

# Visiting the International Space Station - My Mission Diary

## U. Guidoni

ESA Astronaut, ESA Directorate of Manned Spaceflight and Microgravity,  
ESTEC, Noordwijk, The Netherlands

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Having been fortunate enough to be the first European Astronaut to visit and live aboard the International Space Station, I would like to share with you my personal diary of this very special trip. Space Shuttle 'Endeavour', with an international crew of seven, lifted off from Kennedy Space Center in Florida on 19 April for an 11-day mission, which included the delivery of the European-developed 'Raffaello' logistics module to the Station and the attachment of the Station's new 17-metre Canadian Robotic Arm. We returned to Earth, with a landing at Edwards Air Force Base in California, on 1 May. Raffaello had been packed for its outward journey with 10 tons of new Station equipment, including six experiment racks and two storage racks for the US 'Destiny' module, as well as supplies for the astronauts and other equipment for future construction and maintenance work. One of my main tasks during the mission was to oversee the safe unloading of all of the experiments and equipment into the Space Station. I was relieved that the whole exercise went so smoothly and very proud to have been the first astronaut to represent Europe on the International Space Station.

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### Tuesday 17 April 2001

The launch of our STS-100 Space Shuttle mission is rapidly approaching. The crew arrived here at Kennedy Space Center in Florida yesterday. Meanwhile, preparations are continuing at Launch Pad 39A for Thursday's lift-off.

### Thursday 19 April 2001

Commander Kent Rominger, Pilot Jeff Ashby and Mission Specialists Chris Hadfield of the Canadian Space Agency, John Phillips, Scott Parazynski, Yuri Lonchakov of Rosaviakosmos, and myself representing ESA, blasted off in the Space Shuttle 'Endeavour' at 18:41 GMT when the International Space Station (ISS) was over the southern Indian Ocean. Less than nine minutes after launch, Endeavour reached its preliminary orbit and we began to configure systems for in-orbit operations.



Lift-off of Space Shuttle  
'Endeavour' (STS-100) from  
KSC on 19 April

**Friday 20 April**

Space Shuttle 'Endeavour' is on its way to the Station. STS-100 will be the ninth Space Shuttle mission to continue the ISS assembly sequence. Endeavour and our seven-member crew are delivering a new-generation robot arm and the Multi-purpose Pressurised Logistics Module (MPLM), known as 'Raffaello', to the Station. We are scheduled to dock with it on Saturday 21 April at 13:36 GMT.

Today the Shuttle crew checked out the spacesuits and the Orbiter's robotic arm, while the installation of the centreline camera and

target, before resuming the approach at a speed of about one metre every 30 seconds until docking.

Our crew has transferred supplies into the Station's docking port in preparation for Sunday's space walk by Mission Specialists Chris Hadfield and Scott Parazynski. This will be the first of two scheduled space walks to install and activate the Station's new Canadian-built high-tech Robotic Arm 'Canadarm2'.

The Expedition-Two crew of Russian Commander Yuri Usachev and astronauts Jim Voss and Susan Helms have already been aboard the Station for more than a month and are keen to welcome us. But although we are already docked with the Station, due to cabin pressure differences we will not meet face-to-face until Monday, after the first space walk.



**Umberto Guidoni at work (above and facing page) on the International Space Station**

extension of Endeavour's Orbital Docking System ring was going on in preparation for the rendezvous. Another rendezvous engine burn is scheduled shortly before we finish today's activities.

**Saturday 21 April**

Endeavour successfully docked with the International Space Station at 13:59 GMT (15:59 Central European Time), at an altitude of around 400 km above the Southern Pacific, southeast of New Zealand.

The Shuttle approached the Station from behind and below. Commander Kent Rominger and Pilot Jeff Ashby, assisted by the rest of the crew, flew the Shuttle to a point about 200 metres directly below the Space Station. From there, with the cargo bay pointed towards the Station, we flew a quarter circle arc to a point about 100 metres ahead of the Station, and then began a slow approach to the docking port at the forward end of Destiny. When at distance of about 10 metres, Rominger verified good alignment with the Station's docking

Before the start of the space walk, Jeff and I manoeuvred the Shuttle arm to lift the Spacelab Pallet (SLP) containing the Canadarm2, also known as the Space Station Remote Manipulator System, out of Endeavour's payload bay. Then we attached the SLP to the Station's US Laboratory Module Destiny. During their space walk, Hadfield and Parazynski were able to connect cables to give the arm power and allow it to accept computer commands from the US Lab. They unbolted the arm from the pallet, then unfolded its two booms and tightened bolts to make them rigid. The space walkers also installed the UHF antenna on Destiny. Parazynski and Hadfield spent a total of 7 hours and 10 minutes working outside the Station. On completion of the EVA, Endeavour's cabin pressure was increased to match that of the Station. Finally, the hatches between the Shuttle and Station will be opened early on Monday morning.

