

**Mission Overview**

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In February 2008, the European Columbus laboratory will be launched and become an integral part of the International Space Station (ISS), bringing years of organisation and hard work to fruition. With a projected 10 years in orbit, it will create space history as the first European laboratory dedicated to long-term experimentation in weightlessness.



Launch of STS-121 Shuttle Discovery on 4 July 2006. ESA astronaut Thomas Reiter was a member of the crew and became the first European member of an Expedition Crew after arrival at the ISS. (Image: NASA)

ESA astronauts Léopold Eyharts from France and Hans Schlegel from Germany will be crewmembers on the Columbus assembly and commissioning mission. They are scheduled to be launched on Space Shuttle Atlantis in February 2008 on Shuttle flight STS-122 from the Kennedy Space Center in Florida, USA, as part of a 7-man crew together with five NASA colleagues.

The Columbus mission consists of different parts. The first part during the 11-day STS-122 flight (also known to the ISS partners as the 1E assembly mission) will attach the European laboratory to the ISS, and thereafter activate, and begin commissioning of the laboratory. This includes the attachment of European external experiment facilities during the third mission spacewalk and

additional assembly/maintenance tasks. The Columbus mission will continue after undocking of the Shuttle with Léopold Eyharts remaining on the Station for 7-8 weeks as an ISS Expedition Crewmember. He will continue with Columbus commissioning activities, completing the activation of the internal experiment facilities as well as undertaking European scientific, public relations and educational activities and additional activities in his role as ISS Flight Engineer 2. Schlegel will also be undertaking European science and public relations activities as part of the Columbus mission.



ESA astronauts Hans Schlegel (left) and Léopold Eyharts in launch and entry suits during training session at the Johnson Space Center in May 2007 (Image: NASA)

The major activities of the Columbus mission are as follows:

**Columbus laboratory installation**

The Columbus Laboratory will provide a shirt-sleeve environment in which astronauts can undertake experiment procedures using a variety



European Columbus laboratory being lowered onto a work stand in the Space Station Processing Facility at the Kennedy Space Center in June 2006 (Image: NASA)

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of experiment facilities covering a wide range of scientific disciplines. It will be attached to the European-built Node 2, which was docked to the ISS during the STS-120 mission in October 2007.



ESA astronaut Paolo Nespoli floating inside the European-built Node 2 (onto which the Columbus laboratory will be attached), on the International Space Station on 31 Oct. 2007 (Image: NASA)

Columbus will be transported to the Station in the Shuttle's cargo bay. It will be installed on Flight day 4 during the first mission EVA or spacewalk with ESA astronaut Hans Schlegel as one of the two spacewalking astronauts along with NASA astronaut Rex Walheim. Much of the time of the first spacewalk will be spent preparing Columbus in the Shuttle's cargo bay and thereafter unberthing it. The Station's robotic arm will then move the laboratory to its permanent location on the ISS on the starboard or right-hand side of Node 2.



The US Destiny laboratory being moved by robotic arm from Shuttle Atlantis' cargo bay during the STS-98 mission in February 2001 (Image: NASA)

**Columbus activation and commissioning of experiment facilities and systems**

Once Columbus is attached, Schlegel and Eyharts will both be principal astronauts involved with activation and commissioning of the laboratory

along with different NASA colleagues. First the laboratory needs to be connected to the ISS systems for power data and thermal control. Once this is achieved and the pressurised laboratory entered for the first time, on-orbit activities will involve reconfiguring the internal facilities from the launch configuration to their on-orbit configuration. This includes removing launch brackets relocating experiment facilities, and connecting cables between the facilities and the relevant Columbus and ISS systems.



Biolab (A) and the Fluid Science Laboratory (B) integrated into the European Columbus laboratory at the Kennedy Space Center.

