

European laboratory extends ISS science capacity

# Columbus ushers in a new space era

by Clive Simpson & Gerard van de Haar

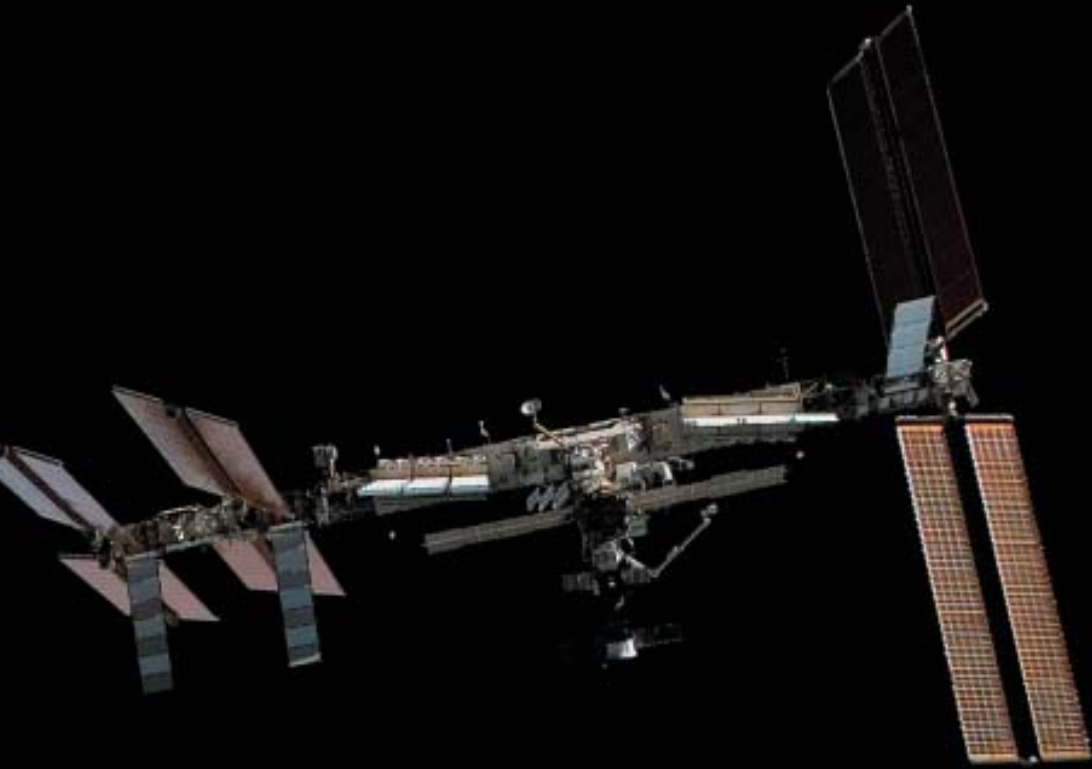
The Space Shuttle Atlantis arrived at the International Space Station (ISS) on 9 February 2008, delivering the long-awaited European Space Agency (ESA) Columbus laboratory which reached space over a decade later than the original plan when the lab was approved in 1987. It was installed two days later and the joint Shuttle/ISS crews conducted three spacewalks to prepare it for scientific work. The much anticipated facility will provide a large number of microgravity research opportunities, even more than the first ISS science module Destiny which was launched exactly seven years earlier, on 7 February 2001, also onboard Atlantis. The Shuttle crew also replaced an expended nitrogen tank on the Station's P1 truss and Atlantis delivered a new ISS crew member, flight engineer Leopold Eyharts, a French ESA astronaut, who replaced NASA's Dan Tani.

*Spectacular lift-off of Atlantis.*



*Hans Schlegel at work on the exterior of Columbus.*





*Columbus attached to the ISS.*





*The left hand booster was damaged more than normal as one of the three parachutes failed to deploy for landing, the higher impact speed causing significant damage to the canopy and aft skirt. Here the booster is being inspected after its return to Port Canaveral on 10 February, a day later than planned because of rough seas. Some elements used on this booster were from STS-1, 55, 68, 88 (first shuttle to ISS), 99 and 101. Jean Nakashima*

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Atlantis and its crew landed back at the Kennedy Space Center, Florida, on 20 February 2008 after completing a 13 day journey of nearly 5.3 million miles in space and 202 Earth orbits.

Associate administrator for space operations Bill Gerstenmaier described the STS-122 mission as one of the programme's most successful Space Station construction missions.