**Monday 23 April**

At 11:25 CET (9:25 GMT) today, the Expedition-Two crew welcomed us aboard the International Space Station. We had a busy day

with the opening of the hatch linking the two spacecraft, the first movements of the new Canadarm2, and the unberthing of Raffaello and its installation on Node 1.

Scott and myself began to use Endeavour's robotic arm to lift the Raffaello Multi-purpose Pressurised Logistics Module out of the payload bay and attach it to the International Space Station's 'Unity' Module. The manoeuvre was completely nominal and the Italian module was 'bolted' with sixteen motorised bolts to the Unity Node, thereby becoming an integral part of the Station.

Tomorrow, the Expedition-Two crew will begin to transfer food, supplies, equipment and two experiment racks from Raffaello to the Station for installation in Destiny.

### Tuesday 24 April

The unloading of Raffaello's 3 tons of supplies and the science racks for the Space Station went pretty smooth.

In preparation, the vestibule between Unity and Raffaello had been pressurised and I activated the MPLM. The first of the MPLM's Environmental Control and Life Support Systems (ECLSS) – developed by ASI for ESA – was activated, namely the air temperature sensor. Today, before the hatch was opened, we took a sample of Raffaello's air and analysed it to confirm no cabin-air contamination. At that point the Inter-Module Ventilation valve was opened and the cabin fan activated to provide a comfortable environment for the crew during their operations. The Positive Pressure Relief valves will be de-activated, since the ISS controls air pressure during open-hatch operations.

Yesterday had been a busy day for all of us aboard the ISS. Our two crews had performed over 10 hours of joint operations before the hatches were closed again in preparation for today's space walk.

The new 11.3 m long Canadarm2 robot arm took its first step, 'walking off' a pallet mounted at the top of the Destiny Laboratory to grab onto an electrical grapple fixture on Destiny capable of providing data, power and telemetry to the dexterous appendage. With Expedition-Two Flight Engineer Susan Helms sending commands from a workstation inside Destiny, the arm began to move off the pallet at 11:13 GMT. Three hours later, after an extensive checkout of all of its joints, the arm affixed itself to the Destiny grapple point, where it will

remain overnight in preparation for its first active moving of a payload – the pallet on which it was launched.

Commander Kent Rominger and Pilot Ashby also fired the Shuttle's jets to raise the Space Station's altitude by 4 km. Two more re-boosts are planned on Wednesday and Thursday to put the Station at the correct altitude for the arrival of a Russian-commanded 'taxi' crew next week, delivering a fresh Soyuz return vehicle to the complex.

Mission Specialists Scott Parazynski and Chris Hadfield began today's EVA at 13:06 GMT (15:06 CET). Thanks to Leonardo's ECLSS system, they worked in shirtsleeve comfort, but for the time being they had to remain on their own. Although Endeavour is still firmly docked with the Station and I supervised the unloading by radio link, the Shuttle is operating at a lower air pressure than the ISS and the hatch between the two was sealed.



The pressure differential is necessary because of the EVA to install new Station equipment. Lower air pressure aboard the Shuttle makes the business of suiting up and unsuiting quicker and wastes less of the on-board oxygen supplies. The reduction in pressure makes no difference to the crew's breathing: as overall pressure falls, the proportion of oxygen is increased. Low air pressure is even more important for space-walking astronauts. 'Normal' air pressure would make their spacesuits hopelessly stiff and unmanageable. However, once Endeavour's EVAs have been completed, the Shuttle will match pressures with the Station and the two crews will be able to share the same space again.

**MPLM attached to the International Space Station's 'Unity' Module**

The first order of business for the space walkers was to connect power, computer and video cables to the Power and Data Grapple Fixture on the side of the Station's Destiny laboratory. They also removed an antenna on Unity that is no longer needed. Cables on the pallet that carried the new robot arm to the Station were disconnected. Once those cables were removed, the Canadarm2 received power and communicated with the Station's Robotics Work Station inside Destiny.

Near the end of the 7-hour space walk, Helms commanded the Station's new robotic arm to pick up the 3000-pound pallet that delivered it to space. She then manoeuvred the pallet through various positions to test the arm with a load. Helms finished today's tests by manoeuvring the pallet over Endeavour's payload bay, where it will remain parked overnight still attached to the robotic arm.

