The CBS News

Space Reporter's Handbook
Mission Supplement

Shuttle Mission STS-112:
Space Station Assembly Mission 9A

EMBARGO NOTICE

CBS News has agreed to a NASA request not to publish or broadcast the shuttle's launch time (or any countdown or time-specific flight plan details) until the agency officially announces the launch time 24 hours before liftoff. DO NOT publish or broadcast any times listed in this document until after the official launch time is released by NASA.

Written and Edited By

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Revision History

Editor's Note
Mission-specific sections of the Space Reporter's Handbook are posted as flight data becomes available. Readers should check the CBS News "Space Place" web site in the weeks before a launch to download the latest edition:

http://www.cbsnews.com/network/news/space/current.html

DATE POSTED	RELEASE NOTES
09/27/02	Initial release
11/07/02	Updating with actual launch time

Introduction

This document is an outgrowth of my original UPI Space Reporter's Handbook, prepared prior to STS-26 for United Press International and updated for several flights thereafter due to popular demand. The current version is prepared for CBS News.

As with the original, the goal here is to provide useful information on U.S. and Russian space flights so reporters and producers will not be forced to rely on government or industry public affairs officers at times when it might be difficult to get timely responses. All of this data is available elsewhere, of course, but not necessarily in one place.

The SRH features a mission-specific "press kit" supplement, a Quick-Look Facts & Figures supplement and several appendixes covering shuttle program background, space demographics, abort data and information about the Challenger accident. The STS-112 version of the CBS News Space Reporter's Handbook was compiled from NASA news releases, JSC flight plans, the Shuttle Flight Data and In-Flight Anomaly List, NASA Public Affairs and the Flight Dynamics office (abort boundaries) at the Johnson Space Center in Houston.

Appendix 3 - Shuttle Abort Background - is written primarily in present tense so portions can be read aloud on the air if necessary. Each abort section is a stand-alone document in that general abort background is repeated in each section. The Quick-Look supplement is provided to serve as a stand-alone quick reference for on-air reporters and anchors during launch and landing. As such, much of the data therein is repeated elsewhere in the SRH.

Sections of NASA's STS-112 press kit, crew bios and the mission TV schedule were downloaded via the Internet, formatted and included in this document. Word-for-word passages (other than lists) are clearly indicated.

The SRH is prepared on a Macintosh computer using Word 5.1 and Adobe Acrobat 5.0. It is a work in progress and while every effort is made to insure accuracy, errors are inevitable in a document of this nature and readers should double check critical data before publication.

As always, questions, comments and suggestions for improvements are always welcome. And if you spot a mistake or a typo, please let me know!

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NASA Media Information

NASA Television Transmission

NASA Television is available through the GE2 satellite system which is located on Transponder 9C, at 85 degrees west longitude, frequency 3880.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, FL; Marshall Space Flight Center, Huntsville, AL; Dryden Flight Research Center, Edwards, CA; Johnson Space Center, Houston, TX; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter

Briefings

A mission press briefing schedule will be issued before launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once each day. The updated NASA television schedule will indicate when mission briefings are planned.

Internet Information

Information is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle 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://shuttle.nasa.gov or http://www.hq.nasa.gov/osf/

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

Information on other current NASA activities is available through the Today@NASA page:

http://www.nasa.gov/today.html

The NASA TV schedule is available from the NTV Home Page:

http://www.nasa.gov/ntv

Status reports, TV schedules and other information also are available from the NASA headquarters FTP (File Transfer Protocol) server, ftp.hq.nasa.gov. Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password.

NASA Public Affairs Contacts

Kennedy Space Center	407-867-2468 (voice) 407-867-2692 (fax) 407-867-2525 (code-a-phone)
Johnson Space Center	281-483-5811 (voice) 281-483-2000 (fax) 281-483-8600 (code-a-phone)
Marshall Space Flight Center	256-544-0034 (voice) 256-544-5852 (fax) 256-544-6397 (code-a-phone).

Acronyms Used in This Document

Abbreviation	Meaning
Alt	Maximum altitude, or apogee, for shuttle missions
Apo	High point, or apogee, of an orbit
CDR	Mission commander; sits in left seat
Cryo	Shuttle fuel cell tank sets
D	Miles traveled
Day/Night	Day or night launch or landing
EOM	End of mission
ET	External tank
FE	Flight engineer
GPC	Shuttle computer software edition
Incl	Inclination
Lnd	Landing time
LV	Launch vehicle designation
ME	Space shuttle main engine serial number
MET	Mission elapsed time
MS	Mission specialist, i.e., a full-time astronaut
OMS	Orbital Maneuvering System
Pad	Launch pad
Per	Low point, or perigee, of an orbit
PLS	Primary landing site
PLT	Shuttle pilot; sits in right seat
PS	Payload specialist, i.e., not a full-time astronaut
Revs	Orbits
RMS	Shuttle robot arm (remote manipulator system)
RO,LO	Right OMS, Left OMS pod serial numbers
RW	Runway
SET	Shuttle program elapsed time
SOM	Start of mission
SRB/SRM	Shuttle booster serial number
SSME	Space shuttle main engine
TD	Touchdown time
T-0	Launch time
VET	Individual vehicle elapsed time

STS-112: Internet Pages of Interest

CBS Shuttle Statistics	http://www.cbsnews.com/network/news/space/spacestats.html
CBS Current Mission Page	http://www.cbsnews.com/network/news/space/current.html
CBS Challenger Background	http://www.cbsnews.com/network/news/space/51Lintro.html
NASA Shuttle Home Page	http://spaceflight.nasa.gov/shuttle/
NASA Station Home Page	http://spaceflight.nasa.gov/station/
NASA News Releases	http://spaceflight.nasa.gov/spacenews/index.html
KSC Status Reports	http://www-pao.ksc.nasa.gov/kscpao/status/stsstat/current.htm
JSC Status Reports	http://spaceflight.nasa.gov/spacenews/reports/index.html
STS-112 NASA Press Kit	http://spaceflight.nasa.gov/spacenews/reports/index.html
STS-112 Imagery	http://spaceflight.nasa.gov/gallery/images/shuttle/
STS-112 Crew Home Page	http://spaceflight.nasa.gov/shuttle/crew/index.html
ISS-5 Crew Home Page	http://spaceflight.nasa.gov/station/crew/exp5
Spaceflight Meteorology Group	http://www.srh.noaa.gov/smg/smgwx.htm
Hurricane Center	http://www.nhc.noaa.gov/index.shtml
Melbourne, Fla., Weather	http://www.srh.noaa.gov/mlb/
Entry Groundtracks	http://spaceflight.nasa.gov/realdata/index.html

STS-112 Crew:

Commander Jeffrey Ashby bio	http://www.jsc.nasa.gov/Bios/htmlbios/ashby.html
Ashby jpg	http://www.jsc.nasa.gov/Bios/portraits/ashby.jpg
Pilot Pamela Melroy bio	http://www.jsc.nasa.gov/Bios/htmlbios/melroy.html
Melroy jpg	http://www.jsc.nasa.gov/Bios/portraits/melroy.jpg
MS1 David Wolf bio	http://www.jsc.nasa.gov/Bios/htmlbios/wolf.html
Wolf jpg	http://www.jsc.nasa.gov/Bios/portraits/wolf.jpg
MS2 Sandra Magnus bio	http://www.jsc.nasa.gov/Bios/htmlbios/magnus.html
Magnus jpg	http://www.jsc.nasa.gov/Bios/portraits/magnus.jpg
MS3 Piers Sellers bio	http://www.jsc.nasa.gov/Bios/htmlbios/sellers.html
Sellers jpg	http://www.jsc.nasa.gov/Bios/portraits/sellers.jpg
MS4 Fyodor Yurchikhin bio	http://www.jsc.nasa.gov/Bios/htmlbios/yurchikhin.html
Yurchikhin jpg	http://www.jsc.nasa.gov/Bios/portraits/yurchikhin.jpg

