Countermeasures Development	Health Consequences of Long-Duration Flight (VASCULAR) will conduct an integrated investigation of mechanisms responsible for changes in blood vessel structure with long-duration space flight and will link this with functional and health consequences that parallel changes with the aging process.	Human Research Facility-2 (HRF-2)	Richard Lee Hughson, Ph.D., University of Waterloo, Waterloo, Ontario, Canada	ISS	Columbus
ALTEA-SHIELD	Anomalous Long-Term Effects in Astronauts – Radiation Shielding	ESA	Radiation Dosimetry	ALTEA-SHIELD aims at obtaining a better understanding of the light flash phenomenon, and more generally the interaction between cosmic rays and brain function, as well as testing different types of shielding material.	Express Rack / ALTEA	**Italy**: L. Narici, F. Ballarini, G. Battistoni, M. Casolini, A. Ottolenghi, P. Picozza, W. Sannita, S. Villari **USA**: E. Benton, J. Miller, M. Shavers **Switzerland**: A Ferrari **Germany**: H. Iwase, D. Schardt **Japan**: T. Sato **Sweden**: L. Sihver	ISS	Destiny

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/Sortie	Ops Location
CETSOL	Columnar-to-Equiaxed Transition in Solidification Processing	ESA	Physical Sciences in Microgravity	CETSOL carries out research into the formation of microstructures during the solidification of metallic alloys specifically the transition from columnar growth to equiaxed growth when crystals start to nucleate in the melt. Results will help to optimise industrial casting processes. (See also MICAST.)	Material Science Laboratory (MSL)	**France**: A Gandin, B. Billia, Y. Fautrelle **Germany**: G. Zimmer-man **Ireland**: D. Browne **USA**: D. Poirier	ISS	Destiny
CFS-A	Coloured Fungi in Space (Part A)	ESA	Biological Sciences in Microgravity	CFS-A will undertake an examination of the survival and growth of different coloured fungi species, which can be relevant to spacecraft contamination, panspermia and planetary protection issues.	No Facility	**Romania**: D. Hasegan, O. Maris G. Mogildea, M. Mogildea	Sortie. Shuttle/ISS	Columbus
DOBIES	Dosimetry for Biological Experiments in Space	ESA	Radiation Dosimetry	The objective of DOBIES is to develop a standard dosimetric method to measure absorbed and equivalent doses for biological samples as a contribution to the DOSIS experiment, and EXPOSE-E (completed) and EXPOSE-R payloads.	European Physiology Modules (EPM)	**Belgium**: F.Vanhaevere	ISS	Columbus
DOSIS	Dose Distribution Inside the ISS	ESA	Radiation Dosimetry	DOSIS maps the actual nature and distribution of the radiation field inside Columbus using different detectors placed around the European laboratory.	European Physiology Modules (EPM)	**Germany**: G. Reitz	ISS	Columbus
EXPOSE-R: Amino	Photochemical processing of amino acids and other organic compounds in Earth orbit	ESA	Astrobiology	The main objective of the Amino experiment is to determine to what extent biologically active molecules (amino acids and peptides) are converted into a mixture of so-called L- and D molecules when exposed to UV-C radiation.	EXPOSE-R	**France**: H. Cottin, P. Coll, F. Raulin, N. Fray, C. Szopa, M.C. Maurel, J. Vergne, A. Brack A. Chabin, M. Bertrand, F. Westall, D. Tepfer, A. Zalar, S. Leach	ISS	Russian Segment external
EXPOSE-R: Endo	Response of endolithic organisms to space conditions	ESA	Astrobiology	The Endo experiment will assess the impact of increased UV-B and UV-C radiation, due to ozone depletion, on algae and cyanobacteria from Antarctic sites under the ozone hole.	EXPOSE-R	**U.K.**: C. Cockell, H. Edwards **Italy**: D. Billi	ISS	Russian Segment external

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
EXPOSE-R: Organic	Evolution of organic matter in space	ESA	Astrobiology	The goal of the Organic experiment, which concerns the evolution of organic matter in space, is to study the effects of UV radiation, low pressure, and heavy ion bombardment on organic molecules of interest in astrophysics and astrobiology.	EXPOSE-R	**Netherlands**: P. Ehren-freund, Z. Peeters, B. Foing, **Spain**: M. Breitfellner **France**: F. Robert **Germany**: E.Jessberger, W. Schmidt, **USA**: F. Salama, M. Mumma	ISS	Russian Segment external
EXPOSE-R: Osmo	Exposure of osmophilic microbes to the space environment	ESA	Astrobiology	Osmo aims to understand the response of microbes to the vacuum of space and to solar radiation. It will especially focus on bacteria that survive in environments of high osmotic pressure.	EXPOSE-R	**USA**: R. Mancinelli	ISS	Russian Segment external
EXPOSE-R: Photo	Measurements of vacuum and solar radiation-induced DNA damages within spores	ESA	Astrobiology	This experiment is studying the effect of exposure of bacterial spores and samples of their DNA to solar UV radiation. The objective is to assess the quantity and chemistry of chemical products produced.	EXPOSE-R	**France**: J. Cadet, T. Douki, J-L.Ravanat, S. Sauvaigo	ISS	Russian Segment external
EXPOSE-R: PUR	Phage and Uracil Response	ESA	Astrobiology	The PUR experiment is studying the effect of solar UV radiation on a type of virus (Phage T7) and an RNA compound (uracil) to determine their effectiveness as biological dosimeters for measuring UV dose in the space environment.	EXPOSE-R	**Hungary**: G. Rontó, A. Fekete, P. Gróf, A. Bérces	ISS	Russian Segment external
EXPOSE-R: Spores	Spores in artificial meteorites	ESA	Astrobiology	Spores will assess how meteorite material acts as a protection for bacterial, fungal and ferny spores against space conditions; i.e., UV, vacuum and ionising radiation.	EXPOSE-R	**Germany**: G. Horneck, B. Hock, C. Panitz, A. Lux-Endrich, K.Neuberger, R. Möller, E. Rabbow, P. Rettberg, D.P. Häder, G. Reitz, **Bulgaria**: T. Dachev, B. Tomov	ISS	Russian Segment external

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
EXPOSE-R: Subtil	Mutational spectra of Bacillus subtilis spores and plasmid DNA exposed to high vacuum and solar UV radiation in the space environment	ESA	Astrobiology	Subtil will determine the extent of mutation of spores and plasmid DNA of the model bacteria *Bacillus subtilis* induced by exposure to space vacuum and solar UV radiation.	EXPOSE-R	**Japan**: N.Munakata, K. Hieda, F.Kawamura	ISS	Russian Segment external
FASES	Fundamental and Applied Studies of Emulsion Stability	ESA	Physical Sciences in Microgravity	FASES will study the links between the physical chemistry of the droplets interface, the liquid films and the collective properties of an emulsion.	Fluid Science Laboratory (FSL)	**Italy**: L. Liggieri, G. Loglio, A. Di Lullo **France**: D. Clausse A. Steinchen, C. Dalmazzone **Germany**: R. Miller	ISS	Columbus
IMMUNO	Neuroendocrine and immune responses in humans during and after a long-term stay on the ISS	ESA	Human Research and Countermeasures Development	The aim of this experiment is to determine changes in hormone production and immune response during and after an ISS mission.	No Facility	**Germany**: A. Chouker, F. Christ, M. Thiel, I. Kaufmann, **Russia**: B. Morukov	ISS	Russian Segment
MATROSHKA-2	MATROSHKA-2	ESA	Radiation Dosimetry	The Matroshka-2 experiment is carrying out a study of radiation absorption on the ISS using a simulated human Phantom and further investigating the effect of using different shielding materials on the process.	MATROSHKA	**Germany**: G. Reitz, R. Beaujean, W. Heinrich, M. Luszik-Badra, M.Scherken-bach **Poland**: P. Olko, P. Bilski **Hungary**: S. Derne, J. Palvalvi **USA**: E. Stassin-opoulos, J. Miller, C. Zeitlin, F. Cucinotta **Russia**: V. Petrov	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
MICAST	Microstructure Formation in Casting of Technical Alloys Under Diffusive and Magnetically Controlled Convective Conditions	ESA	Physical Sciences in Microgravity	MICAST carries out research into the formation of microstructures during the solidification of metallic alloys under diffusive and magnetically controlled convective conditions.	Material Science Laboratory (MSL)	**Germany**: L. Ratke, G. Mueller, G. Zimmer-man **France**: Y. Fautrelle, J. Lacaze **Hungary**: A. Roosz **Canada**: S. Dost **USA**: D. Poirier	ISS	Destiny
OTOLITH	OTOLITH	ESA	Human Research and Countermeasures Development	The otolith organs in the inner ear play an important role in our balance system as detectors of vertical and horizontal acceleration. This experiment will make an assessment of otolith function before and after short-term spaceflight.	No Facility	**Germany**: A Clarke **USA**: S. Wood	Pre and Post-flight (Shuttle)	None
PADIAC	Pathway Different Activators	ESA	Biological Sciences in Microgravity	The goal of PADIAC is to determine the different pathways used for activation of T cells, which play an important role in the immune system.	European Drawer Rack (EDR)/Kubik Incubator	**Switzerland**: I. Walther, A. Cogoli **Italy**: P. Pippia **USA**: M. Hughes-Fulford	ISS	Columbus
PASSAGES	Scaling Body-related Actions in the Absence of Gravity	ESA	Human Research and Countermeasures Development	PASSAGES is designed to test how astronauts interpret visual information due to exposure to weightlessness with a focus on the possible decrease in use of the “Eye-Height” strategy.	No Facility	**France**: M. Luyat, J. Mcintyre	ISS	Columbus
SODI-DSC	Selectable Optical Diagnostics Instrument – Diffusion and Soret Coefficient Measurement for Improvement of Oil Recovery	ESA	Physical Sciences in Microgravity	The DSC experiment will determine diffusion data requirements for petroleum reservoir models, measure Soret diffusion coefficients in liquid mixtures and refine relevant models related to petroleum reservoir evaluation.	Microgravity Science Glovebox (MSG)	**Belgium**: J. C. Legros **France**: J.Caltagirone, J.L. Daridon, **Canada**: Z. Zaghir **Denmark**: A. Shapiro	ISS	Columbus
SODI-COLLOID	SODI-Advanced Photonic Devices in Microgravity	ESA	Physical Sciences in Microgravity	With the fabrication of photonic devices being a very promising application in colloidal engineering, COLLOID will study the growth and properties of advanced photonic materials grown in weightlessness.	Microgravity Science Glovebox (MSG)	**USA**: D. Weitz, P. Segre, W. V. Meyer, **Netherlands**: A. Lagendijk, G. Wegdam	ISS	Columbus