Commissioning the laboratory is a very complex task, not all of which will be carried out during the 11-day Shuttle mission. Léopold Eyharts, who will remain on the Station for three months, will continue commissioning activities in Columbus with members of the Expedition 16 crew. During these commissioning activities all the experiment facilities will become ready for use and the first run of experiments will take place in the Columbus laboratory. The experiment facilities inside Columbus are Biolab for biological experiments, the Fluid Science Laboratory for fluid science experiments, the European Physiology Modules facility for human physiology experiments and the European Drawer Rack, which is a multi-discipline facility for a range of smaller experiments.

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**Install European external payloads (EuTEF and SOLAR) on Columbus**

Two European external experiment facilities, EuTEF and SOLAR will be installed on the outside of the Columbus laboratory during the third EVA of the mission. ESA astronaut Léopold Eyharts will be operating the Station's robotic arm, transporting one of the spacewalking astronauts between the Shuttle cargo bay (where EuTEF and SOLAR are stowed) and the Columbus laboratory's External Payload Facility (where they will be installed). The spacewalking astronauts are Rex Walheim and Stanley Love, both representing NASA. EuTEF houses many different experiments including a variety of exobiology experiments. SOLAR will carry out an in-depth study of the Sun currently scheduled to last two years.



Artist's impression of the external experiment facilities EuTEF and SOLAR situated on Columbus (cutaway view)  
(Image: ESA/D. Ducros)

**Exchange NASA astronaut for an ESA astronaut as a member of the ISS Expedition crew:** ESA astronaut Léopold Eyharts will become the second ESA astronaut to become a member of an ISS long-term Expedition Crew when he arrives at the ISS on the STS-122 flight. In addition to his specific robotics and commissioning tasks in relation to the Columbus mission, he will be undertaking many vital tasks on the ISS that could cover the use of systems and procedures for: ISS guidance and control, environmental control and life support systems, crew health and safety, and EVA operations to name a few. He will remain on the ISS for approximately two months, flying back on the STS-123 flight in 2008.

Eyharts will replace NASA astronaut Dan Tani as ISS Expedition 16 Flight Engineer 2. Tani arrived at the ISS on board the STS-120 Shuttle Discovery mission, which was launched on 23

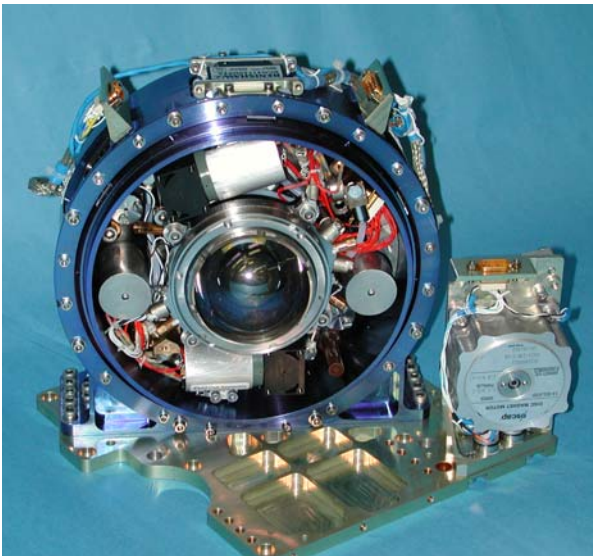
October and landed on 7 November. The STS-120 mission brought the European-built Node 2 to the Station and included ESA astronaut Paulo Nespoli as a crewmember. Tani will come back with the STS-122 crew on the return flight.



ESA astronaut Thomas Reiter, ESA's first long-duration astronaut on the ISS, working on the European Matroshka experiment hardware in December 2006 (Image: NASA)

**Undertake a European experiment programme**  
During their missions, Léopold Eyharts and Hans Schlegel will be undertaking a number of experiments for the European scientific community. This includes runs of the first experiments to be carried out in the experiment facilities in Columbus. Additional European experiments will be carried out by Russian cosmonaut Yuri Malenchenko. These experiments cover a wide range of areas. Those requiring the weightless environment inside the ISS will be in the areas of human physiology and biology, fluid science and radiation dosimetry. Those needing the exposure to the open space environment outside the ISS using the new external experiment payloads on Columbus will also be in a number of different scientific areas including exobiology, solar science and material science, in addition to various monitoring and sensor technologies.