ISS-5 Crew:

Commander Valery Korzun bio	http://www.jsc.nasa.gov/Bios/htmlbios/korzun.html
Korzun jpg	http://www.jsc.nasa.gov/Bios/portraits/korzun.jpg
Peggy Whitson bio	http://www.jsc.nasa.gov/Bios/htmlbios/whitson.html
Whitson jpg	http://www.jsc.nasa.gov/Bios/portraits/whitson.jpg
Sergei Treschev bio	http://www.jsc.nasa.gov/Bios/htmlbios/treschev.html
Treschev jpg	http://www.jsc.nasa.gov/Bios/portraits/treschev.jpg

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STS-112: Quick-Look Mission Data

Flight Data	Crew/Notes	Payload	Hardware
STS-112 (111)	CDR: Navy Capt. Jeffrey Ashby	Primary:	ME 1: 2055-2
OV: Atlantis (26)	PLT: AF Col. Pamela Melroy	S1	ME 2: 2051-2
SOM: 10/07/02	MS1/EV1: David Wolf, Ph.D.	Truss	ME 3: 2048-2
T-0: 03:45:51 p.m.	MS2/FE: Sandra Magnus, Ph.D.	Segment	SRB: Bi115
Pad/MLP: 39B/MLP-3	MS3/EV2:Piers Sellers, Ph.D.		SRM: 87
TAL: Zaragoza	MS4: Fyodor Yurchikhin, Ph.D.	CETA	LO: LP03/30/F6
OMS-2: 143/121 sm			RO: RP04/26/F6
Deorb: TBD	FD: Phil Engelauf	Secondary:	FRCS: FRC4/26/F6
Inclination: 51.6		SHIMMER	ET: 115
EOM: 10/18/02		Various	RMS: 202
TD: 11:46 a.m.		DSOs/DTOs	Software: OI-29
Site: KSC			Cryo sets: 5 PRSD
RW: 15/33			Thrust: 104
Day (84)/Day (91)	**NOTES**: First outboard solar array truss		Xrange: TBD
Revs: 170	segment: S1. CETA cart, various		LNC WGT: 256,917
MET: 10/20:56	secondary experiments. Three spacewalks		S1 WGT: 29,000
VET: 209/01:29:28	to connect S1 truss and to configure		DEP WGT: N/A
SET: 990/23:29:37	coolant/power loops		LND WGT: 201,476

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Countdown and Mission Highlights

Date	Time	Event	Date	Time	Event
09/29	12:00 p.m.	Crew arrives at KSC	10/09	11:29 a.m.	ISS Docking
	09:00 p.m.	Countdown begins	10/10	10:41 a.m.	Spacewalk 1
09/30	04:00 p.m.	Pre-launch briefing	10/12	10:41 a.m.	Spacewalk 2
10/07	06:20 a.m.	Shuttle fueling begins	10/13	02:21 p.m.	Crew news conference
	12:30 p.m.	NASA coverage begins	10/14	10:41 a.m.	Spacewalk 3
		Crew photo op (replay)			
		Crew walkout (replay)	10/16	09:14 a.m.	ISS undocking
	02:31 p.m.	T-20 hold (10 minutes)			
	02:41 p.m.	Resume countdown	10/18	06:42 a.m.	Deorbit timeline begins
	02:52 p.m.	T-9 hold		TBD	Close cargo bay doors
	03:37 p.m.	Resume countdown		10:44 a.m.	Deorbit ignition
	03:46 p.m.	Launch		11:46 a.m.	Landing

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The Sun, Moon and Planets at Launch

10/02/02	Rise	Transit	Set	Az/Alt	Visibility
Sun	07:22 a.m.	01:09 p.m.	06:55 p.m.	253+14	Oh yes
Moon	01:59 p.m.	07:10 p.m.	12:20 a.m.	158+32	Yes (1st qtr)
Planets					No

Space Shuttle and Space Station Crew Data

Rank/Seat	Rank/Seating	Age	History/Time in Space	MS	DOB
CDR	Navy Capt. Jeffrey Ashby	48	STS-93,100 16.7 days	M/0	06/15/54
Pilot	Air Force Col. Pamela Melroy	41	STS-92 12.9	M/0	09/17/61
MS1/EV1	David Wolf, M.D.	46	STS-58, 86/Mir/89 142.0	M/0	08/23/56
MS2/FE	Sandra Magnus, Ph.D.	37	Rookie 0.0	S/0	10/30/64
MS3/EV2	Piers Sellers, Ph.D.	42	Rookie 0.0	M/2	04/11/55
MS4	Fyodor Yurchikhin, Ph.D. (CIS)	43	Rookie 0.0	M/2	01/03/59
	ISS Expedition 5 Crew				
ISS-5 CDR	Russian AF Col. Valeri Korzun	49	TM-24,STS-111/ISS-5 315	S/1	03/05/53
ISS-5 FE	Peggy Whitson, Ph.D.	42	STS-111/ISS-5 118	M/0	02/09/60
ISS-5 FE	Sergei Treschev	44	STS-111/ISS-5 118	M/2	08/18/58

* Time in space as of 10/02/02

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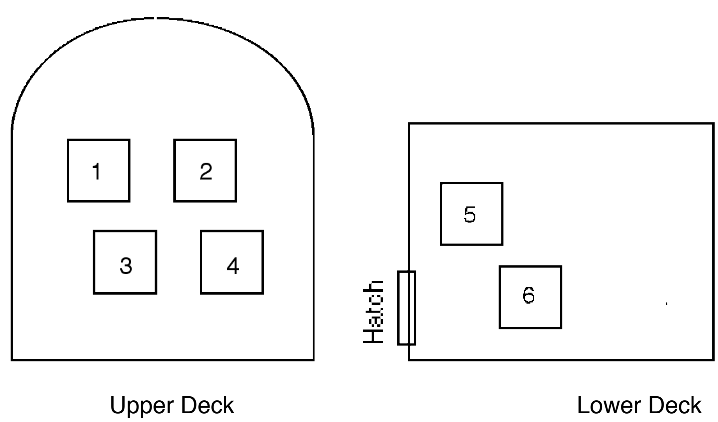
Crew Seating for Launch and Entry

Launch	**Entry**
1. Ashby	1. Ashby
2. Melroy	2. Melroy
3. Magnus	3. Magnus
4. Sellers	4. Wolf
5. Wolf	5. Sellers
6. Yurchikhin	6. Yurchikhin



STS-112 NASA Crew Biographies

1. Commander: Navy Capt. Jeffrey S. Ashby, 48; 3rd flight; Married, no kids; DOB: 06/15/54

PERSONAL DATA
Born June 16, 1954, and raised in the Colorado mountains where he developed a love for skiing, soaring, backpacking and fly fishing. Jeff and his wife, Paige, share their home with two spoiled dogs.

EDUCATION
Graduated from Evergreen High School, Evergreen, Colorado in 1972; received a Bachelor of Science degree in Mechanical Engineering from the University of Idaho in 1976, and a Master of Science degree in Aviation Systems from the University of Tennessee in 1993. Ashby is also a graduate of the Naval Test Pilot School, and the Naval Fighter Weapons School (Top Gun).