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
SOLAR	SOLAR	ESA	Solar Physics	In orbit since February 2008, the Solar facility consists of three instruments and continues to study the Sun's irradiation with unprecedented accuracy across most of its spectral range.	SOLAR – Columbus External Payload Facility	**Germany**: G. Schmidtke **France**: G. Thuillier **Switzerland**: C. Frohlich	ISS	Columbus
SOLO	Sodium Loading in Microgravity	ESA	Human Research and Countermeasures Development	SOLO is carrying out research into salt retention in space and related human physiology effects.	European Physiology Modules (EPM)/Human Research Facilities 1 and 2 (HRF-1 and HRF-2)	**Germany**: P. Frings-Meuthen, M. Heer, N. Kamps, F. Baisch **Denmark**: P. Norsk	ISS	Columbus
SPIN		ESA	Human Research and Countermeasures Development	SPIN is a comparison between pre-flight and post-flight testing of astronaut subjects using a centrifuge and a standardized tilt test to link orthostatic tolerance with otolith-ocular function.	No Facility	**Belgium**: F. Wuyts, N. Pattyn **USA**: S. Moore, B. Cohen, A. Diedrich **Australia**: H. MacDou-gall **France**: G. Clement	Pre/Post flight	Ground-based
TASTE	Taste In Space	ESA	Education	Taste is part of the curriculum of school children across Europe. A tasting session will be recorded on the ISS in order to develop online material for use in the classroom.	No Facility	**Netherlands**: S. Hartevelt, E. Celton, ESA/ESTEC	ISS	Russian Segment
THERMOLAB	THERMOLAB	ESA	Human Research and Countermeasures Development	THERMOLAB is looking into core temperature changes in astronauts performed before during and after exercise on the ISS to investigate thermoregulatory and cardiovascular adaptations during long-duration spaceflight.	Portable Pulmonary Function System (PPFS)	**Germany**: H.C. Gunga, K. Kirsch, E.Koralewski, J. Cornier, H.-V. Heyer, P. Hoffman, J. Koch, F. Sattler **France**: P. Arbeille	ISS	Destiny

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
TRIPLELUX-B	TRIPLELUX-B	ESA	Biological Sciences in Microgravity	TRIPLELUX-B will look into the effect of spaceflight on immune system cells. The cells studied will be invertebrate hemocytes from the blue mussel (Mytilus edulis).	Biolab	**Germany**: Prof Dr P.-D. Hansen	ISS	Columbus
Vessel ID System	Vessel ID System	ESA	Technology Demonstration	The Vessel ID System will demonstrate the space-based capability of identification of maritime vessels and also test the ability of an external grappling adaptor to accommodate small payloads.	No Facility	**Netherlands**: H. Koenig, ESA/ESTEC	ISS	Columbus
Vessel Imaging	Vascular Echography	ESA	Human Research and Countermeasures Development	The main objective of Vessel Imaging is to evaluate the changes in the peripheral blood vessel wall properties (thickness and compliance) and cross sectional areas during long-term spaceflight.	Human Research Facility 1 (HRF-1)	**France**: P. Arbeille	ISS	Columbus
WAICO-2	Waving and Coiling of Arabidopsis Roots	ESA	Biological Sciences in Microgravity	The WAICO experiment aims to understand the interaction between circumnutation (spiralling) and gravitropism (growth in response to gravity) in the model Arabidopsis plant.	Biolab	**Germany**: G. Scherer	ISS	Columbus
ZAG	Z-axis Aligned Gravito-inertial force	ESA	Human Research and Countermeasures Development	This is an investigation into the effect weightlessness has on an astronaut's perception of motion and tilt and his level of performance before and immediately after spaceflight.	No Facility	**France**: G. Clement **USA**: S. Wood, D. Harm, A. Rupert	Pre and Post-flight (Shuttle)	None
3D SPACE	Mental Representation of Spatial Cues During Spaceflight	ESA	Human Research and Countermeasures Development	This experiment involves comparison of pre-flight, flight and post-flight perceptions and mental imagery with special reference to spaceflight-related decreases in vertical percepts.	No Facility	**France**: G. Clement **USA**: C. E. Lathan	ISS	Columbus
CARD	CARD	ESA	Human Research and Countermeasures Development	The main aims of CARD are to understand how weightlessness affects the regulation of blood pressure and establish how some hormones responsible for regulating the cardiovascular system are affected by long-term exposure to weightlessness.	Human Research Facility 2 (HRF-2)/ Pulmonary Function System (PFS)/ European Physiology Module (EPM)	**Denmark**: P. Norsk, N.J. Christen-sen, B. Pump, A. Gabriel-sen, J.G. Nielsen, N. Gadsboll **Germany**: C. Drummer, N. Kentsch	ISS	Columbus

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
EDOS	Early Detection of Osteoporosis	ESA	Human Research and Countermeasures Development	This is a study into the mechanisms underlying the reduction in bone mass, which occurs in astronauts in weightlessnessand will evaluate bone structure pre- and post-flight.	No Facility	**France**: C.Alexandre, L. Braak, L. Vico, **Switzerland**: P. Rueg-segger Germany: M. Heer	Pre/Post flight	Ground-based
EKE	Assessment of endurance capacity by gas exchange and heart rate kinetics during Physical Training	ESA	Human Research and Countermeasures Development	EKE will make an assessment of endurance capacity and heart rate kinetics during physical training of ISS Expedition crew members.	No Facility	**Germany**: U. Hoffman, S. Fasoulas, D. Essfeld, T. Drager	Pre/Post flight	Data sharing with NASA VO2max protocol
ERB-2	Erasmus Recording Binocular 2	ESA	Technology Demonstration	The ERB-2 is a high definition 3D stereoscopic video camera which will be used for taking footage inside the ISS to develop narrated video material for promotional and educational purposes.	European Drawer Rack (EDR)	**Netherlands**: M. Sabbatini, ESA/ESTEC	ISS	Columbus
EXPOSE-R: IBMP	Exposure of resting stages of terrestrial organisms to space conditions	ESA/IBMP	Astrobiology	Samples from the Institute for Biomedical Problems in Moscow which are looking into the effect of exposing a diverse collection of terrestrial organisms in a resting stage of their life cycle to space conditions.	EXPOSE-R	**Russia** : V. Sychev, N. Novikova, V. Alekseev, M. Leven-skikh, O. Gusev, N.Polikarpov, E.Deshevaya **Japan**: T. Okuda	ISS	Russian Segment external
2D Nanotemplate	2D Nanotemplate	JAXA	Applied Research	The 2D Nanotemplate will quantitatively evaluate gravitational effects on a new nanomaterial during its chemical reaction process. To prepare the two-dimensional template with nanoditches for electronic devices. The template is prepared via an isothermal reaction upon mixing of peptides and alkali water. To prevent sedimentation and convective flow, microgravity is needed.	MELFI	Takatoshi Kinoshita, Nagoya Institute of Technology, Naokiyo Koshikawa, JAXA	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
PADLES	Passive Dosimeter for Life Science Experiments in Space	JAXA	Human Spaceflight Technology Development	Area PADLES surveys the space radiation environment inside Kibo using the PADLES analysis system and passive and integrating dosimeter developed by JAXA for measuring absorbed dose, LET distributions, and dose equivalents. Ultimate goals of this program are to support risk assessment and dose management for Japanese astronauts, and to update radiation assessment models for human spaceflight in the next generation. There are 17 Area PADLES dosimeters installed in Kibo's Pressurized Module (PM) and Kibo's Experiment Logistics Module-Pressurized Section (ELM-PS). They are replaced during each space station expedition. This series of experiments began from Expedition 17.	No Facility	Keiji Murakami, Akiko Nagamatsu, JAXA	ISS	Kibo
Ferulate	Regulation by Gravity of Ferulate Formation in Cell Walls of Wheat Seedlings	JAXA	Life Science	The objective of this experiment is to confirm the hypothesis under which microgravity conditions modify the endogenous levels of abscisic acid, which in turn causes the reduction of the formation of cell wall-bound ferulic and diferulic acids by decreasing the activity of phenylalanine ammonia-lyase, and thereby decreases the mechanical strength of cell walls.	CBEF	Kazuyuki Wakabayashi, Osaka City University	ISS	Kibo
Hydro Tropi	Hydrotropism and Auxin-inducible Gene Expression in Roots Grown in Microgravity Conditions	JAXA	Life Science	The hydrotropic response mechanism will be separated from that of gravitropism to understand the regulatory mechanisms of root growth orientation, and to determine whether hydrotropic response can be used to control root growth orientation in microgravity.	CBEF	Hideyuki Takahashi, Tohoku University	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
JAXA PCG	High-Quality Protein Crystal Growth Experiment	JAXA	Applied Research	JAXA PCG seeks to grow crystals of biological macromolecules using the counter diffusion technique. The main scientific objective of the JAXA PCG experiment is to produce fine-quality protein crystals in microgravity. The crystals will be grown in the JAXA PCG Canister using the Protein Crystallization Research Facility (PCRF) in the RYUTAI rack. The space-grown crystals will be applied to structural biology and pharmaceutical activities. This experiment is a JAXA-ROSCOSMOS science collaboration. JAXA is performing the onboard experiments, including samples from the Russian research group, and OSCOSMOS is operating the launch and retrieval.	PCRF	Masaru Sato, JAXA	ISS	Kibo
Marangoni Exp	Chaos, Turbulence and its Transition Process in Marangoni Convection	JAXA	Fluid Science	A liquid bridge 50 mm in diameter is formed between a pair of supporting disks. A temperature difference between disks is imposed gradually. Thermocapillary convection (Marangoni convection) occurs due to surface tension gradient. The flow and temperature fields are observed in each stage. The transition conditions and processes are investigated precisely. In this experiment, an insertion thermocouple will be used to measure the surface temperature fluctuation.	FPEF	Koichi Nishino, Yokohama National University	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