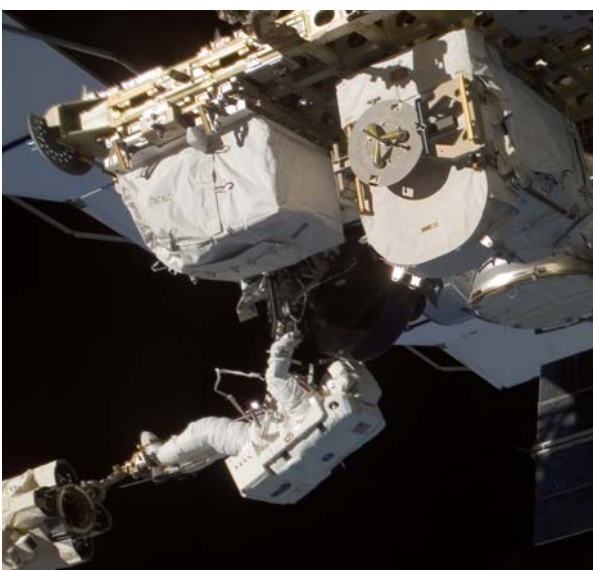
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The Fluid Cell Assembly of Geoflow, the core of the first experiment to take place in the Fluid Science Laboratory in Columbus. See experiment programme (Image: EADS Astrium)

ESA astronaut Léopold Eyharts will also carry out a number of educational activities during his mission.

**Remove and return Control Moment Gyroscope**  
During the third EVA or spacewalk a failed Control Moment Gyroscope temporarily situated on an External Stowage Platform will be removed and placed in the Shuttle's cargo bay for return to Earth. The Control Moment Gyroscopes are used to control the orbital orientation of the Space Station.



Canadian Space Agency astronaut Dave Williams installs failed Control Moment Gyroscope on External Stowage Platform 2 in August 2007 (Image: NASA)

**Remove and Replace Nitrogen Tank Assembly**  
During the second EVA or spacewalk of the mission, ESA astronaut Hans Schlegel and NASA astronaut Rex Walheim will remove and replace a Nitrogen Tank Assembly on the P1 truss section. This is an important piece of equipment that forms part of the external thermal control system of the ISS. The old Nitrogen tank Assembly will be placed in the Shuttle's cargo bay for return to earth.

**Delivery of Supplies/Equipment**  
As well as bringing some standard logistics supplies for the Shuttle and ISS Expedition Crews, the mission will also bring equipment to the ISS, which will be used, for example, to outfit Columbus (inside and outside) as well as additional equipment that will be installed during spacewalks. One additional piece of equipment that will be brought to the ISS will be the European Flywheel Exercise Device. This is a resistance exercise device that acts to countermeasure muscle atrophy, bone loss, and impairment of muscle function in astronauts.



Former ESA astronaut Philippe Perrin testing the Flywheel Exercise device the 35<sup>th</sup> parabolic flight campaign in October 2003 (Image: ESA)

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The STS-122 Atlantis crew. Front row : ESA astronaut Léopold Eyharts (centre) and NASA astronauts Stephen Frick, commander (left), and Alan Poindexter, pilot (right). Back row from left NASA astronauts Leland Melvin, Rex Walheim, Stanley Love and ESA astronaut Hans Schlegel (Image: NASA)

**The Crew**

ESA astronauts Léopold Eyharts and Hans Schlegel form part of a seven-member Shuttle crew along with NASA astronauts Stephen Frick (Shuttle commander), Alan Poindexter (pilot) and mission specialists Rex Walheim, Stanley Love and Leland Melvin. On the ISS when they arrive will be the Expedition 16 Crew: ISS Commander Peggy Whitson (NASA), and ISS Flight Engineers Yuri Malenchenko (Roscosmos) and Daniel Tani (NASA) who Léopold Eyharts will be replacing.