SPECIAL HONORS
Awards include the Distinguished Flying Cross, Defense Superior Service Medal, Defense Meritorious Service Medal, Meritorious Service Medal, four Navy Air Medals, two Navy Commendation Medals, Navy Achievement Medal, and two NASA Space Flight Medals. Ashby was selected as the Navy's Attack Aviator of the Year in 1991.

EXPERIENCE
Designated as a naval aviator in 1978, Ashby has accumulated over 7000 flight hours and 1000 aircraft carrier landings. He completed five aircraft carrier deployments, and flew 65 combat missions in the FA-18 during Operations Desert Storm and Southern Watch in Iraq, and Operation Continue Hope in Somalia. Ashby also participated in the development of the FA-18 aircraft, directing tests of the Hornet's smart weapons and electronic warfare systems. He flew test flights for over 80 projects including carrier suitability, ordnance release, and flying qualities of the night attack and reconnaissance versions of the Hornet. Ashby served as the Commanding Officer of Strike Fighter Squadron 94. Under his leadership, VFA-94 earned the coveted Battle "E" Award and designation as the Navy's top FA-18 squadron in 1994. Ashby reported to the Johnson Space Center for training with Group XV in March 1995.

SPACE FLIGHTS
STS-93 - Ashby's first space flight was in July 1999 as pilot aboard Space Shuttle Columbia which deployed the Chandra X-ray Observatory. Chandra is the third in a series of NASA's Great Observatories following the Hubble Space Telescope, and the Compton Gamma Ray Observatory. Chandra was designed to conduct comprehensive studies of the universe, and has enabled scientists to study exotic phenomena such as exploding stars, quasars, and black holes.

STS-100 - Ashby flew as pilot aboard Space Shuttle Endeavour in April 2001, on assembly flight 6A of the International Space Station. This was the most complex robotics flight in the history of the Space Shuttle program, responsible for installing both the Canadian-built Robotic Arm, and the Italian-made Logistics Module "Raffaello". Ashby operated the Shuttle robotic arm to lift a pallet containing the Space Station robotic arm from Endeavour's payload bay, and attached it to the International Space Station. After undocking Endeavour from the station, Ashby piloted a unique separation and fly-around profile that enabled IMAX-3D images of the International Space Station.

Ashby has flown a total of 267 orbits around the Earth and logged over 400 hours in space.

Ashby will serve as Commander of STS-112 scheduled to launch in August 2002 on Space Shuttle Atlantis.

FEBRUARY 2002

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2. Pilot: Air Force Col. Pamela Melroy, 41; 2nd flight; married, no kids; DOB: 09/17/61

PERSONAL DATA
Born September 17, 1961, in Palo Alto, California. Considers Rochester, New York, to be her hometown. Married to Christopher Wallace. She enjoys theatre, tap and jazz dancing, reading, cooking, and flying. Her parents, David and Helen Melroy, reside in upstate New York.

EDUCATION
Graduated from Bishop Kearney High School, Rochester, New York, in 1979. Bachelor of science degree in physics and astronomy from Wellesley College, 1983. Master of science degree in earth & planetary sciences from Massachusetts Institute of Technology, 1984.

ORGANIZATIONS
Member of the Society of Experimental Test Pilots, the Order of Daedalians, and the 99s.

SPECIAL HONORS
Recipient of the Air Force Meritorious Service Medal, First Oak Leaf Cluster; Air Medal, First Oak Leaf Cluster; Aerial Achievement Medal, First Oak Leaf Cluster; and Expeditionary Medal, First Oak Leaf Cluster

EXPERIENCE
Melroy was commissioned through the Air Force ROTC program in 1983. After completing a masters degree, she attended Undergraduate Pilot Training at Reese Air Force Base in Lubbock, Texas and was graduated in 1985. She flew the KC-10 for six years at Barksdale Air Force Base in Bossier City, Louisiana, as a copilot, aircraft commander and instructor pilot. Melroy is a veteran of JUST CAUSE and DESERT SHIELD/DESERT STORM, with over 200 combat and combat support hours. In June 1991, she attended the Air Force Test Pilot School at Edwards Air Force Base, California. Upon her graduation, she was assigned to the C-17 Combined Test Force, where she served as a test pilot until her selection for the astronaut program. She has logged over 5,000 hours flight time in over 45 different aircraft.

NASA EXPERIENCE
Selected as an astronaut candidate by NASA in December 1994, Melroy reported to the Johnson Space Center in March 1995. She completed a year of training and evaluation and is qualified for flight assignment as a shuttle pilot. Initially assigned to astronaut support duties for launch and landing, she has also worked Advanced Projects for the Astronaut Office. She was the pilot on STS-92 in 2000 and has logged over 309 hours in space. Melroy is assigned as pilot on STS-112 scheduled to launch in 2002.

SPACE FLIGHT EXPERIENCE
STS-92 Discovery (October 11-24, 2000) was launched from the Kennedy Space Center, Florida and returned to land at Edwards Air Force Base, California. During the 13-day flight, the seven member crew attached the Z1 Truss and Pressurized Mating Adapter 3 to the International Space Station using Discovery's robotic arm and performed four space walks to configure these elements. This expansion of the ISS opened the door for future assembly missions and prepared the station for its first resident crew. The STS-92 mission was accomplished in 202 orbits, traveling 5.3 million miles in 12 days, 21 hours, 40 minutes and 25 seconds.

AUGUST 2002

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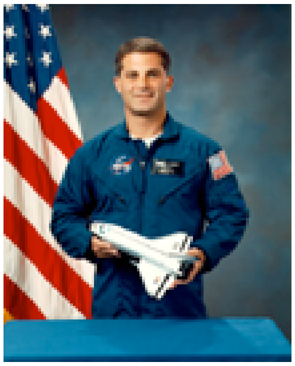
3. MS1/EV1: David Wolf, M.D., 46; 3rd flight; married, no kids; DOB: 08/23/56



PERSONAL DATA
Born August 23, 1956, in Indianapolis, Indiana. Married. He enjoys sport aerobatic flying, scuba diving, handball, running, and water skiing. His parents, Dr. and Mrs. Harry Wolf, reside in Indianapolis.

EDUCATION
Graduated from North Central High School, Indianapolis, Indiana, in 1974; received a bachelor of science degree in electrical engineering from Purdue University in 1978, and a doctorate of medicine from Indiana University in 1982. He completed his medical internship (1983) at Methodist Hospital in Indianapolis, Indiana, and USAF flight surgeon primary training at Brooks Air Force Base in San Antonio, Texas.

ORGANIZATIONS
Member of the Institute of Electrical and Electronics Engineers; the Aerospace Medical Association; the Experimental Aircraft Association; the International Aerobatic Club; and the Air National Guard.

SPECIAL HONORS
Recipient of the NASA Exceptional Engineering Achievement Medal (1990); NASA Inventor of the Year, 1992. Dr. Wolf graduated "with distinction" from the honors curriculum in electrical engineering at Purdue University and received an Academic Achievement Award upon graduation from medical school. He received the Carl R. Ruddell scholarship award for research in medical ultrasonic signal and image processing. He is a member of Eta Kappa Knu and Phi Eta Sigma honorary societies. Dr. Wolf has received 11 U.S. Patents and over 20 Space Act Awards for 3-dimensional tissue engineering technologies earning the Texas State Bar Patent of the Year in 1994. He has published over 40 technical papers.