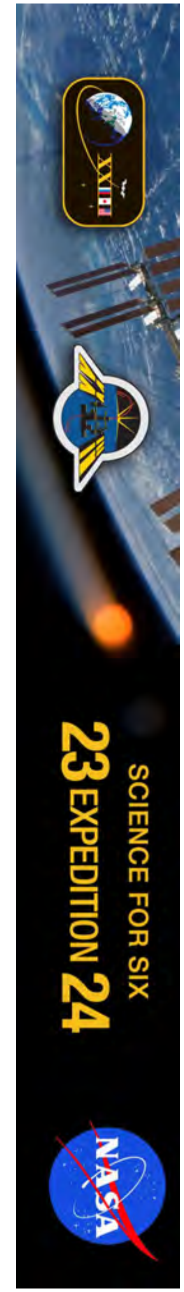
Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Marangoni UVP	Spatiotemporal Flow Structure in Marangoni Convection	JAXA	Fluid Science	Marangoni UVP is an experiment of Marangoni convection led by Yasushi Takeda of Hokkaido University, and performed using the Fluid Physics Experiment Facility (FPEF) in the RYUTAI rack in Kibo. The operational method is similar to that of the preceding Marangoni experiment: Chaos, Turbulence, and its Transition Process in Marangoni Convection (MEIS). During the experiment, the flow phenomenon will be investigated using a pulsed ultrasonic velocity profiler to obtain the spatiotemporal velocity field inside the fluid column, so as to investigate and clarify the flow transition scheme from laminar to turbulence through chaos. The experiment cell of this experiment will be delivered to the ISS on the HTV-1 Mission scheduled to launch to the ISS in September 2009.	FPEF	Shinichi Yoda, JAXA	ISS	Kibo
Microbe-II	Studies on Microbiota on board the International Space Station and Their Relationship to Health Problems	JAXA	Life Science	The purpose of this experiment is to monitor microbes in Kibo that may affect the health of the crew. The monitoring of stress from microbes on crew members is evaluated for its impact on space medicine. This experiment includes sampling using Microbial Detection Sheets, Yeast and Mold, Microbe Adhesive Sheets, and Blue/White Wipes in five specific areas of Kibo for molecular and biological analysis.	No Facility	Koichi Makimura , Teikyo University	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
MAXI	Monitor of All-sky X-ray Image	JAXA	X-ray Astronomy	MAXI is an external observatory operated on the EF. MAXI was launched and installed on Kibo's EF during the STS-127 Mission. MAXI has been and will be monitoring X-ray variability for more than 1,000 X-ray sources covering the entire sky. MAXI consists of two types of highly sensitive X-ray slit cameras: the Gas Slit Camera (GSC) and the Solid-state Slit Camera (SSC). The GSC uses a gas proportional counter for X-ray detection, and the SSC uses Peltier-cooled CCDs for X-ray detection. MAXI is equipped with 12 GSCs and 2 SSCs. The discoveries of X-ray novae and gamma-ray bursts with MAXI are to be distributed worldwide via the Internet, so that astronomical observatories may conduct follow-up and detailed observations with telescopes or astronomical satellites.	JEM-EF	Masaru Matsuoka, JAXA	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Myco Lab	Cbl-Mediated Protein Ubiquitination Downregulates the Response of Skeletal Muscle Cells to Growth Factors in Space	JAXA	Life Science	A gene modified cell line from rat muscle cell (L - 6) is utilized, which can be grown as an attached culture in the Meas Exp culture chamber. The cells are launched at ambient using “Meas Exp CO2 bag”, which maintains an adequate concentration of CO2. After the crew member exchanges the medium using the “Meas Exp Solution Exchanger,” the cells are cultivated using the CBEF at 37° C for 12 days. After 11 days of incubation, there is another medium exchange, including IGF-1 for one half of the chambers, and then incubation continues for one more day. After 12 total days of incubation, all chambers are washed using PBS, the RNA is preserved using RNAlater, and frozen for recovery (in MELFI and the STS freezer). After recovery, cells are analyzed for microgravity effects using an RT-PCR assay, DNA microarray, and Western blotting.	CBEF	Takeshi Nikawa, University of Tokushima	ISS	Kibo



International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
NANOSKELETON	Production of a High-performance Nanomaterial: "Nanoskeleton" in Microgravity	JAXA	Applied Research	Nanoskeleton1 will quantitatively evaluate gravitational effects on a new nanomaterial during its chemical reaction process. The nanoskeleton, a coined word that is defined as a functional nanoframework, is expected to be a highly functional material because of its high surface area. The high surface area is due to the pore structure and functionality of the framework itself. The TiO2 nanoskeleton, especially, has potential as a high-performance photocatalyst and highly efficient dye-sensitized solar cell. The TiO2 nanoskeleton is synthesized from a mixture of CTAB surfactant solution and TiOSO4-H2SO4 solution at 40° C or 3 days under isothermal conditions. The nanoskeleton experiment will be performed using the CBEF in the SAIBO rack. Oil will be used to enlarge the pore size of the honeycomb structure of the TiO2 nanoskeleton so that flotation of the oil can be suppressed in microgravity. All of the experiment samples will be retrieved and evaluated on the ground. The retrieved samples will be evaluated to clarify convective flow, flotation, and sedimentation effects on the sample quality. During the experiment, temperature and downlinked images of the samples will be monitored. Results of this study may enable the synthesizing of nanoskeleton materials on a mass production scale, and eventually, commercial realization of nanoskeleton materials as photocatalytic particles and so on. This experiment will be performed under JAXA's ISS Applied Research Center promotion program, which is joint university/industry/government research.	CBEF, MELFI	Masakazu Abe, Tokyo University of Science Naokiyo Koshikawa, JAXA	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Neuro Rad	Biological Effects of Space Radiation and Microgravity on Mammalian Cells	JAXA	Life Science	A cell line from human neuroblastoma (SK-N-SH) is utilized, which can be grown as an attached culture in the Meas Exp Culture Chamber. The cells are launched in the incubator (at 37° C) using the "Meas Exp CO2 Bag," which maintains an adequate concentration of CO2. The cells are kept in the "Meas Exp CO2 Bag" (without utilizing CO2 from CBEF) and cultured using the CBEF at 37° C in the ISS. After approximately 13 days or 23 days in the CBEF, the cells chambers are washed using PBS (Phosphate Buffered Saline) and treated with RNAlater and CELLBANKER® to facilitate recovery of the frozen cells (in MELFI and the STS freezer). After recovery, the cells are analyzed for space radiation effects of microgravity using a DNA microarray, Western blotting, and mutation assays.	CBEF	Hideyuki Majima, Kagoshima University		
SEDA-AP	Space Environment Data Acquisition Equipment-Attached Payload	JAXA	Astrophysics/Earth Observation	SEDA-AP is an external experiment conducted on the Exposed Facility (EF). SEDA-AP was launched and installed on Kibo's Exposed Facility (EF) during the STS-127 Mission, and it has been collecting space environment data ever since. It consists of common bus equipment, a mast that extends the neutron monitor sensor into space, and seven measurement units that measure space environment data. The measurement units are (1) Neutron Monitor (NEM), (2) Heavy Ion Telescope (HIT), (3) Plasma Monitor (PLAM), (4) Standard Dose Monitor (SDOM), (5) Atomic Oxygen Monitor (AOM), (6) Electronic Device Evaluation Equipment (EDEE), and (7) Micro-Particles Capture (MPAC) and Space Environment Exposure Device (SEED).	JEM-EF	Tateo Goka, JAXA	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
SMILES	Superconducting Submillimeter-Wave Limb-Emission Sounder	JAXA	Astrophysics/Earth Observation	SMILES is an external observatory to be operated on the EF. SMILES will be launched and installed during the HTV-1 Mission and aims at globally mapping stratospheric trace gases, using the most sensitive submillimeter receiver. A Superconductor/ Insulator/Superconductor (SIS) mixer in a dedicated cryostat with a mechanical cooler achieved SMILES's super-high sensitivity. SMILES will observe ozone depletion-related molecules, such as ClO, HCl, HO2, HNO3, BrO, and O3, in the frequency bands of 624.32 to 626.32 GHz and 649.12 to 650.32 GHz. A scanning antenna will cover tangent altitudes from 10 to 60 km every 53 seconds, while tracing the latitudes from 38°S to 65°N along its orbit. Due to its global coverage capability, SMILES can observe the low- and mid-latitudinal areas, as well as the Arctic peripheral region. SMILES data will enable us to investigate chlorine and bromine chemistry, and will provide a database for ozone variations in time and position around the upper troposphere and lower stratosphere.	JEM-EF	Masato Shiotani, Kyoto University	ISS	Kibo