**Wednesday 25 April**

Six days after launch, our Shuttle mission STS-100 continues to go according to plan. While robotic-arm operations are underway by Expedition-Two crew members Susan Helms and Jim Voss aboard the Station, my Shuttle crew members and I continue the task of unpacking the Raffaello high-tech 'moving van'. It was a big day for me with the transfer of the powered experiments from the Shuttle's mid-deck to the US Lab.

Today, I woke up to the sound of 'Con te Partiro' ('With You I Will Go'), sung by Italian opera singer Andrea Bocelli. I felt moved when Steve MacLean called from the Mission Control Center and started to talk in Italian.

The crew continued to transfer equipment from Raffaello to the ISS. Endeavour's schedule allows for a maximum of three EVAs. But yesterday's intense activity – astronauts Chris Hadfield and Scott Parazynski were at work for almost 8 hours – went so well that the third EVA will probably be unnecessary. Pressures were equalised some time yesterday and the Shuttle crew helped Usachev, Voss and Helms with the unloading and restowing of Raffaello's contents. Today, the Canadarm will 'pass' the SLP pallet to the Shuttle's own robotic arm.

'Pallet' is actually quite a misleading term. The device has nothing in common with the wooden pack-and-stack units used by forklift trucks on Earth. It is a sophisticated payload carrier, and one with a long history. Back in the 1980s, when ESA built the pressurised modules for the Spacelab programme, it also built the unpressurised payload carriers

without which the manned modules would be useless.

The two Spacelabs have long since been retired. But the un-pressurised modules, the humble pallets, are still at work on the ISS. Raffaello and the other MPLMs are often described as 'space moving vans'. If so, then the pallets are the 'pick-up trucks' – both robust and long lasting.

**Thursday 26 April**

As Shuttle Mission STS-100 comes to an end – Endeavour will undock from the ISS on 28 April – there has been no let-up for us.



The Raffaello logistics module has now been almost completely unloaded, and all of us have been busy installing the new equipment and scientific experiments on the Station. We would have been even busier if work schedules had not been affected by an annoying computer problem.

The trouble showed up in the early hours yesterday, as we slept after a hard day's work. ISS flight controllers on the ground reported that the Station's Command and Control Computer Number 1 was no longer responding to their inputs. The ISS has three of these 'CC' computers, so the controllers spent much of the night assigning CC-1's functions to the two backups. But they too seemed to be affected by the same software glitch and for a time the Station's communications had to be routed through the docked Shuttle's systems. Controllers have been rebooting and restarting the computers in an attempt to clear the fault. Although the problem is neither life-threatening nor safety-critical, it is certainly an irritation.

One consequence was the postponement of a scheduled manoeuvre with the newly fitted robotic arm. The arm was carried to the Station on the European-built Spacelab pallet during Tuesday's EVA. After installing the arm, we had left the pallet 'parked' beside the Station. We had planned to use the arm yesterday to lift the pallet back into Endeavour's cargo bay. With luck, the job should be accomplished today. It will be the most complicated operation so far performed by Canadarm2, but a task still easily within the capabilities of the world's most sophisticated robotic handling device.

Unlike its predecessors – the original Canadarm is the robot lifter fitted in the cargo bay of each Space Shuttle – the 17-metre Canadarm2 has no permanent anchoring point. The European Robotic Arm that will later serve the Russian Zvezda module is similarly dexterous. Each end is equipped with a Latching End Effector that can take hold on the Station while the other end deals with the job in hand. Canadarm2 can actually flip itself around the Station, moving from anchor point to anchor point.



### Friday 27 April

We, the seven Shuttle astronauts and three ISS crew members, began our day in excellent health, but with a deepening sense of frustration. Continuing computer problems have stalled some important mission activities, and Endeavour's undocking, originally scheduled for tomorrow, has been postponed for one or two days, pending Russian concurrence.

After a series of re-boots, controllers had managed to get one of the Station's systems up and running. But with no working backup available, mission tasks planned for Wednesday and Thursday have had to be postponed. The problem seems to lie in the complex software in the Destiny computers. While experts on the ground check out thousands of lines of code, flight controllers are planning a tricky re-synchronisation procedure later today that should bring their recalcitrant machines back on line.

Fortunately, the ESA-provided Data-Management System (DMS-R) in the Russian Service Module 'Zvezda' – the software that actually 'flies' the Station and looks after most routine functions – is working smoothly, so we are in no danger. Since Endeavour has more than enough power and supplies to remain in orbit for as long as necessary, the two-day extension poses no problems for our Shuttle crew.

