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It's just mind-boggling to see the amount of time and...Read MorePage 2 Space Shuttle mission to the International Space Station STS-128Discovery approaches the ISS with Leonardo in its payload bayMission typeISS assemblyOperatorNASACOSPAR ID2009-04ASATCAT no.35811Mission duration13 days, 20 hours, 54 minutes, 55 secondsDistance travelled9,262,217 kilometres (5,755,275 mi)Orbits completed219 Spacecraft propertiesSpacecraftSpace Shuttle DiscoveryLaunch mass121,422 kilograms (267,689 lb)[1] CrewCrew size7MembersFrederick W. SturckowKevin A. FordPatrick G. ForresterJosé M. HernándezJohn D. OlivasChrister FuglesangLaunchingNicole StottLandingTimothy Kopra Start of missionLaunch date29 August 2009, 03:59 (2009-08-29UTC)C03:59Z2]Launch siteKennedy LC-39A End of missionLanding date12 September 2009, 00:53 (2009-09-12UTC)C0:54Z2] UTCLanding siteEdwards Runway 22 Orbital parametersReference systemGeocentricRegimeLow EarthPerigee altitude219 kilometres (136 mi)[3]Apogee altitude264 kilometres (164 mi)[3]Inclination51.6 degrees[3]Period89.33 minutes[3]Epoch29 August 2009[3] Docking with ISSDocking portPMA-2(Harmony forward)Docking date31 August 2009, 00:54 UTCUndocking date8 September 2009, 19:26 UTCTime docked8 days, 18 hours, 32 minutes Seated (l-r) Ford and Sturckow. Standing (l-r) are Hernández, Olivas, Stott, Fuglesang and Forrester.Space Shuttle program– STS-127STS-129 → STS-128 (ISS assembly flight 17A) was a NASA Space Shuttle mission to the International Space Station (ISS) that launched on 28 August 2009. Space Shuttle Discovery carried the Multi-Purpose Logistics Module Leonardo as its primary payload. Leonardo contained a collection of experiments for studying the physics and chemistry of microgravity. Three spacewalks were carried out during the mission, which removed and replaced a materials processing experiment outside ESA's Columbus module, and returned an empty ammonia tank assembly.[4] The mission's first launch attempt was delayed due to weather concerns, including multiple weather violations in NASA's launch rules, beginning over two hours before the scheduled launch.[5][6][7] The second launch attempt, scheduled for 26 August 2009 at 01:10:22 EDT, was called off the previous evening due to an anomaly in one of the orbiter's fuel valves.[8][9][10] The launch finally took place on 28 August 2009 at 23:59 EDT. Discovery landed on 11 September 2009 at Edwards Air Force Base, which was the last landing of a shuttle to occur at the California site. Crew Position[4] Launching astronaut Landing astronaut Commander Frederick W. SturckowFourth (last NASA) spaceflight Pilot Kevin A. FordFirst spaceflight Mission Specialist 1 Patrick G. ForresterThird and last spaceflight Mission Specialist 2 José M. HernándezOnly spaceflight Mission Specialist 3 John D. OlivasSecond and last spaceflight Mission Specialist 4 Christer Fuglesang, ESASecond and last spaceflight Mission Specialist 5 Nicole StottExpedition 20First spaceflight Timothy KopraExpedition 20First spaceflight Crew notes Nicole Stott was originally scheduled to return aboard Soyuz TMA-15, but a change in the flight plan was made due to the possible flight delays in future shuttle missions, which could have extended Canadian astronaut Robert Thirsk's mission beyond the six-month duration preferred for station crew members.[11] STS-128 was the final Space Shuttle flight used for ISS crew rotation, with Nicole Stott replacing Tim Kopra. Stott returned on STS-129, but that flight did not bring her replacement. The mission of Christer Fuglesang was named Aliseé by the European Space Agency.[12] The name was proposed by Jürgen Modlich from Baierbrunn, Germany. The name refers to the 15th-century explorer who used the trade winds to follow Christopher Columbus across the oceans to the New World. STS-128 also marked the first time two Hispanic Americans were on the same crew. John "Danny" Olivas of El Paso, Texas, made his second trip into space, and José M. Hernández of Stockton, California, made his first. Both are of Mexican heritage. Mission payload Location Cargo Mass Bays 1–2 Orbiter Docking System EMU 3009 EMU 3015 1,800 kilograms (4,000 lb) ~260 kilograms (570 lb) Bay 3P Shuttle Power Distribution Unit (SPDU) ~17 kilograms (37 lb) Bay 4P APC/MISSE Carrier 57 kilograms (126 lb) Bay 5P APC/MISSE Carrier 57 kilograms (126 lb) Bay 7S ROEU umbilical ~79 kilograms (174 lb) Bays 7–12 Leonardo (MPLM FM-1) 12,131 kilograms (26,744 lb) Bay 13 Lightweight MPSS Carrier (LMC) 1,780 kilograms (3,920 lb) Starboard Sill Orbiter