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
UROKO	Regulation of Bone Metabolism in Space: Analysis by an In Vitro Assay System Using Goldfish Scales as a Model of Bone	JAXA	Life Science	Scales, (UROKO in Japanese (regenerating scales)) collected from goldfish under anesthesia will be launched at +4° C. They will be incubated for 2 or 4 days at 20° C under microgravity using the cell biology experiment facility (CEBF) and compared with a 1G control in space. We will use the regenerating scales in goldfish because osteoblasts and osteoclasts in the regenerating scales were more active than those in normal scales. After the experiments, the specimens will be frozen at -80° C or fixed with formalin at 4° C.	CBEF	Nobuo Suzuki, Kanazawa University	ISS	Kibo
AgCam-2	Agricultural Camera – 2	NASA	Earth and Space Science	The Agricultural Camera - 2 (AgCam-2) will take frequent images, in visible and infrared light, of vegetated areas on the Earth, principally of growing crops, rangeland, grasslands, forests, and wetlands in the northern Great Plains and Rocky Mountain regions of the United States. Images will be delivered directly to requesting farmers, ranchers, foresters, natural resource managers and tribal officials to help improve their environmental stewardship of the land. Images also will be shared with educators for classroom use.		George A. Seielstad, Ph.D., University of North Dakota, Grand Forks, N.D.	ISS	
BCAT-3	Binary Colloidal Alloy Test – 3	NASA	Physical and Materials Science	Binary Colloidal Alloy Test – 3 (BCAT-3) will determine phase separation rates and add needed points to the phase diagram of a model critical fluid system. Crewmembers photograph samples of polymer and colloidal particles -- tiny nanoscale spheres suspended in liquid -- that model liquid/gas phase changes. Results will help scientists develop fundamental physics concepts previously cloaked by the effects of gravity.		David A. Weitz, Ph.D., Harvard University, Cambridge, Mass. Peter J. Lu, Ph.D., Harvard University, Cambridge, Mass.	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
BCAT-4	Binodal Colloidal Aggregation Test – 4	NASA	Physical and Materials Science	Binary Colloidal Alloy Test – 4 (BCAT-4) is a follow-on experiment to BCAT-3. BCAT-4 will study ten colloidal samples. Seven of these samples will determine phase separation rates and add needed points to the phase diagram of a model critical fluid system initially studied in BCAT-3. Three of these samples will use model hard-spheres to explore colloidal crystal formation, providing insight into how nature brings order out of disorder.		David A. Weitz, Ph.D., Harvard University, Cambridge, Mass. Peter J. Lu, Ph.D., Harvard University, Cambridge, Mass. Paul M. Chaikin, Ph.D., Princeton University, Princeton, NJ and New York University, New York	ISS	
BCAT-5	Binary Colloidal Alloy Test – 5	NASA	Physical and Materials Science	Binary Colloidal Alloy Test – 5 (BCAT-5) is a suite of four investigations which will photograph randomized colloidal samples onboard the International Space Station to determine their resulting structure over time. The use of EarthKAM software and hardware will allow the scientists to capture the kinetics, or evolution, of their samples, as well as the final equilibrium state of each sample.		Arjun Yodh, Ph.D., University of Pennsylvania, University Park, Pa. Matthew Lynch, Ph.D., Procter and Gamble, Cincinnati David Weitz, Ph.D., Harvard University, Cambridge, Mass. Paul Chaikin, Ph.D., New York University, New York	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Bio	Biology	NASA	Technology	Biology (Bio) determines the magnifications that are possible with a microscope in an International Space Station vibration environment. Bio will image three-dimensional biological sample particles, tissue samples and live organisms. This will be done to indicate the microscope capabilities for viewing biological specimens.			ISS	
BRIC-16	Biological Research in Canisters – 16	NASA	Biology and Biotechnology	Biological Research in Canisters – 16 (BRIC-16) germinates *Arabidopsis thaliana* seeds in microgravity to be returned to Earth for analysis by investigator teams.		Howard Levine, Ph.D., Kennedy Space Center, Cape Canaveral, Fla.	Sortie	
Bisphosphonates	Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss	NASA	Human Research	Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss (Bisphosphonates) will determine whether antiresorptive agents which help reduce bone loss, in conjunction with the routine inflight exercise program, will protect station crewmembers from the regional decreases in bone mineral density documented on previous station missions.		Adrian LeBlanc, Ph.D., Division of Space Life Sciences, Universities Space Research Association, Houston	ISS	
CCF	Capillary Channel Flow	NASA	Technology	Capillary Channel Flow (CCF) is a versatile experiment for studying a critical variety of inertial-capillary dominated flows key to spacecraft systems that cannot be studied on Earth. CCF results are immediately useful for the design, testing, and instrumentation for verification and validation of liquid management systems of current orbiting, design stage, and advanced spacecraft envisioned for future exploration missions.		Michael Dreyer, Ph.D., University of Bremen, Bremen, Germany	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
CEO	Crew Earth Observations	NASA	Earth and Space Science	Crew Earth Observations (CEO) takes advantage of the crew in space to observe and photograph natural and human-made changes on Earth. The photographs record the Earth's surface changes over time, along with dynamic events such as storms, floods, fires and volcanic eruptions. These images provide researchers on Earth with key data to better understand the planet.		Susan Runco, Johnson Space Center, Houston	ISS	
CFE-2	Capillary Flow Experiment – 2	NASA	Physical and Materials Science	Capillary Flow Experiment – 2 (CFE-2) is a suite of fluid physics experiments that investigate capillary flows and flows of fluids in containers with complex geometries. Results will improve current computer models that are used by designers of low gravity fluid systems and may improve fluid transfer systems on future spacecraft.		Mark M. Weislogel, Ph.D., Portland State University, Portland, Ore.	ISS	
CSI-05	Commercial Generic Bioprocessing Apparatus Science Insert – 05	NASA	Education	Commercial Generic Bioprocessing Apparatus Science Insert – 05 (CSI-05) is one investigation in the CSI program series. The CSI program provides the K-12 community opportunities to utilize the unique microgravity environment of the International Space Station as part of the regular classroom to encourage learning and interest in science, technology, engineering and math.		Louis Stodieck, Ph.D., University of Colorado - Boulder, BioServe Space Technologies, Boulder, Colo.	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

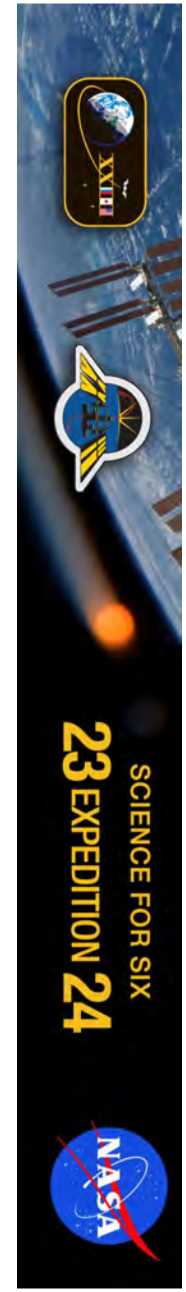
Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
CSLM-2	Coarsening in Solid Liquid Mixtures-2	NASA	Physical and Materials Science	Coarsening in Solid Liquid Mixtures-2 (CSLM-2) examines the kinetics of competitive particle growth within a liquid metal matrix. During this process, small particles of tin suspended in a liquid tin-lead matrix shrink by losing atoms to larger particles of tin, causing the larger particles to grow, or coarsen. This study defines the mechanisms and rates of coarsening in the absence of gravitational settling. This work has direct applications to metal alloy manufacturing on Earth, including materials critical for aerospace applications (e.g., the production of better aluminum alloys for turbine blades).		Peter W. Voorhees, Ph.D., Northwestern University, Evanston, Ill.	ISS	
CVB	Constrained Vapor Bubble	NASA	Physical and Materials Science	Constrained Vapor Bubble (CVB) operates a miniature wickless heat pipe, or heat exchanger, to understand the physics of evaporation and condensation as they affect heat transfer processes in microgravity.		Peter C. Wayner, Jr., Ph.D., Rensselaer Polytechnic Institute, Troy, N.Y. Joel Plawsky, Sc.D., Rensselaer Polytechnic Institute, Troy, N.Y.	ISS	
Cube Lab	Cube Lab	NASA	Education	Cube Lab is a low-cost 1 kilogram platform for educational projects on the International Space Station.			ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
DECLIC-ALI	DEvice for the study of Critical LIquids and Crystallization – Alice Like Insert	NASA	Physical and Materials Science	DEvice for the study of Critical LIquids and Crystallization (DECLIC) is a multi-user facility used to study transparent media and their phase transitions in microgravity onboard the International Space Station. The Alice Like Insert (ALI) portion of DECLIC studies the dynamics of near-ambient temperature critical fluids of sulfur hexafluoride, a colorless, odorless, non-toxic and non-flammable gas known and carbon dioxide. ALI is one of the modules developed for DECLIC that will be used to continue the program on fluid physics and dynamics close to critical point.		Yves Garrabos, Ph.D., Institut de Chimie de la Matière Condensée de Bordeaux, Bordeaux, France Daniel Beysen, Ph.D., Physique et Mecanique des Milieux Heterogenes, Paris, France	ISS	
DTN	Delay Tolerant Networking	NASA	Technology	The Delay Tolerant Networking (DTN) will test communication protocols with the Commercial Generic Bioprocessing Apparatus (CGBA) onboard the International Space Station that can be used for exploration. The primary purpose of this activity is to rapidly mature the technology for use in NASA's exploration missions and space communications architecture.		Kevin Gifford, Ph.D., University of Colorado, Boulder, Colo.	ISS	
EPO-Demos	Education Payload Operation – Demonstrations	NASA	Educational Activities	Education Payload Operation – Demonstrations (EPO-Demos) are recorded video education demonstrations performed on the International Space Station by crewmembers using hardware already onboard the station. EPO-Demos are videotaped, edited, and used to enhance existing NASA education resources and programs for educators and students in grades K-12. EPO-Demos are designed to support the NASA mission to inspire the next generation of explorers.		Matthew Keil, Johnson Space Center, Houston	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
EPO-Robo	Education Payload Operations – Robotics	NASA	Educational Activities	Education Payload Operations – Robotics (EPO-Robo) creates an on-orbit video demonstration explaining robotic arm operations on the Space Shuttle and the International Space Station.		Matthew Keil, Johnson Space Center, Houston	ISS	
EarthKAM	Earth Knowledge Acquired by Middle School Students	NASA	Educational Activities	Earth Knowledge Acquired by Middle School Students (EarthKAM), an education activity, allows middle school students to program a digital camera on board the International Space Station to photograph a variety of geographical targets for study in the classroom. Photos are made available on the World Wide Web for viewing and study by participating schools around the world. Educators use the images for projects involving Earth Science, geography, physics and social science.		Sally Ride, Ph.D., University of California – San Diego	ISS	
Functional Task Test	Physiological Factors Contributing to Changes in Postflight Functional Performance	NASA	Human Research	Physiological Factors Contributing to Changes in Postflight Functional Performance (Functional Task Test) will test astronauts on an integrated suite of functional and physiological tests before and after short and long-duration space flight. The study will identify critical mission tasks that may be impacted, map physiological changes to alterations in physical performance and aid in the design of countermeasures that specifically target the physiological systems responsible for impaired functional performance.		Jacob Bloomberg, Ph.D., Johnson Space Center, Houston	Pre/ Postflight	
Ham Radio-ARISS	Ham Radio – Amateur Radio on the International Space Station	NASA	Educational Activities	Utilizing ham radio's, Ham Radio – Amateur Radio on the International Space Station (Ham Radio – ARISS) gets students interested in space exploration by allowing them to talk directly with the crews living and working aboard the station.			ISS	