EXPERIENCE
As a research scientist at the Indianapolis Center for Advanced Research from 1980 to 1983, he developed digital signal and image processing techniques utilizing matched filter detection of high time-bandwidth product transmissions producing "state of the art" high resolution medical ultrasonic images to the 100 micron level. He also developed new doppler demodulation techniques extending the range velocity product limitation of conventional pulsed doppler systems. He is a USAF senior flight surgeon in the Air National Guard (1982 to present) and is a member of the Board of Directors of the National Inventors Hall of Fame. He has logged over 2000 hours of flight time including air combat training as a weapons systems officer (F4 Phantom jet), T-38 Talon, and competition aerobatics (PITTS Special and Christen Eagle).

NASA EXPERIENCE
In 1983, Dr. Wolf joined the Medical Sciences Division, Johnson Space Center, Houston, Texas. He was responsible for development of the American Flight Echocardiograph for investigating cardiovascular physiology in microgravity. Upon completion he was assigned as chief engineer for design of the Space Station medical facility. In 1986 he was assigned to direct development of the Space Bioreactor and associated tissue engineering and cancer research applications utilizing controlled gravitational conditions. This resulted in the state of the art NASA rotating tissue culture systems. He has particular expertise in the design of real time computer process control systems, communications, bioprocessing, physiology, fluid dynamics, and aerospace medicine. Dr. Wolf is an active public speaker.

Selected as a NASA astronaut in January 1990, Dr. Wolf became qualified for space flight in July 1991. His technical assignments have included Orbiter vehicle processing and test at Kennedy Space Center (1991-1992) and spacecraft communications (CAPCOM) (1994-1995). He is qualified for Extravehicular Activity (Spacewalk), Remote Manipulator System (Robot Arm), and Rendezvous. He was CAPCOM for the first and third Shuttle-Mir rendezvous. He trained at the Gagarin Cosmonaut Training Center in Star City, Russia, in preparation for a long-duration stay aboard Mir. Most recently, he was assigned to the EVA Development Group focusing on assembly techniques for the International Space Station. Dr. Wolf has logged 142 days in space including a 4 hour EVA in a Russian Orlan spacesuit. He was a mission specialist on STS-58, and served as Board Engineer 2 for 119 days aboard the Russian Space Station Mir. Currently, he is.assigned to STS-112 scheduled to launch in 2002.

SPACEFLIGHT EXPERIENCE

STS-58 Columbia (10/16/93-11/1/93) was a 14-day dedicated Spacelab life sciences research mission. During this record length shuttle mission the crew conducted neurovestibular, cardiovascular, cardiopulmonary, metabolic, and musculoskeletal research utilizing microgravity to reveal fundamental physiology normally masked by earth gravity. Mission duration was 336 hours, 13 minutes, 01 seconds. On September 25, 1997, Dr. Wolf launched aboard Space Shuttle Atlantis as part of the STS-86 crew. Following docking, September 28, 1997 marked the official start of his 119 days aboard Mir. He returned with the crew of STS-89 aboard Shuttle Endeavour on January 31, 1998. Mission duration was 128 days.

FEBRUARY 2002

4. MS2/FE: Sandra H. Magnus, Ph.D., 37; 1st flight; single, no kids; DOB: 10/30/64

PERSONAL DATA
Born October 30, 1964 in Belleville, Illinois. Enjoys soccer, reading, travel, water activities .

EDUCATION
Graduated from Belleville West High School, Belleville, Illinois, in 1982; received a bachelor degree in physics and a master degree in electrical engineering from the University of Missouri-Rolla in 1986 and 1990, respectively, and a doctorate from the School of Material Science and Engineering at the Georgia Institute of Technology in 1996.

ORGANIZATIONS
ASM/TMS (Metallurgical/Material Society), Material Research Society.

SPECIAL HONORS
Outstanding Graduate Teaching Assistant Award (1994 and 1996), Saturn Team Award (1994), Performance Bonus Award (1989).

EXPERIENCE
During 1986 to 1991, Magnus worked for McDonnell Douglas Aircraft Company as a stealth engineer where she worked on internal research and development studying the effectiveness of RADAR signature reduction techniques. She was also assigned to the Navy's A-12 Attack Aircraft program primarily working on the propulsion system until the program was cancelled. From 1991 to 1996, Magnus completed her thesis work which was supported by NASA-Lewis Research Center through a Graduate Student Fellowship and involved investigations on materials of interest for "Scandate" thermionic cathodes. Thermodynamic equilibria studies along with conductivity and emission measurements on compounds in the Ba O.SC2O3.WO3 ternary system were conducted to identify compounds with potential use in these types of cathodes.

NASA EXPERIENCE
Selected by NASA in April 1996, Dr. Magnus reported to the Johnson Space Center in August 1996. Having completed two years of training and evaluation, she is qualified for flight assignment as a mission specialist. From January 1997 through May 1998 Dr. Magnus worked in the Astronaut Office Payloads/Habitability Branch. Her duties involved working with ESA, NASDA and Brazil on science freezers, glove boxes and other facility type payloads. In May 1998 Dr. Magnus was assigned as a "Russian Crusader" which involves travel to Russia in support of hardware testing and operational products development. Currently, Dr. Magnus is assigned to STS-112 scheduled to launch in 2002.

FEBRUARY 2002

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5. MS3/EV2: Piers J. Sellers, Ph.D., 42; 1st flight; married, 2 kids; DOB: 04/11/55

PERSONAL DATA
Born April 11, 1955 in Crowborough, Sussex, United Kingdom. Married. Two children.

EDUCATION
Graduated from Cranbrook School, Cranbrook, Kent, United Kingdom, in 1973; received a bachelor of science degree in ecological science from the University of Edinburgh (Scotland) in 1976, and received a doctorate in biometeorology from Leeds University (United Kingdom) in 1981.

ORGANIZATIONS
American Geophysical Union (AGU), American Meteorology Society (AMS).

AWARDS
NASA Exceptional Scientific Achievement Award in 1994; Arthur Fleming Award in 1995; Fellow of AGU in 1996; AMS Houghton Award in 1997.

EXPERIENCE
Piers has worked on research into how the Earth's Biosphere and Atmosphere interact. His work involved computer modeling of the climate system, satellite remote sensing studies and field work utilizing aircraft, satellites and ground teams in places such as Kansas, Russia, Africa, Canada and Brazil.

NASA EXPERIENCE
Selected as an astronaut candidate by NASA in April 1996, Piers reported to the NASA Johnson Space Center in August 1996. Having completed two years of training and evaluation, he is qualified for flight assignment as a mission specialist. He was initially assigned technical duties in the Astronaut Office Computer Support Branch, and most recently served in the Astronaut Office Space Station Branch. Currently, he is assigned to STS-112 scheduled to launch in 2002.

FEBRUARY 2002

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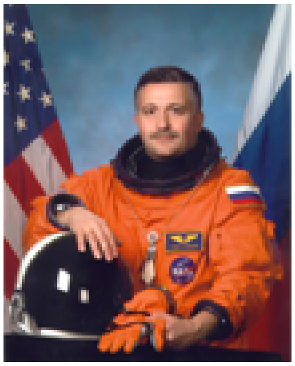
6. MS4: Fyodor Nikolayevich Yurchikhin, Ph.D., 43; 1st flight; married, 2 kids; DOB: 01/03/59



PERSONAL DATA
Born January 3, 1959, in Batumi, Autonomous Republic of Ajara in Georgia. Married to Larisa Anatolievna Yurshikina, born in Shyolkovo, Moscow region. They have two daughters. His father, Nikolai Fyodorovich Yurchikhin, and mother, Mikrula Sofoklevna Yurchikhina, reside in Sindos, Greece. He also has a brother, 2 years younger. Hobbies include collecting stamps and space logos, sports, history of cosmonautics, and promotion of space. He also enjoys reading history, science fiction and the classics.