Steve Frick commanded the flight and was joined by pilot Alan Poindexter, mission specialists Leland Melvin, Rex Walheim, Stanley Love and ESA astronauts Hans Schlegel from Germany and Leopold Eyharts from France.

Eyharts remained aboard the Space Station, replacing Expedition 16 flight engineer Dan Tani, who returned to Earth on Atlantis after nearly four months in space. Eyharts will return on Shuttle Endeavour's STS-123 mission, which was targeted for launch on 11 March 2008 at the time of writing.

The mission included three spacewalks to outfit Columbus with power, data and cooling cables, installation of two science facilities on the lab's exterior, replacement of an expended nitrogen tank on the Space Station's cooling system, and retrieval of a failed ISS control moment gyroscope - a device that helps control the orientation of the Station - for its return to Earth.

STS-122 was the 121st space shuttle flight, the 29th flight for shuttle Atlantis and the 24th flight to the ISS. The next flight for Atlantis will be the final Hubble Space Telescope servicing mission in the summer.

With Atlantis and its crew safely home, the stage was set for the next phase of Station assembly when the STS-123 mission will deliver the Japan Aerospace Exploration

Agency (JAXA) Kibo logistics module element and Canada's new robotics system, Dextre.

## European outpost

Columbus is Europe's first permanent manned outpost in orbit. The 7 m long, 4.5 m wide and 21 tonne module, is described by ESA as a "state-of-the-art multi-disciplinary laboratory".

It was attached to the Harmony (Node 2) module and once leak checks and initial electrical, fluid and data connections were completed, the module's hatch was opened on 12 February by Eyharts and Schlegel, marking Europe's new status as a full partner and co-owner of the ISS. "This is a great moment and Hans and I are very proud to be here and to ingress for the first time the Columbus module," Eyharts said.

Outfitting work inside Columbus began within hours as the laboratory entered its commissioning phase, commanded and controlled by the purpose-built Columbus Control Centre in Oberpfaffenhofen near Munich, Germany.

Schlegel, who sat out the first of the STS-122 crew's three spacewalks due to an illness but recovered in time for the mission's second excursion on 13 February, said the spaceflight marked a milestone for Europe.

"From now on, Europe has its presence in space," he said, adding that the mission was a experience of a lifetime. "For ESA, for all of Europe, it's the beginning of the human spaceflight."

With the addition of Columbus, the pressurised volume of the Space Station was increased by a mere 15 percent but its science capacity was more than doubled. Two modules of the Japanese laboratory

Kibo will be added in March and May, and a Russian Multi-Purpose Laboratory Module (MLM) will follow in 2011.

The commissioning of Columbus signals the start of a new era for ESA ISS activities. As a fully-fledged partner of the programme, ESA will now not only enjoy the benefits of Columbus but will also contribute to ISS logistics.

This will largely be achieved through the launch of unmanned servicing missions carried out by the Automated Transfer Vehicle (ATV), designed to deliver spares, scientific experiments, crew support equipment (food, clothing), fluids and propellant, and to perform reboost to compensate for orbital decay of the ISS. The first ATV - called Jules Verne - is to be launched by an Ariane 5 from French Guiana in the first part of March with a docking later in the month.

As Columbus is coming to life, so too is the network of nine User Support and Operations Centres (USOCs), which has been set up all over Europe to facilitate the interface between researchers and the science payloads onboard, and to allow investigators to control their experiments and receive real-time data on their results.

Over the coming month, the USOC network's activity will increase dramatically as the science facilities and experiments already onboard Columbus are commissioned and switched to operational status, and as more science payloads are delivered to the module later on.

Columbus was designed to support some 500 experiments per year for ten years, covering cell and plant biology, astrobiology, human physiology, fluid and material sciences, fundamental physics, astronomy, remote sensing and technology.

## Preparations

After Columbus had arrived from Europe at the Kennedy Space Center in May 2006, preparations for its launch started and were finished in October 2007; in November the module was placed in Atlantis, the day after the Shuttle had rolled to the pad.

As reported earlier (*Spaceflight*, March 2008 p93), on 6 and 9 December the countdown was stopped early on launch day as two of the Shuttle's four Engine Cut-off Sensors (ECOs), located on the External Tank, failed to operate normally. It was only after weeks of examinations, testing and repairs, that Atlantis was ready to try again.