International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
HREP-HICO	HICO and RAIDS Experiment Payload – Hyperspectral Imager for the Coastal Ocean	NASA	Earth and Space Science	HICO and RAIDS Experiment Payload – Hyperspectral Imager for the Coastal Ocean (HREP-HICO) will operate a Visible and Near-InfraRed (VNIR) Maritime Hyperspectral Imaging (MHSI) system, to detect, identify and quantify coastal geophysical features from the International Space Station.		Mike Corson, Naval Research Laboratory, Washington	ISS	
HREP-RAIDS	HICO and RAIDS Experiment Payload – Remote Atmospheric and Ionospheric Detection System (RAIDS)	NASA	Earth and Space Science	The HICO and RAIDS Experiment Payload – Remote Atmospheric and Ionospheric Detection System (HREP-RAIDS) experiment will provide atmospheric scientists with a complete description of the major constituents of the thermosphere -- layer of the Earth's atmosphere -- and ionosphere -- uppermost layer of the Earth's atmosphere -- global electron density profiles at altitudes between 100 - 350 kilometers.		Scott Budzien, Naval Research Laboratory, Washington	ISS	
IVGEN	IntraVenous Fluid GENeration for Exploration Missions	NASA	Human Research	IntraVenous Fluid GENeration for Exploration Missions (IVGEN) will demonstrate the capability to purify water to the standards required for intravenous administration, then mix the water with salt crystals to produce normal saline. This hardware is a prototype that will allow flight surgeons more options to treat ill or injured crewmembers during future long-duration exploration missions.		John McQuillen, Glenn Research Center, Cleveland (Hardware Project Scientist)	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Integrated Cardiovascular	Cardiac Atrophy and Diastolic Dysfunction During and After Long Duration Spaceflight: Functional Consequences for Orthostatic Intolerance, Exercise Capability and Risk for Cardiac Arrhythmias	NASA	Human Research	Cardiac Atrophy and Diastolic Dysfunction During and After Long Duration Spaceflight: Functional Consequences for Orthostatic Intolerance, Exercise Capability and Risk for Cardiac Arrhythmias (Integrated Cardiovascular) will quantify the extent, time course and clinical significance of cardiac atrophy, or decrease in the size of the heart muscle, associated with long-duration space flight. This experiment also will identify the mechanisms of this atrophy and the functional consequences for crewmembers who will spend extended periods of time in space.		Benjamin D. Levine, M.D., Institute for Exercise and Environmental Medicine, Presbyterian Hospital and University of Texas Southwestern Medical Center at Dallas Michael W. Bungo, M.D., University of Texas Medical School, Houston	ISS	
Integrated Immune	Validation of Procedures for Monitoring Crewmember Immune Function	NASA	Human Research	Validation of Procedures for Monitoring Crew Member Immune Function (Integrated Immune) will assess the clinical risks resulting from the adverse effects of spaceflight on the human immune system and will validate a flight-compatible immune monitoring strategy. Researchers will collect and analyze blood, urine and saliva samples from crewmembers before, during and after space flight to monitor changes in the immune system. Changes in the immune system will be monitored by collecting and analyzing blood and saliva samples from crewmembers during flight and blood, urine, and saliva samples before and after flight.		Clarence Sams, Ph.D, Johnson Space Center, Houston	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Kids In Micro-g	Kids In Micro-gravity!	NASA	Educational Activities	Kids In Micro-gravity! (Kids in Micro-g) is a student experiment design challenge geared toward grades 5 - 8. Its purpose is to give students a hands-on opportunity to design an experiment or simple demonstration that could be performed both in the classroom and aboard the International Space Station.		Mark Severance, Johnson Space Center, Houston	ISS	
MAMS	Microgravity Acceleration Measurement System	NASA	Technology	Microgravity Acceleration Measurement System (MAMS) is an ongoing study of the small forces, or vibrations and accelerations, on the station that result from the operation of hardware, crew activities, as well as dockings and maneuvering. Results will be used to generalize the types of vibrations affecting vibration-sensitive experiments. Investigators seek to better understand the vibration environment on the space station to enable future research.		William Foster, Glenn Research Center, Cleveland	ISS	
MAUI	Maui Analysis of Upper Atmospheric Injections	NASA	Technology	Maui Analysis of Upper Atmospheric Injections (MAUI) will observe the Space Shuttle engine exhaust plumes from the Maui Space Surveillance Site in Hawaii. The observations will occur when the space shuttle fires its engines at night or twilight. A telescope and all-sky imagers will take images and data while the space shuttle flies over the Maui site. The images will be analyzed to better understand the interaction between the spacecraft plume and the upper atmosphere of Earth.		Rainer A. Dressler, Ph.D., Hanscom Air Force Base, Lexington, Mass.	Sortie	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
MDCA-FLEX	Multi-User Droplet Combustion Apparatus – Flame Extinguishment Experiment	NASA	Technology	Multi-User Droplet Combustion Apparatus – FLame Extinguishment Experiment (MDCA-FLEX) will assess the effectiveness of fire suppressants in microgravity and quantify the effect of different possible crew exploration atmospheres on fire suppression. The goal of this research is to provide definition and direction for large scale fire suppression tests and selection of the fire suppressant for next generation crew exploration vehicles.		Forman A. Williams, University of California, San Diego	ISS	
MDCA-FLEX-2	Multi-User Droplet Combustion Apparatus – Flame Extinguishment Experiment – 2	NASA	Technology	Multi-User Droplet Combustion Apparatus – FLame Extinguishment Experiment – 2 (MDCA-FLEX-2) will assess the effectiveness of fire suppressants in microgravity and quantify the effect of different possible crew exploration atmospheres on fire suppression. The goal of this research is to provide definition and direction for large scale fire suppression tests and selection of the fire suppressant for next generation crew exploration vehicles.		Forman A. Williams, University of California, San Diego	ISS	
MISSE-7	Materials International Space Station Experiment – 7	NASA	Physical and Materials Science	The Materials International Space Station Experiment-7 (MISSE-7) is a test bed for materials and coatings attached to the outside of the International Space Station being evaluated for the effects of atomic oxygen, ultraviolet, direct sunlight, radiation and extremes of heat and cold. This experiment allows the development and testing of new materials to better withstand the rigors of space environment. Results will provide a better understanding of the durability of various materials when they are exposed to the space environment with applications in the design of future spacecraft.		Robert Walters, Ph.D., Naval Research Laboratory, Washington	ISS	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
MISSE-8	Materials International Space Station Experiment – 8	NASA	Physical and Materials Science	The Materials on International Space Station Experiment – 8 (MISSE-8) is a test bed for materials and computing elements attached to the outside of the International Space Station. These materials and computing elements are being evaluated for the effects of atomic oxygen, ultraviolet, direct sunlight, radiation and extremes of heat and cold. This experiment allows the development and testing of new materials and computing elements that can better withstand the rigors of space environments. Results will provide a better understanding of the durability of various materials and computing elements when they are exposed to the space environment, with applications in the design of future spacecraft.		Robert Walters, Ph.D., Naval Research Laboratory, Washington Phillip Jenkins, Naval Research Laboratory, Washington	ISS	
Micro-2	Microbiology – 2	NASA	Biology and Biotechnology	Microbiology – 2 (Micro-2) is a fundamental biology experiment and will expand our understanding of the fundamental basis of how spaceflight affects the biological and molecular functions of the cell and the molecular mechanisms by which cells and tissues respond to spaceflight conditions.			ISS	
Mouse Immunology	Mouse Immunology	NASA	Biology and Biotechnology	Mouse Immunology will expand the knowledge base of the effects of space environment on mammalian immunology and provide fundamental knowledge for current applications that form a foundation for future long-duration space exploration missions.		Paula Dumars, Ames Research Center, Moffett Field, Calif.	Sortie	