Boom Sensor System (OBSS) ~382 kilograms (842 lb) Port Sill Canadarm 410 kilograms (900 lb) Total: 16,973 kilograms (37,419 lb) Multi-Purpose Logistics Module (MPLM) Leonardo Leonardo, as flown on STS-128. The primary payload of STS-128 was the Multi-Purpose Logistics Module Leonardo to assist with establishing a six-man crew capacity by bringing extra supplies and equipment to the station. The Multi-Purpose Logistics Module contained three racks for life support, a crew quarter to be installed in Kibo, a new treadmill (COLBERT) that will temporarily be placed in Node 2 and later in Node 3, and an Air Revitalization System (ARS) that will temporarily be placed in Kibo and later in Node 3. Leonardo Specifications Length: 21 feet (6.4 m) Diameter: 15 feet (4.6 m) Payload Mass (launch): 27,510 pounds (12,480 kg) Payload Mass (return): 16,268 pounds (7,379 kg) Empty Weight: 9,810 pounds (4,450 kg) Lightweight Multi-Purpose Carrier (LMC) LMC with ATA and EuTEF STS-128 The shuttle carried a Lightweight Multi-Purpose Experiment Support Structure Carrier (LMC) with Ammonia Tank Assembly (ATA).[13] The new ammonia tank will replace an empty tank during an EVA. TriDAR The shuttle flew the first test flight of the TriDAR, a 3D dual-sensing laser camera, intended for potential use as an autonomous rendezvous and docking sensor. The TriDAR successfully tracked the ISS position and orientation from the shuttle during docking operations.[13] Other science packages It also contained three racks dedicated to science, FIR (Fluids Integrated Rack) and the first Materials Science Research Rack (MSRR-1) to be placed in Destiny and MELFI-2 (Minus Eighty Laboratory Freezer for ISS) to be placed in Kibo. The FIR enabled detailed study of how liquids behave in microgravity, a crucial detail for many chemical reactions. One experiment, for instance, examined how mixtures known as colloids behave without being stirred by sedimentation and convection. Another using the Light Microscopy Module (LMM) will examine how an ideal heat pipe works without the distortions of gravity.[14] Mission experiments The STS-128 mission (as did STS-125 and STS-127) took part in crew seat vibration tests that will help engineers on the ground understand how astronauts experience launch. They will then use the information to help design the crew seats that will be used in future NASA spacecraft. STS-128 repeated the Boundary Layer Transition (BLT) Detailed Test Objective (DTO) experiment that was done by the same shuttle during STS-119. In this experiment, one of the thermal protection systems was raised to create a boundary layer transition in which the air flow becomes turbulent beyond a certain speed. During STS-119 the tile was raised 0.25 inches (6.4 mm) above the others, tripping the flow at Mach 15 during reentry. In the modification being done, the tile has been raised 0.35 inches (8.9 mm) to trip at Mach 18 producing more heat. Discovery undertook the testing of a catalytic coating which was meant to be used by the Orion (spacecraft). Two TPS tiles located in the protuberance downstream from the BLT tile had been fully coated with the catalytic material in order to understand the entry heating performance. The tiles were instrumented to collect a wide variety of data.[15] Mission milestones The mission marked: 159th NASA crewed space flight 128th Space Shuttle mission since STS-1 37th flight of Discovery 30th shuttle mission to the ISS 103rd post-Challenger mission 15th post-Columbia mission 32nd shuttle night NASA's first Space Shuttle launch to take place during two calendar days 25th anniversary of Discovery's first flight, STS-41-D (30 August 1984) Shuttle processing Discovery rolled out from the Orbiter Processing Facility to the Vehicle Assembly Building after the external tank was cleared for use and was mated with it.[16][17] The foam insulation on the first underwrest stringent pull tests after the foam liberated and hit the orbiter during STS-127.[18] The STS-128's tank initially exhibited no concerns while the STS-127 case was determined to be a one-off case due to surface contamination prior to application.[19][20] The main change from previous missions is the change of the Ground Umbilical Carrier Plates (GUCP) being used during launch. The quick release vents exhibited leaks during STS-119 and STS-127, which were determined to be due to a misalignment in the vent. This led to the one part rigid seal in the external tank being replaced with a two part flexible seal.