EDUCATION
After graduation from high school in Batumi in 1976, he entered the Moscow Aviation Institute named after Sergey Ordzhonikidze. He finished studying in 1983, and is qualified as a mechanical engineer, specializing in airspace vehicles. In 2001, he graduated from the Moscow Service State University with a Ph.D. in economics.

EXPERIENCE
After graduating from the S. Ordzhonikidze Moscow Aviation Institute, Yurchikhin worked at the Russian Space Corporation Energia from September 1983 until August 1997. 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.

In August 1997, he was enrolled in the RSC Energia cosmonaut detachment as a cosmonaut-candidate.

From January 1998 to November 1999, he completed his basic training course. In November 1999, he was qualified as a test cosmonaut. In January 2000, he started training in the test-cosmonaut group for the ISS program.

Currently, Yurchikhin is assigned to STS-112 scheduled to launch in 2002.

AUGUST 2002

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1. ISS-5: Peggy Whitson, 42; 1st flight ongoing; married, no kids; DOB: 02/09/60

PERSONAL DATA
Born February 9, 1960 in Mt. Ayr, Iowa. Hometown is Beaconsfield, Iowa. Married to Clarence F. Sams, Ph.D. She enjoys windsurfing, biking, basketball, water skiing.

EDUCATION
Graduated from Mt. Ayr Community High School, Mt. Ayr, Iowa, in 1978; received a bachelor of science degree in biology/chemistry from Iowa Wesleyan College in 1981, and a doctorate in biochemistry from Rice University in 1985.

AWARDS/HONORS
Two patents approved (1997, 1998); Group Achievement Award for Shuttle-Mir Program (1996); American Astronautical Society Randolph Lovelace II Award (1995); NASA Tech Brief Award (1995); NASA Space Act Board Award (1995, 1998); NASA Silver Snoopy Award (1995); NASA Exceptional Service Medal (1995); NASA Space Act Award for Patent Application; NASA Certificate of Commendation (1994); Submission of Patent Disclosure for "Method and Apparatus for the Collection, Storage, and Real Time Analysis of Blood and Other Bodily Fluids (1993); Selected for Space Station Redesign Team (March-June 1993); NASA Sustained Superior Performance Award (1990); Krug International Merit Award (1989); NASA-JSC National Research Council Resident Research Associate (1986-1988); Robert A. Welch Postdoctoral Fellowship (1985-1986); Robert A. Welch Predoctoral Fellowship (1982-1985), Summa Cum Laude from Iowa Wesleyan College (1981); President's Honor Roll (1978-81); Orange van Calhoun Scholarship (1980); State of Iowa Scholar (1979); Academic Excellence Award (1978).

EXPERIENCE
From 1981 to 1985, Whitson conducted her graduate work in biochemistry at Rice University, Houston, Texas, as a Robert A. Welch Predoctoral Fellow. Following completion of her graduate work she continued at Rice University as a Robert A Welch Postdoctoral Fellow until October 1986. Following this position, she began her studies at NASA Johnson Space Center, Houston, Texas, as a National Research Council Resident Research Associate. From April 1988 until September 1989, Whitson served as the Supervisor for the Biochemistry Research Group at KRUG International, a medical sciences contractor at NASA-JSC. In 1991-1997, Whitson was also invited to be an Adjunct Assistant Professor in the Department of Internal Medicine and Department of Human Biological Chemistry and Genetics at University of Texas Medical Branch, Galveston, Texas. In 1997, Whitson began a position as Adjunct Assistant Professor at Rice University in the Maybee Laboratory for Biochemical and Genetic Engineering.

NASA EXPERIENCE
From 1989 to 1993, Whitson worked as a Research Biochemist in the Biomedical Operations and Research Branch at NASA-JSC. In 1990, she gained the additional duties of Research Advisor for the National Research Council Resident Research Associate. From 1991-1993, she served as Technical Monitor of the Biochemistry Research Laboratories in the Biomedical Operations and Research Branch. From 1991-1992 she was the Payload Element Developer for Bone Cell Research Experiment (E10) aboard SL-J (STS-47), and was a member of the US-USSR Joint Working Group in Space Medicine and Biology. In 1992, she was named the Project Scientist of the Shuttle-Mir Program (STS-60, STS-63, STS-71, Mir 18, Mir 19) and served in this capacity until the conclusion of the Phase 1A Program in 1995. From 1993-1996 Whitson held the additional responsibilities of the Deputy Division Chief of the Medical Sciences Division at NASA-JSC. From 1995-1996 she served as Co-Chair of the U.S.-Russian Mission Science Working Group. In April 1996, she was selected as an astronaut candidate and started training, in August 1996. Upon completing two years of training and evaluation, she was assigned technical duties in the Astronaut Office Operations Planning Branch and served as the lead for the Crew Test Support Team in Russia from 1998-99. Whitson is currently training to serve as a prime crew member on Increment 5 which will launch aboard Utilization Flight 2 (STS-112) from Florida.

MARCH 2002

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2. ISS-5: Russian Air Force Col. Valeri Korzun, 49; 2nd flight ongoing; single, 1 child; DOB: 03/05/53

PERSONAL DATA
Born March 5, 1953, in Krasny Sulin. He has a son, Nikita. His father is Korzun Grigori Andreevich, and his mother, Korzun Maria Arsentievna.

EDUCATION
Graduated from Kachin Military Aviation College in 1974; Commander Department of the Gagarin Air Force Academy in 1987.

SPECIAL HONORS
Awarded six Air Force Medals.

EXPERIENCE
After graduation from the Military College in 1974, he served as a pilot, a senior pilot, flight section, commander of air squadron in the Air Force. In 1987, he was selected as a cosmonaut for training at the Gagarin Cosmonaut Training Center after successfully graduating from the Gagarin Military Air-Force Academy.

Starting December 1987 through June 1989, he took the course of General Space Training. Korzun was certified as a Test-Cosmonaut in 1989.

From September 1989 through September 1992, he trained for space flight as part of the test-cosmonauts group. From October 1992 to March 1994, he took a training course for flight onboard the spacecraft "Soyuz TM" as commander of the rescue vehicle. From March 1994 to June 1995, he trained as a group member for flight onboard the orbital complex "Mir".

March 1994 through January 1995, he served as a deputy Director of the 27KC crew training complex flight as supervisor of communication with the crew.

Korzun is a 1st class military pilot. He has logged 1473 hours, and has flown 4 types of aircrafts. He is an Instructor of Parachute Training, and has completed 377 parachute jumps.

June 1995 through August 1996, he completed training as a flight engineer for the Mir-22/ NASA-3 and "Cassiopia" (sponsored by CNES) programs.

August 17, 1996 through March 2, 1997, he completed a 197-day flight onboard the Mir station. The program included joint flights with NASA 2, 3 and 4 astronauts, a French astronaut and a German astronaut. Korzun performed 2 space walks totaling 12 hours and 33 minutes.

OCTOBER 2000

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3. ISS-5: Sergei Treschev, 42; 1st flight ongoing; married, 2 kids; DOB: 08/18/58

PERSONAL DATA
Born 18 August, 1958, in Volynsky District, Lipetsk Region (Russia). Married to Elvira Victorovna Trescheva. There are two sons in the family, Dmitry and Alexy. His father is Yevgeny Georgievich Treschev, and his mother is Nina Davydovna Trescheva. His hobbies include soccer, volleyball, ice hockey, hiking, tennis, music, photography, and video.

EDUCATION
Graduated from the Moscow Energy Institute in 1982.