International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
MSL-CETSOL and MICAST	Materials Science Laboratory – Columnar-to-Equiaxed Transition in Solidification Processing and Microstructure Formation in Casting of Technical Alloys under Diffusive and Magnetically Controlled Convective Conditions	NASA	Physical and Materials Science	The Materials Science Laboratory – Columnar-to-Equiaxed Transition in Solidification Processing and Microstructure Formation in Casting of Technical Alloys under Diffusive and Magnetically Controlled Convective Conditions (MSL-CETSOL and MICAST) are two investigations that support research into metallurgical solidification, semiconductor crystal growth (Bridgman and zone melting), and measurement of thermo-physical properties of materials. This is a cooperative investigation with the European Space Agency and NASA for accommodation and operation aboard the International Space Station.		Charles-Andre Gandin, Ph.D., Ecole de Mines de Paris, ARMINES-CEMEF, Sophia Antipolis, France (CETSOL) Lorenz Ratke, Prof., German Aerospace Center, Cologne, Germany (MICAST)	ISS	
NLP-Cells-4	National Laboratory Pathfinder – Cells – 4	NASA	Biology and Biotechnology	National Lab Pathfinder – Cells – 4 (NLP-Cells-4) is a commercial payload serving as a pathfinder for the use of the International Space Station as a National Laboratory after station assembly is complete. It contains several different experiments that examine cellular replication and differentiation of cells. This research is investigating the use of spaceflight to enhance or improve cellular growth processes used in ground based research.			Sortie	
NLP-Cells-5	National Laboratory Pathfinder – Cells – 5	NASA	Biology and Biotechnology	National Lab Pathfinder – Cells – 5 (NLP-Cells-5) is a commercial payload serving as a pathfinder for the use of the International Space Station as a National Laboratory after station assembly is complete. It contains several different experiments that examine cellular replication and differentiation of cells. This research is investigating the use of spaceflight to enhance or improve cellular growth processes used in ground based research.			Sortie	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
NLP-Vaccine-8	National Laboratory Pathfinder – Vaccine – 8	NASA	Biology and Biotechnology	National Lab Pathfinder – Vaccine – 8 (NLP-Vaccine-8) is a commercial payload serving as a pathfinder for the use of the International Space Station as a National Laboratory after station assembly is complete. It contains several different pathogenic, or disease causing, organisms. This research is investigating the use of spaceflight to develop potential vaccines for the prevention of different infections caused by these pathogens on Earth and in microgravity.		Timothy Hammond, M.B.B.S., Durham Veterans Affairs Medical Center, Durham, N.C.	Sortie	
NLP-Vaccine-9	National Laboratory Pathfinder – Vaccine – 9	NASA	Biology and Biotechnology	National Lab Pathfinder – Vaccine – 9 (NLP-Vaccine-9) is a commercial payload serving as a pathfinder for the use of the International Space Station as a National Laboratory after station assembly is complete. It contains several different pathogenic, or disease causing, organisms. This research is investigating the use of spaceflight to develop potential vaccines for the prevention of different infections caused by these pathogens on Earth and in microgravity.		Timothy Hammond, M.B.B.S., Durham Veterans Affairs Medical Center, Durham, N.C.	Sortie	
NLP-Vaccine-10	National Laboratory Pathfinder – Vaccine – 10	NASA	Biology and Biotechnology	National Lab Pathfinder – Vaccine – 10 (NLP-Vaccine-10) is a commercial payload serving as a pathfinder for the use of the International Space Station as a National Laboratory after station assembly is complete. It contains several different pathogenic, or disease causing, organisms. This research is investigating the use of spaceflight to develop potential vaccines for the prevention of different infections caused by these pathogens on Earth and in microgravity.		Timothy Hammond, M.B.B.S., Durham Veterans Affairs Medical Center, Durham, N.C.	Sortie	

International Space Station Experiments – Expedition 21 and 22 (continued)

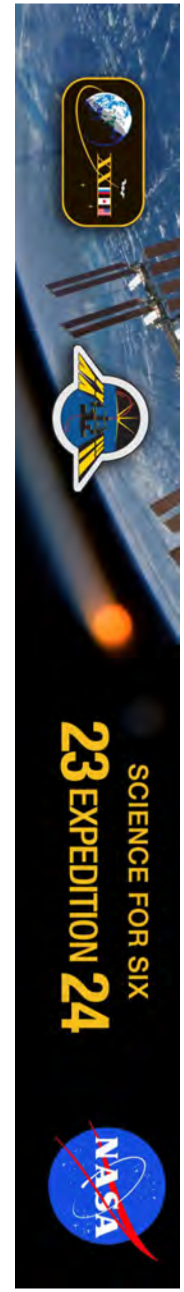
Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Nutrition	Nutritional Status Assessment	NASA	Human Research	Nutritional Status Assessment (Nutrition) is a comprehensive in-flight study to understand changes in human physiology during long-duration space flight. This study includes measures of bone metabolism, oxidative damage and chemistry and hormonal changes, as well as assessments of the nutritional status of the astronauts participating in the study. The results will have an impact on the definition of nutritional requirements and development of food systems for future exploration missions. This experiment also will help researchers understand the effectiveness of measures taken to counteract the effects of spaceflight, as well as the impact of exercise and pharmaceutical countermeasures on nutritional status and nutrient requirements for astronauts.		Scott M. Smith, Ph.D., Johnson Space Center, Houston, TX	ISS	
PACE	Preliminary Advanced Colloids Experiment	NASA	Physical and Materials Science	Preliminary Advanced Colloids Experiment (PACE) will characterize the capability of conducting high magnification colloid experiments with the Light Microscopy Module (LMM) to determine the minimum size particles which can be resolved.		William V. Meyer, Ph.D., Glenn Research Center, Cleveland	ISS	
Pro K	Dietary Intake Can Predict and Protect Against Changes in Bone Metabolism during Spaceflight and Recovery	NASA	Human Research	The Dietary Intake Can Predict and Protect Against Changes in Bone Metabolism during Spaceflight and Recovery (Pro K) investigation is NASAs first evaluation of a dietary countermeasure to lessen bone loss of astronauts. Pro K proposes that a flight diet with a decreased ratio of animal protein to potassium will lead to decreased loss of bone mineral. Pro K will have an impact on the definition of nutritional requirements and development of food systems for future exploration missions, and could yield a method of counteracting bone loss that would have virtually no risk of side effects.		Scott M. Smith, Ph.D., Johnson Space Center, Houston	ISS	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Reaction Self Test	Psychomotor Vigilance Self Test on the International Space Station	NASA	Human Research	The Psychomotor Vigilance Self Test on the International Space Station (Reaction Self Test) is a portable 5-minute reaction time task that will allow the crewmembers to monitor the daily effects of fatigue on performance while on board the International Space Station.		David F. Dinges, Ph.D., University of Pennsylvania School of Medicine, Philadelphia	ISS	
Repository	National Aeronautics and Space Administration Biological Specimen Repository	NASA	Human Research	The National Aeronautics and Space Administration Biological Specimen Repository (Repository) is a storage bank that is used to maintain biological specimens over extended periods of time and under well-controlled conditions. Biological samples from the International Space Station, including blood and urine, will be collected, processed and archived during the preflight, inflight and postflight phases of station missions. This investigation has been developed to archive biosamples for use as a resource for future spaceflight related research.		Kathleen A. McMonigal, M.D., Johnson Space Center, Houston	ISS	
SAME	Smoke and Aerosol Measurement Experiment	NASA	Technology	Smoke and Aerosol Measurement Experiment (SAME) measures smoke properties, or particle size distribution, of typical particles from spacecraft fire smokes to provide data to support requirements for smoke detection in space and identify ways to improve smoke detectors on future spacecraft.		David Urban, Ph.D., Glenn Research Center, Cleveland	ISS	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
SAMS-II	Space Acceleration Measurement System-II	NASA	Technology	Space Acceleration Measurement System (SAMS-II) is an ongoing study of the small forces, or vibrations and accelerations, on the station that result from the operation of hardware, crew activities, as well as dockings and maneuvering. Results will be used to generalize the types of vibrations affecting vibration-sensitive experiments. Investigators seek to better understand the vibration environment on the space station to enable future research.		William Foster, Glenn Research Center, Cleveland	ISS	
SEITE	Shuttle Exhaust Ion Turbulence Experiments	NASA	Technology	Shuttle Exhaust Ion Turbulence Experiments (SEITE) will use space-based sensors to detect the ionospheric turbulence inferred from the radar observations from a previous Space Shuttle Orbital Maneuvering System (OMS) burn experiment using ground-based radar.		Paul A. Bernhardt, Ph.D., Naval Research Laboratory, Washington	Sortie	
SIMPLEX	Shuttle Ionospheric Modification with Pulsed Localized Exhaust Experiments	NASA	Technology	The Shuttle Ionospheric Modification with Pulsed Localized Exhaust Experiments (SIMPLEX) will investigate plasma turbulence driven by rocket exhaust in the ionosphere using ground-based radars.		Paul A. Bernhardt, Ph.D., Naval Research Lab, Washington	Sortie	
SNFM	Serial Network Flow Monitor	NASA	Technology	Using a commercial software CD, Serial Network Flow Monitor (SNFM) monitors the payload local area network (LAN) to analyze and troubleshoot LAN data traffic. Validating LAN traffic models may allow for faster and more reliable computer networks to sustain systems and science on future space missions.		Carl Konkel, Boeing, Houston	ISS	