The Columbus mission is borne out of the ISS Intergovernmental Agreement in which Columbus formed a major contribution by ESA and an agreement between ESA and NASA whereby one ESA astronaut will be involved in the Columbus assembly mission and further that ESA can provide astronauts to be members of the ISS Expedition crews following attachment of Columbus to the Station.

## Mission Overview

### Key Mission Data

#### SHUTTLE CREW:

Shuttle Commander:	<b>Stephen Frick</b> (NASA)
Shuttle Pilot:	<b>Alan Poindexter</b> (NASA)
Mission Specialist:	<b>Hans Schlegel</b> (ESA)
Mission Specialist:	<b>Rex Walheim</b> (NASA)
Mission Specialist:	<b>Stanley Love</b> (NASA)
Mission Specialist:	<b>Leland Melvin</b> (NASA)
ISS Flight Engineer (Ascent):	<b>Léopold Eyharts</b> (ESA)
ISS Flight Engineer (Descent):	<b>Dan Tani</b> (NASA)

#### SPACECRAFT:

Shuttle Orbiter: **Atlantis**

#### MISSION:

European Mission Name:	<b>Columbus</b>
Shuttle Mission Designation:	<b>STS-122</b>
ISS Assembly Flight Designation:	<b>1E</b>
Primary Payload:	<b>Columbus</b>
Secondary Payloads:	<b>EuTEF, SOLAR, Nitrogen Tank Assembly</b>

#### LAUNCH and LANDING SITES:

Launch Site:	<b>Launch Pad 39A, Kennedy Space Center Florida, USA.</b>
Primary Landing Site:	<b>Kennedy Space Center, Florida, USA</b>
Secondary Landing Sites:	<b>Edwards Air Force Base, California, USA White Sands Space Harbor, New Mexico, USA</b>

#### MISSION PARAMETERS:

Scheduled Launch Date:	<b>7 February 2008</b>
Launch Window:	<b>10 minutes</b>
Altitude (In orbit):	<b>226 kilometres</b>
ISS Altitude:	<b>~400 kilometres</b>
Inclination:	<b>51.6°</b>
Mission Duration:	<b>11 days</b>

## Columbus Laboratory Logo



The Columbus Laboratory logo (Image: ESA/D. Ducros)

Columbus takes its name from the famous Genoan navigator Christopher Columbus who made the notable voyages to the Americas from 1492 to 1504. The lower half of the Columbus logo consists of a lighter blue circle symbolising the Earth surrounded by a darker blue ellipse signifying the initial orbit of the Shuttle transporting Columbus after launch. Above these the International Space Station is symbolised at its higher orbiting altitude.