[21] Discovery later rolled out from the VAB Launch Complex 39A on 4 August 2009, in a slow drive on the top of the Crawler-transporter. The 3.4-mile (5.5 km) rollout began at 02:07 EDT, and ended with the launch platform secured in place at about 13:50 EDT. The move took longer than expected due to adverse weather conditions, which included lightning warnings. The crawler also had to pause occasionally so mud could be removed from its treads and bearings. Technicians then quickly prepared the shuttle to host the crew's countdown dress rehearsal known as the Terminal Countdown Demonstration Test (TCDT). [22] Discovery's seven astronauts flew to Kennedy on 5 August 2009 for the training activity which concludes later in the week with a complete practice countdown, minus liftoff, involving the crew and the launch team.[23] Meanwhile, in an unprecedented operation, modifications were made to the left Solid rocket booster on the pad.[24] The modifications involved replacement of a check valve filter assembly in the booster which was found to have broken.[25] In a potentially delaying factor, in depth testing of the external tank with X-ray revealed voids in the foam which might have formed during the injection molding of the foam. This has also been decided as a suspect factor in the foam shedding during STS-127. The air in the voids could have expanded due to the high temperatures generated during ascent thus breaking the foam. The reviews considered a rollback as an option since the defect could not be set right in the pad.[25][26][27] Later, the tank was cleared for launch as is without any additional inspections.[28] Launch attempts The first launch attempt was delayed by 24 hours due to weather concerns, including multiple weather violations in NASA's launch rules beginning over 2 hours before the scheduled launch.[5][6][7] During the second attempt on Wednesday morning, a problem with a LH2 fill-and-drain fuel valve inside Discovery's aft compartment led to another scrubbing. The problem arose when sensors did not detect the closure of the valve which was thought to be with the sensors rather than the valve itself.[9][10] After inserting the orbiter's tank, which involved draining it, tests were conducted on the valves. Despite the valves working normally, another delay was called for to have more confidence in the system, and to give the console operators who performed the test some rest.[29][30][31] The launch team evaluated the issue, passing on a possible launch window on 27 August 2009 at 01:10 EDT. The launch was delayed until 23:59 EDT, 28 August 2009, to allow the engineers to be fully satisfied with the vehicle.[32] Later the mission was cleared for launch which involved a flight rule waiver for cycling the valve and a discussion to analyze the test failure of an Ares-1 booster that was similar to the SRBs used for the mission.[33] NASA feared another delay when storms formed near the Kennedy Space Center on 28 August 2009, but the weather cleared in time for a successful launch of Discovery at 23:59 EDT.[34][35][36] Attempt Planned Result Turnaround Reason Decision point Weather go (%) Notes 1 25 Aug 2009, 1:36:05 am Scrubbed — Weather 25 Aug 2009, 1:25 am (T- 9:00 hold) 80%[37] Precipitation and lightning in launch and landing area[5][6][7] 2 26 Aug 2009, 1:10:01 am Scrubbed 0 days, 23 hours, 34 minutes Technical 25 Aug 2009, 5:52 pm 70%[37] Failure indicator on LH2 inboard fill and drain valve[29][30][31] 3 28 Aug 2009, 11:59:37 pm Successful 2 days, 22 hours, 50 minutes 60%; later 80%[38] Mission timeline 28 August (Flight Day 1 - Launch) Space Shuttle Discovery launches from Kennedy Space Center, 28 August 2009 After launch at 23:59 EDT, Discovery opened her payload bay doors. Once the doors were opened the crew deployed the Ku-band antenna and activated the Shuttle Remote Manipulator System (SRMS). Once the Ku-band antenna was deployed and activated the crew then down-linked photos from the External Tank Umbilical Well Camera system, so controllers on the ground could see how the tank performed and how much if any foam was shed during ascent. 29 August (Flight Day 2 - TPS survey) During Discovery's first full day on orbit, the crew used the SRMS to grapple the Orbiter Boom Sensor System (OBSS) and survey the wing leading edges, nose and other parts of the Thermal Protection System (TPS), as well as the Orbital Maneuvering System (OMS) Pods. During this time some of the crew were preparing the space suits that will be used during the 3 Extra-vehicular activities (EVA) and setting up the tools that will be used during the docking. 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