International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
SODI-Colloid	Selectable Optical Diagnostics Instrument – Aggregation of Colloidal Solutions	NASA	Physical and Materials Science	Selectable Optical Diagnostics Instrument – Aggregation of Colloidal Suspensions (SODI-Colloid) will study the aggregation, or mass, phenomena of colloids in the microgravity environment onboard the International Space Station.		Gerard Wegdam, Professor, Van der Waals-Zeeman Institute, University of Amsterdam, Amsterdam, The Netherlands	ISS	
SPHERES	Synchronized Position Hold, Engage, Reorient, Experimental Satellites	NASA	Technology	Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES) are bowling-ball sized spherical satellites. They will be used inside the space station to test a set of well-defined instructions for spacecraft performing autonomous rendezvous and docking maneuvers. Three free-flying spheres will fly within the cabin of the space station, performing flight formations. Each satellite is self-contained with power, propulsion, computers and navigation equipment. The results are important for satellite servicing, vehicle assembly and formation flying spacecraft configurations.		David W. Miller, Ph.D., Massachusetts Institute of Technology, Cambridge, Mass.	ISS	
STL	Space Tissue Loss	NASA	Biology and Biotechnology	Space Tissue Loss (STL) advances research objectives for U.S. Army s Combat Casualty Care Research Program by defining cellular effects and growth characteristics in microgravity for immune system modulation, shock response abatement and directed tissue regeneration.		F. Pearce, Walter Reed Army Institute of Research, Silver Spring, Md.	Sortie	
STP-H3-Canary	Space Test Program – Houston 3 – Canary	NASA	Technology	Space Test Program – Houston 3 – Canary (STP-H3-Canary) is one of four individual experiments that will test concepts in low Earth orbit for long-duration spaceflight. This experiment investigates the interaction of ions with the background plasma environment around the station.		Geoff Mcharg, Ph.D., United States Air Force Academy, Colorado Springs, Colo.	ISS	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
STP-H3-DISC	Space Test Program – Houston 3 – Digital Imaging Star Camera	NASA	Technology	Space Test Program – Houston 3 – Digital Imaging Star Camera (STP-H3-DISC) is one of four individual experiments that will test concepts in low Earth orbit for long-duration spaceflight. This experiment is a low size, weight and power sensor used for pointing knowledge of 0.02 degree or greater.		Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio Geoff Mcharg, Ph.D., US Air Force Academy, Colo. Andrew Nicholas, Naval Research Laboratory, Washington	ISS	
STP-H3-MHTEX	Space Test Program – Houston 3 – Massive Heat Transfer Experiment	NASA	Technology	Space Test Program – Houston 3 – Massive Heat Transfer Experiment (STP-H3-MHTEX) is one of four individual experiments that will test concepts in LEO for long-duration spaceflight. This experiment plans to achieve flight qualification of an advanced capillary pumped loop system.		Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio Andrew Nicholas, Naval Research Laboratory, Washington Geoff Mcharg, Ph.D., US Air Force Academy, Colo.	ISS	

International Space Station Experiments – Expedition 21 and 22 (continued)

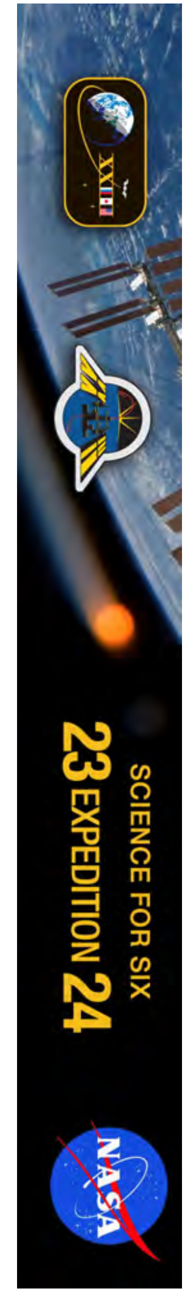
Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
STP-H3-VADER	Space Test Program – Houston 3 – Variable Emissivity Radiator Aerogel Insulation Blanket Dual zone thermal control Experiment suite for Responsive space	NASA	Technology	Space Test Program – Houston 3 – Variable Emissivity Radiator Aerogel Insulation Blanket Dual zone thermal control Experiment suite for Responsive space (STP-H3-VADER) is one of four individual experiments that will test a robust, reconfigurable thermal control system applicable to a wide range of missions and satellite classes. It will also test a new form of MLI protection using Aerogel material as the thermal isolator.		Andrew Williams, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio Andrew Nicholas, Naval Research Laboratory, Washington Geoff Mcharg, Ph.D., US Air Force Academy, Colo.	ISS	
SWAB	Surface, Water and Air Biocharacterization - A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft Environment	NASA	Biology and Biotechnology	A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft (SWAB) will use advanced molecular techniques to comprehensively evaluate microbes on board the space station, including pathogens. It also will track changes in the microbial community as spacecraft visit the station and new station modules are added. This study will allow an assessment of the risk of microbes to the crew and the spacecraft.		Duane L. Pierson, Ph.D., Johnson Space Center, Houston	ISS	
Sleep-Long	Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Long	NASA	Human Research	Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Long (Sleep-Long) will examine the effects of spaceflight and ambient light exposure on the sleep-wake cycles of the crewmembers during long-duration stays on the space station.		Charles A. Czeisler, M.D., Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston Laura K. Barger, Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston	ISS	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
Sleep-Short	Sleep-Wake Actigraphy and Light Exposure During Spaceflight-Short	NASA	Human Research	Sleep-Wake Actigraphy and Light Exposure During Spaceflight - Short (Sleep-Short) will examine the effects of spaceflight on the sleep of the astronauts during space shuttle missions. Advancing state-of-the-art technology for monitoring, diagnosing and assessing treatment of sleep patterns is vital to treating insomnia on Earth and in space.		Charles A. Czeisler, M.D., Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston Laura K. Barger, Ph.D., Brigham and Women's Hospital, Harvard Medical School, Boston	Sortie	
SpaceDRUMS	Space-Dynamically Responding Ultrasonic Matrix System	NASA	Physical and Materials Science	Space Dynamically Responding Ultrasonic Matrix System (SpaceDRUMS) comprises a suite of hardware that enables containerless processing. Using a collection of 20 acoustic beam emitters, SpaceDRUMS can completely suspend a baseball-sized solid or liquid sample during combustion or heat-based synthesis. Because the samples never contact the container walls, materials can be produced in microgravity with an unparalleled quality of shape and composition. The ultimate goal of the SpaceDRUMS hardware is to assist with the development of advanced materials of a commercial quantity and quality, using the space-based experiments to guide development of manufacturing processes on Earth.		Jacques Guigne, Ph.D.,Guigne Space Systems, Incorporated, Paradise, Newfoundland, Canada Hu Chun Yi, Ph.D., Guigne Space Systems, Incorporated, Huntsville, AL	ISS	
Spinal Elongation	Spinal Elongation and its Effects on Seated Height in a Microgravity Environment	NASA	Human Research	The purpose of the Spinal Elongation and its Effects on Seated Height in a Microgravity Environment (Spinal Elongation) study is to provide quantitative data as to the amount of change that occurs in the seated height due to spinal elongation in microgravity.		Sudhakar Rajulu, Ph.D., Johnson Space Center, Houston	Sortie	

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
TAGES	Transgenic *Arabidopsis* Gene Expression System	NASA	Biology and Biotechnology	Transgenic Arabidopsis Gene Expression System (TAGES) investigation is one in a pair of investigations that use the Advanced Biological Research System (ABRS) facility. TAGES uses Arabidopsis thaliana, thale cress, with sensor promoter-reporter gene constructs that render the plants as biomonitors, or an organism used to determine the quality of the surrounding environment, using real-time nondestructive Green Fluorescent Protein imagery and traditional postflight analyses.		Robert Ferl, Ph.D., University of Florida, Gainesville, Fla. Anna-Lisa Paul, Ph.D., University of Florida, Gainesville, Fla.	ISS	
Tropi	Analysis of a Novel Sensory Mechanism in Root Phototropism	NASA	Biology and Biotechnology	Analysis of a Novel Sensory Mechanism in Root Phototropism (Tropi) studies *Arabidopsis thaliana* plants sprouting from seeds to gain insights into sustainable agriculture for future long-duration space missions.		John Kiss, Ph.D., Miami University, Oxford, Ohio	ISS	
VCAM	Vehicle Cabin Atmosphere Monitor	NASA	Technology	Vehicle Cabin Atmosphere Monitor (VCAM) identifies gases that are present in minute quantities in the International Space Station breathing air that could harm the crew's health. If successful, instruments like VCAM could accompany crewmembers during long-duration exploration missions.		Ara Chutjian, Ph.D., California Institute of Technology, Pasadena, CA and Jet Propulsion Laboratory, Pasadena, Calif.	ISS	
VO2max	Evaluation of Maximal Oxygen Uptake and Submaximal Estimates of VO_2max Before, During, and After Long Duration International Space Station Missions	NASA	Human Research	Evaluation of Maximal Oxygen Uptake and Submaximal Estimates of VO2max Before, During, and After Long Duration International Space Station Missions (VO2max) documents changes in maximum oxygen uptake for crewmembers onboard the station on long-duration missions.		Alan D. Moore, Jr., Ph.D., Johnson Space Center, Houston	ISS	



International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
RAMBO-2	Ram Burn Observations – 2	NASA	Technology	Ram Burn Observations – 2 (RAMBO-2) is an experiment in which the Department of Defense uses a satellite to observe space shuttle orbital maneuvering system engine burns. Its purpose is to improve plume models, which predict the direction the plume, or rising column of exhaust, will move as the shuttle maneuvers on orbit. Understanding the direction in which the spacecraft engine plume, or exhaust flows could be significant to the safe arrival and departure of spacecraft on current and future exploration missions.		William L. Dimpfl, Ph.D., Aerospace Corporation, Los Angeles	Sortie	
ТХН-9	Kristallizator (Crystallizer)	RSA	Physico-chemical processes and material in condition of cosmos	Biological macromolecules crystallization and obtaining bio-crystal films under microgravity conditions.	JAXA PCG	NA	ISS	Klibo
КПТ-21 (ТЕХ-20)	Plazmennyi Kristall (Plasma Crystal)	RSA	Physico-chemical processes and material in condition of cosmos	Study of the plasma-dust crystals and fluids under microgravity.	"PC-3 Plus" experimental unit	NA	ISS	MRM2
ГФИ-1	Relaksatsiya	RSA	Geophysics and located beside land outer space	Study of chemiluminescent chemical reactions and atmospheric light phenomena that occur during high-velocity interaction between the exhaust products from spacecraft propulsion systems and the Earth atmosphere at orbital altitudes and during the entry of space vehicles into the Earth upper atmosphere.	"Fialka-MB-Kosmos" - Spectrozonal ultraviolet system	NA	ISS	NA
ГФИ-8	Uragan	RSA	Geophysics and located beside land outer space	Experimental verification of the ground and space-based system for predicting natural and man-made disasters, mitigating the damage caused, and facilitating recovery.	Fotospektralinaya system	NA	ISS	NA
ГФИ-12	Impulse (Pulse)	RSA	Geophysics and located beside land outer space	Ionospheric sounding by pulsed plasma sources.	IPI-SM	NA	ISS	Unattended