EXPERIENCE
From 1982 to 1984, he served as a group leader in an Air Force regiment. From 1984 to 1986, he worked as a foreman and as an engineer at the RSC ENERGIA. His responsibilities included the analysis and planning of cosmonaut activities aboard the Orbital Station and their inflight technical training. He also developed technical documentation and was involved in setting up cosmonaut training for flight together with Yu. Gagarin Cosmonaut Training Center. He supported crew training aboard the MIR Orbital Station in order to maintain their skills in performing certain descent and emergency escape operations. He also participated as a test operator in testing of the ground-based complex (transport vehicle/MIR core module/KVANT-2 module docked configuration) to optimize the Life Support System of ??367/734.

In 1992, he was enrolled in the RSC ENERGIA cosmonaut detachment. From 1992 to 1994, he completed his basic training course. From 1994 to 1996, he underwent a course of advance training as a test cosmonaut.

From June 1999 to July 2000 Treschev trained as a flight engineer for the Soyuz-TM backup ISS contingency crew.

OCTOBER 2000

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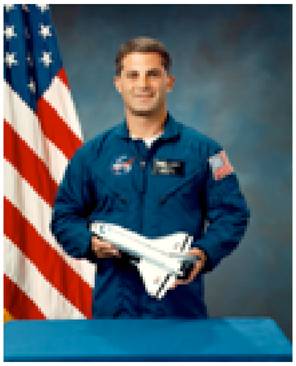
STS-112 Crew Photographs

Commander Jeffrey Ashby

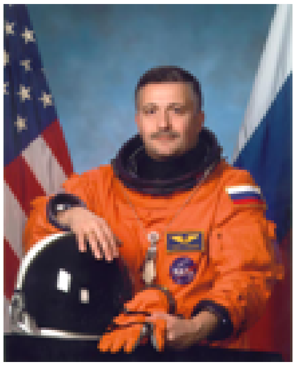
Pilot Pamela Melroy



MS1/EV1 David Wolf

MS2/FE Sandra Magnus

MS3/EV2 Piers Sellers



MS4 Fyodor Yurchikhin

ISS-5 Crew Photographs

ISS-5 FE Peggy Whitson
Launch on STS-111
Land on STS-113

ISS-5 FE Sergei Treschev
Launch on STS-111
Land on STS-113

ISS-5 CDR Valery Korzun
Launch on STS-111
Land on STS-113

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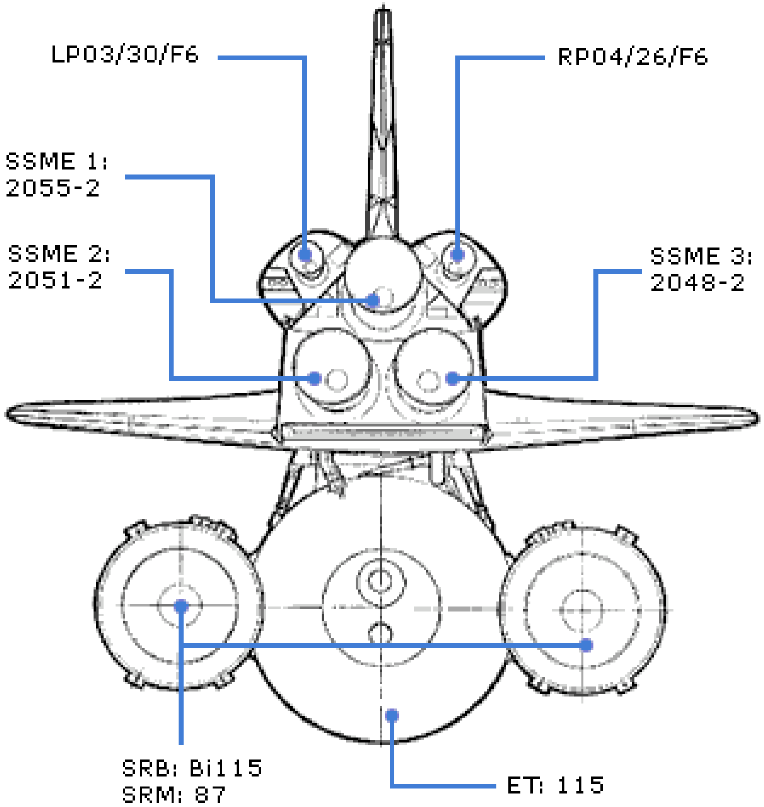
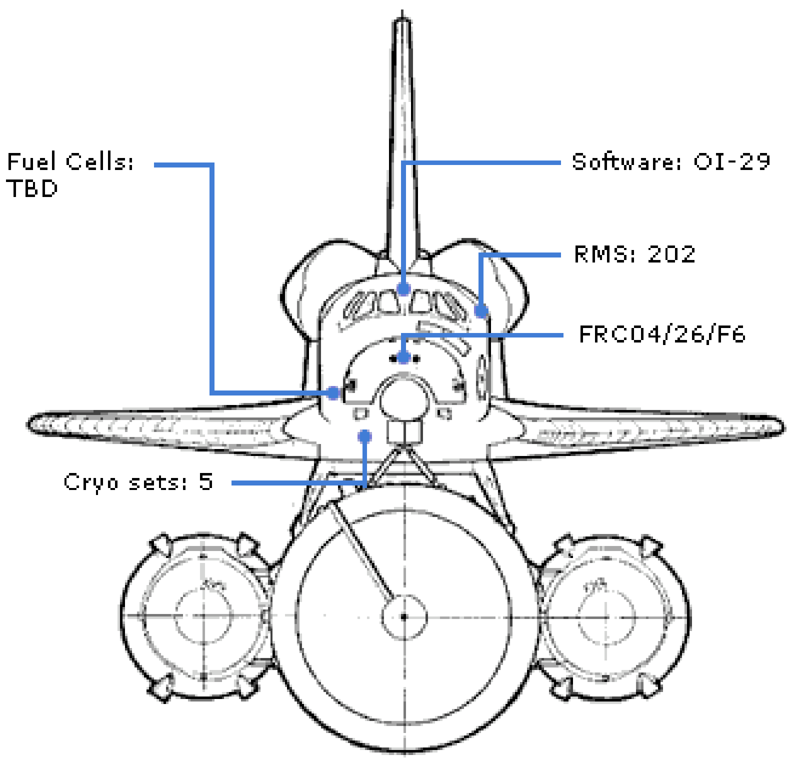
STS-112 Flight Hardware





STS-112 Ascent Events Summary

	Time	Event	Inertial Velocity (mph)
RTLS	0:11	START ROLL MANEUVER	927
ONLY	0:18	END ROLL MANEUVER	1002
	0:33	START THROTTLE DOWN (72%)	1207
02:21	0:49	START THROTTLE UP (104.5%)	1432
	1:01	MAX Q (753 psf)	1650
	2:03	SRB STAGING	3628
	2:13	START OMS ASSIST (1:29 duration)	3750
TAL	**2:22**	2 ENGINE TAL MORON (104.5%, 2s)	3887
ONLY	2:23	2 ENGINE TAL BEN GUERIR (104.5%, 2s)	3887
	2:27	2 ENGINE TAL ZARAGOZA (104.5%, 2s)	3955
02:16	3:54	NEGATIVE RETURN (104.5%, 3s)	5591
ATO	**4:39**	PRESS TO ATO (104.5%, 2s, 160 u/s)	6819
to	5:23	DROOP ZARAGOZA (109%,Os)	8183
Orbit	5:26	SINGLE ENGINE OPS-3 ZARAGOZA (109%,Os,2EO SIMO)	8251
	5:47	ROLL TO HEADSUP	9001
03:45	6:04	SINGLE ENGINE TAL ZARAGOZA (104.5%,2s,2EO SIMO)	9751
	6:30	PRESS TO MECO (104.5%, 2s, 160 u/s)	10842
		SINGLE ENGINE TAL MORON (109%,Os,2EO SEQ,1st EO @ 5670 VI)	11046
		SINGLE ENGINE TAL BEN GUERIR (109%,Os,2EO SEQ,1st EO @ 5700 VI)	11046
	7:03	NEGATIVE BEN GUERIR (2@67%)	12478
	7:04	SINGLE ENGINE PRESS-TO-MECO (104.5%, 2s, 633 u/s)	12615
	7:22	3G LIMITING	13638
	7:22	NEGATIVE MORON (2@67%)	13638
	7:42	LAST 2 ENG PRE-MECO TAL ZARAGOZA (67%)	14933
	7:48	LAST SINGLE ENG PRE-MECO TAL ZARAGOZA (104.5%)	15342
	7:53	LAST 3 ENG PRE-MECO TAL ZARAGOZA (67%)	15683
	7:54	23K	15683
	8:17	LAST TAL DIEGO GARCIA	17183
	8:24	MECO COMMANDED	17524
	8:30	ZERO THRUST	17607