The astronauts arrived 4 February, three days before the scheduled launch, and in their comments after stepping out of their

Gulfstream aircraft made reference to their launch delay.

European astronauts Eyharts and Schlegel both stated that Columbus was finally about to be put to use, with Schlegel adding that this was also the case for the operations centre in Germany.

Though countdown went smoothly in the final days weather predictions were getting worse, with the day before launch a 70 percent chance of no-go because of weather, possibly causing further delays. Insiders were even inclined to believe the launch was jinxed, as also the SRB's had elements from previous missions with big launch day problems like STS-41D, 31, 55, 68, 93, 99, 101; even a segment from a STS-107 booster was used for the second time.

Nevertheless the crew was all smiles on 7 February when they walked out their way to the pad, waving enthusiastically to the gathered media and friends. As they stepped into the orbiter, Schlegel was holding a card reading 'Go Columbus'.

The day started out sunny and, much to the surprise of the local meteorologists, it was still nice when the crew entered the orbiter around 11 am local time, four hours before scheduled lift-off.

Even as the launch came nearer and nearer the weather continued to stay fine. And with no technical issues - also the ECO sensors performing perfectly - the last minutes and seconds before engine start were ticking away. It was only then that many of the (happily) surprised onlookers - both Europeans and Americans - realised the launch of Columbus was actually to become reality that day!

Lift-off occurred in almost blue skies at 14.45.30 local time and was a particularly spectacular event, not only because of the usual loud noise and bright exhaust light but this time more vibrations than normal could be felt, both on the chest and through the ground! And as the two boosters fell away two minutes later, the gathered crowd cheered.

As soon as Columbus had safely reached orbit, the ESA party - which included German State Secretary Hintze, ESA director general Jean-Jacques Dordain, ESA Manned space director Daniel Sacotte and ESA astronauts Thomas Reiter, Christer Fuglesang and Paolo Nespoli served champagne.

Dordain gave a short speech where he toasted that Columbus had finally been launched and added, "the longer the wait, the more pleasure you have at the end!".



*Leopold Eyharts at work in the Columbus laboratory.*

NASA

At the news conference an hour after the launch, NASA administrator Michael Griffin called STS-122 "one of the more significant Shuttle launches", while Dordain was happy that ESA was now a "visible and concrete ISS partner". Dordain thanked Griffin for the nice ride to orbit after fixing the Shuttle as well as the weather!

### Orbital greetings

Atlantis arrived in clean shape at the Space Station, with only a small tear found in the orbiter's right OMS pod after launch. A similar rip was on the previous Atlantis mission (STS-117), this time on the left OMS pod and repaired during an EVA.

Docking occurred a bit earlier than planned on 9 February at 1717 UTC; it happened to be ISS commander's Peggy Whitson's birthday who considered the Columbus module and visitors her presents! The Atlantis' crew was warmly welcomed after hatch opening at 1840 UTC.

Two days later Columbus was brought over with the Station's arm from the Shuttle and was docked to the Node-2 Harmony starboard side at 2144 UTC, with ESA astronaut and new ISS crew member Eyharts proclaiming that "the European Columbus module is now part of the ISS"!

Eyharts, with Tani and Melvin, was at the controls of the Station's robotic arm for the final capture and initial berthing of Columbus.

The laboratory was installed during the first spacewalk of the STS-122 mission. From outside the ISS, astronauts Walheim

and Love prepared the module for installation before the Station's robotic arm was used to lift Columbus into position.

"Another great day for the European Space Agency. A great day for our European industry and a great day for Europe in general," said Alan Thirkettle, ESA's ISS programme manager.

Another celebration was on 15 February when Melvin turned 44 while operating the ISS arm during the final EVA, by Love and Walheim (who performed all three). Three days later, Atlantis undocked from ISS after a highly successful performance.

### Personal tragedy

NASA's Dan Tani, launched to the Station aboard the shuttle Discovery last October, originally planned to come home in December. But his ride home, Atlantis, was grounded by fuel sensor problems and his stay in space was extended two months. Along with missing the holidays with his family, Tani was in orbit when his mother was killed in a 19 December car accident.

Tani said on the day of his return from orbit that he had prepared notes that might help future long-duration space fliers cope with personal tragedies, as well as nuts-and-bolts advice about living and working in space.

"There are tips on what I think people on the Space Station might think about if they have a family tragedy similar to what I had, more administrative kind of stuff, and things I think will help them communicate with their family more," he said.