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International Space Station Experiments – Expedition 23 and 24 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
ГФИ-16	Vsplesk (Burst)	RSA	Geophysics and located beside land outer space	Seismic effects monitoring. Researching high-energy particles streams in near-Earth space environment.	"Vsplesk" hardware	NA	ISS	Unattended
МБИ-12	Sonokard	RSA	Biomedical studies	Integrated study of physiological functions during sleep period throughout a long space flight.	Sonokard	NA	ISS	NA
МБИ-15	Pilot	RSA	Biomedical studies	Researching for individual features of state psychophysiological regulation and crewmembers professional activities during long space flights.	Sonokard	NA	ISS	NA
МБИ-16	Vzaimodeistvie (Interaction)	RSA	Biomedical studies	Monitoring of the group crew activities under space flight conditions.	Neyrolab-M	NA	ISS	NA
МБИ-18	Dykhanie	RSA	Biomedical studies	Study of respiration regulation and biomechanics under space flight conditions.	Dykhanie-1	NA	ISS	NA
МБИ-20	Tipologia	RSA	Biomedical studies	Researching for typological features of the activities of the ISS crews as operators activities in long term space flight phases.	Tipologia kit	NA	ISS	NA
МБИ-21	Pneumocard	RSA	Biomedical studies	Study of space flight factors impacts on vegetative regulation of blood circulation, respiration and contractile heart function during long space flights.	Pneumocard kit	NA	ISS	NA
БИО-1	Poligen	RSA	Biomedical studies	Detection of genotypic features (experimental object – Drozophila midge), determining individual characteristics of resistance to the long-duration flight factors.	Drozophila-2 kit	NA	ISS	NA
БИО-2	Biorisk	RSA	Biomedical studies	Study of space flight impact on microorganisms-substrates systems state related to space technique ecological safety and planetary quarantine problem.	Biorisk-KM kit	NA	ISS	NA
Д33-12	Rusalka	RSA	Remote flexing the Land	Testing of the procedure to determine the carbon dioxide and methane content in the Earth atmosphere to understand a role of natural processes in human activity.	Rusalka kit	NA	ISS	NA

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
ДЗЗ-13	Seyener	RSA	Remote flexing the Land	Experimental methodses of the interaction of the crews to cosmic station with court Fishing in process of searching for and mastering commercial-productive region of the World ocean.	Camera	NA	ISS	NA
КПТ-3	Econ	RSA	Remote flexing the Land	Experimental researching of ISS RS resources estimating for ecological investigation of areas.	Econ kit	NA	ISS	NA
ИКЛ-2В	BTN-Neutron	RSA	Study of the Solar system	Study of fast and thermal neutrons fluxes.	Detection Block Electronic Equipment Block Mechanical interface	NA	ISS	Unattended
БТХ-5	Laktolen	RSA	Cosmic biotechnology	Effect produced by space flight factors on Laktolen producing strain.	Bioekologiya kit	NA	ISS	NA
БТХ-6	ARIL	RSA	Cosmic biotechnology	Effect produced by SFFs on expression of strains producing interleukins 1α, 1β, "ARIL."	Bioekologiya kit	NA	ISS	NA
БТХ-7	OChB	RSA	Cosmic biotechnology	Effect produced by SFFs on strain producing superoxidodismutase (SOD).	Bioekologiya kit	NA	ISS	NA
БТХ-8	Biotrack	RSA	Cosmic biotechnology	Study of space radiation heavy charged particles fluxes influence on genetic properties of bioactive substances cells-producers.	Bioekologiya kit	NA	ISS	NA
БТХ-10	Kon'yugatsiya (Conjugation)	RSA	Cosmic biotechnology	Working through the process of genetic material transmission using bacteria conjugation method.	Rekomb-K	NA	ISS	NA
БТХ-11	Biodegradatsiya	RSA	Cosmic biotechnology	Assessment of the initial stages of biodegradation and biodeterioration of the surfaces of structural materials.	Bioproby kit	NA	ISS	NA
БТХ-14	Bioemulsiya (Bioemulsion)	RSA	Cosmic biotechnology	Study and improvement of closed-type autonomous reactor for obtaining biomass of microorganisms and bioactive substance without additional ingredients input and metabolism products removal.	Biocont-T thermo-vacuum container	NA	ISS	NA
БТХ-26	Cascad (cascade)	RSA	Cosmic biotechnology	Study of various types cells cultivation processes.	Changeable bioreactor	NA	ISS	NA

International Space Station Experiments – Expedition 21 and 22 (continued)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
БТХ-27	Astrovaktsina (astrovaccine)	RSA	Cosmic biotechnology	Cultivation of E.Coli-protein Caf1 producer in zero-g.	Bioecologia kit	NA	ISS	NA
БТХ-35	Membrane	RSA	Cosmic biotechnology	Study of the possibility of the reception in principal new пористых material with regular structure for use as filter and membrane.	Membrane kit	NA	ISS	MRM2
БТХ-39	Asepsises	RSA	Cosmic biotechnology	Development of the methods and on-board technical facilities of the ensuring the aseptic conditions of the undertaking BTH - an experiment in condition of the space flight.	Asepsises kit	NA	ISS	MRM1
БТХ-40	BIF (bifidobacterias)	RSA	Cosmic biotechnology	Study of the influence factor space flight on technological and биомедицинские of the feature bifidobacterias.	Bioecologia kit	NA	ISS	NA
БТХ-41	Bakteriofag	RSA	Cosmic biotechnology	Study of the influence factor space flight on bakteriofages.	Bioecologia kit	NA	ISS	NA
TEX-14 (SDTO 12002-R)	Vektor-T	RSA	Technical studies and experiments	Study of a high-precision system for ISS motion prediction.	Bioecologia kit	NA	ISS	Unattended
TEX-15 (SDTO 13002-R)	Izgib	RSA	Technical studies and experiments	Study of the relationship between the onboard systems operating modes and ISS flight conditions.	Russian motion control and navigation system sensors	NA	ISS	NA
TEX-22 (SDTO 13001-R)	Identifikatsiya	RSA	Technical studies and experiments	Identification of disturbance sources when the microgravity conditions on the ISS are disrupted.	Russian accelerometers	NA	ISS	NA
TEX-38	Veterok	RSA	Technical studies and experiments	Otrabotka new technology to optimize gas ambience in inhabited compartment ISS RS.	Ventilator-degogger	NA	ISS	NA
TEX-44	Sreda-ISS (Environment)	RSA	Technical studies and experiments	Studying ISS characteristics as researching environment.	Movement control system sensors	NA	ISS	Unattended
TEX-50	Contur (Sidebar)	RSA	Technical studies and experiments	Development of the methods of management through Internet robot-manipulator on ISS.	Rokviss hardware Universal Working Place УРМ-Д	NA	ISS	Unattended
КПТ-2	Bar	RSA	Technical studies and experiments	Testing of principles and methods for the Space Station leak area control, selection of the sensor design and configuration.	Bar hardware	NA	ISS	NA

International Space Station Experiments – Expedition 21 and 22 (concluded)

Acronym	Title	Agency	Category	Summary	Facility	Principal Investigator	ISS/ Sortie	Ops Location
РБО-3	Matryeshka-R	RSA	Study of the physical conditions in outer spaces on orbit ISS	Study of radiation environment dynamics along the ISS RS flight path and in ISS compartments, and dose accumulation in anthropomorphous phantom, located inside and outside ISS.	Phantom and bubble dosimeter passive detectors unit	NA	ISS	NA
ОБР-3	MAI-75	RSA	Formation and popularization cosmic studies	Spacecraft and up-to-date technologies for personal communications.	Digital photo and video equipment and amateur radio communicatio n system	NA	ISS	NA
КПТ-10	Kulonovskiy crystal	RSA	Formation and popularization cosmic studies	System speaker Study of the charged particles in magnetic field in condition the microgravity.	KUC hardware	NA	SS	MRM2
КНТ-36	EXPOSE-R	RSA	Commercial	Exposure of material samples in open space conditions to study the effect of ultraviolet radiation on them.	EXPOSE-R monoblock accessories kit	NA	ISS	NA

Digital NASA Television

NASA Television can be seen in the continental United States on AMC-6, at 72 degrees west longitude, Transponder 17C, 4040 MHz, vertical polarization, FEC 3/4, Data Rate 36.860 MHz, Symbol 26.665 Ms, Transmission DVB. If you live in Alaska or Hawaii, NASA TV can now be seen on AMC-7, at 137 degrees west longitude, Transponder 18C, at 4060 MHz, vertical polarization, FEC 3/4, Data Rate 36.860 MHz, Symbol 26.665 Ms, Transmission DVB.

Digital NASA TV system provides higher quality images and better use of satellite bandwidth, meaning multiple channels from multiple NASA program sources at the same time.

Digital NASA TV has four digital channels:

1. NASA Public Service ("Free to Air"), featuring documentaries, archival programming, and coverage of NASA missions and events.
2. NASA Education Services ("Free to Air/Addressable"), dedicated to providing educational programming to schools, educational institutions and museums.
3. NASA Media Services ("Addressable"), for broadcast news organizations.
4. NASA Mission Operations (Internal Only).

Note: Digital NASA TV channels may not always have programming on every channel simultaneously.

Internet Information

Information is available through several sources on the Internet. The primary source for mission information is the NASA Human Space Flight Web, part of the World Wide Web. This site contains information on the crew and its mission and will be updated regularly with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

http://spaceflight.nasa.gov

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

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