MECO apogee/perigee: 137/36 statute miles
OMS-2 apogee/perigee: 143/121 statute miles

❑ ❑ ❑

Shuttle and Payload Weights

Vehicle/Payload	Pounds
Shuttle Liftoff Weight:	4,521,436
Orbiter/Payload Liftoff Weight:	256,917
Orbiter/Payload Landing Weight:	201,476

STS-112 Mission Statistics

111th	Shuttle mission since STS-1	**25th**	51.6-degree incl. flight
4th	Of 5 flights planned for 2002	**60th**	Planned KSC landing
86th	Post-Challenger mission	**91st**	Day landing
26th	Flight of Atlantis (OV-104)	**46th**	Day landing at KSC
49th	Launch off pad 39B	**1st**	KSC landing in a row
84th	Day launch	**16.69**	Years since STS-51L
37th	Day launch off pad 39B	**6,091.21**	Days since 51L

❑ ❑ ❑

Atlantis (OV-104)

Flow Director: TBD

OV	#	STS	Launch	D/	H:	M:	S	Notes
-	-	FRF	09/12/85	00	00	00	00	FRF: 2011, 2019, 2017; 100%
1	21	51-J	10/03/85	04	01	44	38	DOD
2	23	61B	11/26/85	06	21	04	49	3 comsats EASE/ACCESS EVA
3	27	27	12/02/88	04	09	05	37	DOD (Lacrosse?)
4	29	30	05/04/89	04	00	56	28	Magellan Venus Probe
5	31	34	10/18/89	04	23	39	20	Galileo Jupiter Probe
6	34	36	02/28/90	04	10	18	22	DOD
7	37	38	11/15/90	04	21	54	31	DOD
8	39	37	04/05/91	05	23	32	44	Gamma Ray Observatory
9	42	43	08/02/91	08	21	21	25	TDRS-5
10	44	44	11/19/91	06	22	50	44	Defense Support Program satellite
11	46	45	03/24/92	08	22	09	28	ATLAS-1 (atmospheric research flight)
12	49	46	07/31/92	07	23	15	03	TSS (cable jams); EURECA deployment
13	66	66	11/03/94	10	22	34	02	ATLAS-3
14	69	71	06/27/95	09	19	22	17	Mir Docking No. 1
15	73	74	11/12/95	08	04	30	44	Mir Docking No. 2
16	76	76	03/22/96	09	05	15	53	Mir Docking No. 3
17	79	79	09/16/96	10	03	19	28	Mir Docking No. 4
18	81	81	01/12/97	10	04	55	21	Mir Docking No. 5
19	84	84	05/15/97	09	05	19	56	Mir Docking No. 6
20	87	86	09/25/97	10	19	20	50	Mir Docking No. 7
21	98	101	05/29/00	09	20	09	08	ISS 2A.2a (FGB servicing)
22	99	106	09/08/00	11	19	11	01	ISS 2A.2b (Zvezda servicing)
23	102	98	02/07/01	12	21	20	03	ISS 5A (Destiny module)
24	105	104	07/12/01	12	18	34	56	ISS 7A (airlock)
25	109	110	04/08/02	10	19	42	38	ISS-8A (S0 truss)
			TOTAL:	**209**	**01**	**29**	**28**	

STS-112 Launch and Flight Control Personnel

Space Shuttle Mission Control

Shift	Flight Director	CAPCOM	PAO
Ascent	John Shannon	Ken Ham Duane Carey	Rob Navias
STS Orbit 1 (lead)	Phil Engelauf	Lisa Nowak	Rob Navias
STS Orbit 2	Cathy Koerner	Cady Coleman	Kelly Humphries
STS Planning	John Curry	Stephanie Wilson	John Ira Petty
STS Entry	John Shannon	Ken Ham Duane Carey	Rob Navias
STS Moscow	Bryan Austin	N/A	N/A

Space Station Mission Control

Shift	Flight Director	CAPCOM	
ISS Orbit 1	Mark Kirasich	Robert Thirsk	N/A
ISS Orbit 2 (lead)	Andrew Algate	Stan Love	N/A
ISS Oribt 3	Annette Hasbrook	Michael Massimino	N/A

STS-112 Quick-Look Personnel List

Position	Name
Launch director	Michael Leinbach
NASA Test Director	Jeff Spaulding
Voice of launch control	Bruce Buckingham
Voice of mission control	Rob Navias
Launch weather pilot	Charles Precourt
Landing weather pilot (KSC)	Charles Precourt
Landing weather pilot (EAFB)	Michael Bloomfield
TAL pilot-Banjul	N/A
TAL pilot-Zaragoza	Charles Hobaugh
TAL pilot-Ben Guerir	Not staffed
TAL pilot-Moron	Gregory Johnson
JSC PAO rep at KSC	Kylie Moritz
JSC PAO rep at Moscow	N/A
Astronaut support personnel	Robert Behnken (lead)

STS-112 Pre-Launch Timeline

Editor's Note

Due to post Sept. 11 security precautions, NASA for the moment is not releasing mission-specific shuttle countdowns in advance. Only the terminal phase of the countdown can be posted here.

ACRONYMS: STA: Shuttle Training Aircraft; MEC: master events controller; PRSD: power reactant storage and distribution system; TSM: tail service mast; SSME: space shuttle main engine; BFC: backup flight computer; NEP: non-essential personnel; SSV: space shuttle vehicle; PIC: pyro initiator; FCE: flight crew equipment; GPS: general purpose computer; NTD: NASA test director; LOX: liquid oxygen; LH2: liquid hydrogen; APU: auxilliary power unit

TIME	EVENT
	Monday, Oct. 7, 2002
TBD	

STS-112 Launch Windows

Editor's note: The "preferred" launch times listed below are embargoed. They cannot be broadcast or published until NASA has officiallly released the actual launch window 24 hours before launch.

Date	Window Open	Preferred T-0	Window Close
10/07/02	03:40:51 p.m.	03:45:51 p.m.	03:50:50 p.m.

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STS-112 Flight Plan

Editor's Note
Due to post Sept. 11 security precautions, NASA for the moment is not releasing the shuttle's exact launch time until 24 hours before liftoff. The following flight plan is embarged until then. The launch time given in the flight plan cannot be released in any form - traditional print, electronic media or broadcast - until it is officially released by NASA.