The delay in Endeavour's departure has a knock-on effect on the launch of a Russian Soyuz craft planned for Saturday 28 April, since the ISS cannot at present accommodate a Soyuz and a Shuttle at the same time. The Soyuz mission is what ISS people call a 'taxi flight'. One Soyuz craft is always docked to the Station to serve as a 'lifeboat' in case of an emergency, but the spacecraft's systems and propellant stores deteriorate with time, so every six months a replacement is launched. Its crew pass a few days with the ISS crew, then return in the Soyuz that has reached its 'best-before' date and leave their own spacecraft behind as the new lifeboat.

Saturday's Soyuz launch was an interesting space premiere. The three-seater spacecraft needs only two cosmonauts to operate it. The world's first space tourist, American millionaire Dennis Tito, occupied the third seat. The ISS partners had agreed to Tito's trip, albeit with some misgivings. Could it turn out that the world's first space tourist runs into the world's first space charter-flight cancellation?

### Saturday 28 April

8:56 am CET: the crews of the ISS and the Shuttle are enjoying a well-earned night's rest after a hectic day that saw the resolution of most of the mission's problems. And I can sleep as sound as any – the Raffaello logistics module, my special charge, is safely back in the Shuttle's cargo bay.

In space and on the ground, astronauts and flight controllers wrestled with the computer problems. They got one of the backup computers working, but the other two remained intractable. Controllers were reluctant to attempt to undock Raffaello with only one computer working, since any glitch would have left the arm attached to the SLP in an awkward configuration, and in the way of the trajectory that the Shuttle arm is supposed to follow to cradle the MPLM in the cargo bay. But one of the payload computers loaded with the command and control software beamed from the ground was pressed into service as a backup, and Raffaello was successfully undocked at about 8.30 pm CET yesterday.

The module had already been deactivated and packed with 800 kg of material to be returned to Earth – work that could be accomplished without computer assistance. Endeavour also fired her motors to boost the Station's altitude by about 4 kilometres: the Shuttle's own computers could handle this manoeuvre.

Controllers sent new software to the stalled prime command computer last night. With support from this reprogrammed computer, they hope to use the Station's robotic arm today to move its loading pallet into the Shuttle's cargo bay. The flawed prime computer will also be part of Endeavour's return cargo, slated for disassembly and analysis: everyone wants to find out just what went wrong.



After his flight, Umberto Guidoni (far right), his fellow STS-100 crew members and ESA Director General Antonio Rodotà (centre) meet Romano Prodi, President of the European Commission

Yesterday's good work has reduced the possible two-day delay in Endeavour's departure to just one day. Meanwhile, the Russian Soyuz 'taxi flight' to the Station has been launched on schedule, at 8.37 a.m. CET. As things stand, the crew will have to endure at least an extra full day in orbit in the cramped Soyuz craft: it cannot dock with the ISS before Endeavour has left.

### Sunday 29 April

Our two crews are very near to bringing our troubled mission to a successful conclusion. We hope to have three computers running this morning, which will allow Endeavour to undock and begin her journey home at around 7 pm CET, just one day later than planned. If all goes well, Endeavour will be clear of the Station before the arrival of the Russian Soyuz.

We are not wasting our additional time in space. Those not engaged in solving the computer problem are working with the ISS team to repair the Station's exercise treadmill. Its walking surface had worn out. So when Endeavour leaves, it will be 'back to the treadmill' for Station Commander Yury Usachev and astronauts James Voss and Susan Helms.

### Monday 30 April - Mission accomplished!

My six shipmates and I waved goodbye to the International Space Station from aboard the Shuttle Endeavour at 18:34 CET yesterday. Endeavour undocked almost 27 hours later than originally planned.

Springs in the docking port pushed the loaded Shuttle gently away from the Station. Then, before igniting her main motor for orbital separation, the Shuttle flew slowly around the station at a distance of around 150 metres while Mission Specialist Yuri Lonchakov took pictures with an IMAX camera. The separation burn took place at 19.28 CET, and Endeavour is now hundreds of kilometres from the ISS.

Landing is scheduled at the Kennedy Space Center at 14.03 CET tomorrow.

### Tuesday 1 May - Homeward bound!

We spent our last hours in space cleaning up, and stowing away equipment no longer needed for the mission. It is a routine chore, but not as easy as it sounds. In the weightlessness of orbit, everyday objects from pens and clipboards to breakfast crumbs, have a surprising ability to find their way into the most awkward places. That's why space farers soon learn to be tidy, and why crews aboard the ultra-high-technology Shuttle make sure they have plenty of low-technology adhesive tape to stop things getting lost in the first place!

The de-orbit burn is an hour away and we get the 'GO' from Mission Control in Houston to put on our space suits and get ready for re-entry. The weather is bad in Florida and we are targeting Edwards Air Force Base in California. Our wives are waiting for us in Florida and they will be disappointed – but we are going to meet them tomorrow!