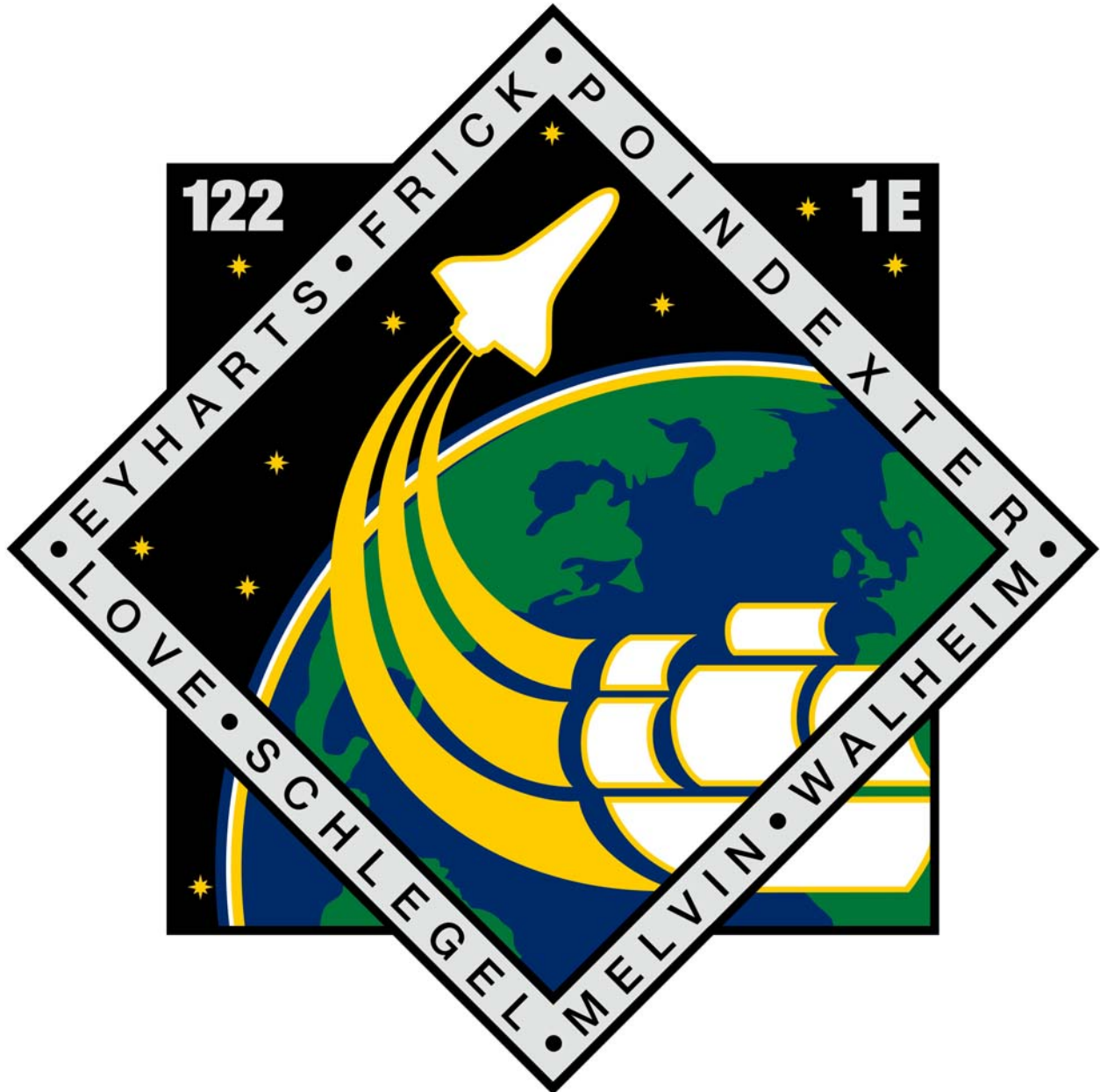
The white strip across the Earth symbolises two different things. Firstly it symbolises the path from east to west, which Christopher Columbus took on his way to the Americas. Secondly it symbolises the path of the Columbus laboratory from west to

east from the launch pad in Florida into orbit and to the International Space Station, following an orbital path symbolised by the stars. These stars (10 gold and one blue) symbolise the eleven ESA Member States that contribute to the human spaceflight programme within ESA. With last star being the central part of the ISS the stars also symbolise the fact that following its orbital journey, the Columbus laboratory, will become an integral part of the International Space Station.

This final star, not only symbolises the Columbus laboratory, it also symbolises the spark of genius inherent in the groundbreaking science that will take place in the laboratory once it is commissioned.

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## Shuttle Mission Patch



Shuttle Mission Patch (Image: NASA)

The STS-122 patch depicts the continuation of the voyages of the early explorers to today's frontier, space. The ship denotes the travels of the early expeditions from the east to the west. The space shuttle shows the continuation of that journey along the orbital path from west to

east. A little more than 500 years after Columbus sailed to the new world, the STS-122 crew will bring the European laboratory module "Columbus" to the International Space Station to usher in a new era of scientific discovery.