TIME	DD	HH	MM	EVENT
10/07/02				
Mon 03:46 PM	00	00	00	STS-112 launch
Mon 03:55 PM	00	00	09	Main engine cutoff
Mon 04:36 PM	00	00	50	OMS-2 burn to circularize orbit
Mon 05:16 PM	00	01	30	Payload bay door opening
Mon 06:16 PM	00	02	30	GIRA installation/SEE setup
Mon 06:16 PM	00	02	30	PGSC setup
Mon 07:01 PM	00	03	15	OCAC setup
Mon 07:21 PM	00	03	35	NC1 rendezvous rocket firing
Mon 07:26 PM	00	03	40	Group B computer powerdown
Mon 09:46 PM	00	06	00	Crew sleep begins
10/08/02				
Tue 05:46 AM	00	14	00	Crew wakeup
Tue 07:46 AM	00	16	00	Middeck payload check
Tue 08:41 AM	00	16	55	NC2 rendezvous rocket firing
Tue 08:46 AM	00	17	00	EMU checkout prep
Tue 09:16 AM	00	17	30	EMU checkout
Tue 09:16 AM	00	17	30	Robot arm (RMS) powerup
Tue 09:31 AM	00	17	45	RMS checkout
Tue 10:16 AM	00	18	30	RMS payload bay survey
Tue 10:46 AM	00	19	00	SAFER checkout
Tue 10:46 AM	00	19	00	RMS powerdown
Tue 11:01 AM	00	19	15	MAGR unstow and setup
Tue 11:16 AM	00	19	30	EMU prep for transfer to ISS
Tue 12:01 PM	00	20	15	Ergometer setup
Tue 12:01 PM	00	20	15	OIU activation
Tue 12:31 PM	00	20	45	Crew meal

TIME	DD	HH	MM	EVENT
Tue 01:31 PM	00	21	45	OSVS powerup
Tue 01:31 PM	00	21	45	SHIMMER installation
Tue 01:46 PM	00	22	00	OSVS checkout
Tue 01:46 PM	00	22	00	SHIMMER checkout
Tue 01:56 PM	00	22	10	SHIMMER deactivation and stow
Tue 02:31 PM	00	22	45	OSVS powerdown
Tue 02:46 PM	00	23	00	Logistics transfer preps
Tue 03:31 PM	00	23	45	ODS ring extension
Tue 03:46 PM	01	00	00	Rendeavous tools checkout
Tue 05:31 PM	01	01	45	NC3 rendezvous rocket firing
Tue 07:46 PM	01	04	00	Crew sleep begins
10/09/02				
Wed 03:46 AM	01	12	00	STS crew wakeup
Wed 05:16 AM	01	13	30	ISS crew wakeup
Wed 06:06 AM	01	14	20	Group B computer powerup
Wed 06:21 AM	01	14	35	ISS rendezvous timeline begins
Wed 06:41 AM	01	14	55	NH rendezvous rocket firing
Wed 07:11 AM	01	15	25	EMU removal
Wed 07:16 AM	01	15	30	ISS daily planning conference
Wed 07:26 AM	01	15	40	NC4 rendezvous rocket firing
Wed 08:59 AM	01	17	13	TI rendezvous rocket firing
Wed 10:01 AM	01	18	15	ISS crew meal
Wed 10:41 AM	01	18	55	Begin approach timeline
Wed 11:06 AM	01	19	20	ISS crew configures PMA-2 for docking
Wed 11:29 AM	01	19	43	Docking
Wed 12:01 PM	01	20	15	Hatch leak checks
Wed 12:11 PM	01	20	25	Group B computer powerdown
Wed 12:31 PM	01	20	45	ODS prepped for ingress
Wed 12:51 PM	01	21	05	Post-rendezvous PGSC config
Wed 12:51 PM	01	21	05	Hatch opening
Wed 01:36 PM	01	21	50	Handshake and welcome ceremony
Wed 01:51 PM	01	22	05	Safety briefing
Wed 02:06 PM	01	22	20	EMU reconfig
Wed 02:36 PM	01	22	50	O2 P/B config
Wed 03:06 PM	01	23	20	REBA checkout
Wed 03:31 PM	01	23	45	EMU to airlock check
Wed 03:31 PM	01	23	45	EVA tools configured
Wed 03:46 PM	02	00	00	SSRMS S1 install tagup
Wed 04:01 PM	02	00	15	Soyuz suits/seatliner preps
Wed 04:41 PM	02	00	55	Joint EVA procedures review
Wed 05:31 PM	02	01	45	ISS daily planning conference
Wed 07:46 PM	02	04	00	STS/ISS crew sleep begins
10/10/02				
Thu 03:46 AM	02	12	00	STS crew wakeup
Thu 04:16 AM	02	12	30	ISS crew wakeup
Thu 05:31 AM	02	13	45	ISS daily planning conference
Thu 05:46 AM	02	14	00	EVA camera setup
Thu 06:06 AM	02	14	20	OSVS powerup
Thu 06:06 AM	02	14	20	EVA prep begins
Thu 06:31 AM	02	14	45	SSRMS grapples S1 truss
Thu 07:06 AM	02	15	20	S1 in high hover position
Thu 07:36 AM	02	15	50	Quest airlock depress to 10.2 psi
Thu 07:36 AM	02	15	50	S1 attachment begins
Thu 08:56 AM	02	17	10	EVA-1: Spacesuit purge begins
Thu 08:56 AM	02	17	10	Quest airlock repressurized to 14.7 psi

TIME	DD	HH	MM	EVENT
Thu 09:06 AM	02	17	20	Whitson/SSRMS: 1st capture
Thu 09:11 AM	02	17	25	EVA-1: Oxygen pre-breathe begins
Thu 09:31 AM	02	17	45	Whitson/SSRMS: 2nd capture
Thu 09:56 AM	02	18	10	S1 bolt loading
Thu 10:11 AM	02	18	25	EVA-1: Quest airlock depressurization begins
Thu 10:16 AM	02	18	30	OSVS powerdown
Thu 10:36 AM	02	18	50	SSRMS ungrapples S1
Thu 10:41 AM	02	18	55	EVA-1: Egress
Thu 10:56 AM	02	19	10	EVA-1: Sortie setup
Thu 10:56 AM	02	19	10	ISS midday meal
Thu 11:41 AM	02	19	55	EVA-1: EV1 mates zenith tray
Thu 11:41 AM	02	19	55	EVA-1: EV2 radiator beam launch lock release
Thu 12:31 PM	02	20	45	EVA-1: SASA deploy (EV1 and EV2)
Thu 01:46 PM	02	22	00	EVA-1: EV1 disconnects CETA cart locks
Thu 01:46 PM	02	22	00	EVA-1: EV2 radiator beam launch lock release
Thu 02:16 PM	02	22	30	EVA-1: S1 nadir ETVCG installation (EV1 and EV2)
Thu 03:46 PM	03	00	00	EVA-1: EV1 disconnects CETA cart launch locks
Thu 03:46 PM	03	00	00	EVA-1: EV2 mates S1 nadir tray
Thu 04:21 PM	03	00	35	EVA-1: Clean up
Thu 04:21 PM	03	00	35	RMS powerdown
Thu 04:51 PM	03	01	05	EVA-1: Airlock ingress
Thu 05:11 PM	03	01	25	EVA-1: Airlock repressurization
Thu 06:31 PM	03	02	45	ISS daily planning conference
Thu 08:46 PM	03	05	00	STS/ISS crew sleep begins
10/11/02				
Fri 04:46 AM	03	13	00	STS/ISS crew wakeup
Fri 06:46 AM	03	15	00	ISS daily planning conference
Fri 07:46 AM	03	16	00	STS/ISS crew off duty time
Fri 09:46 AM	03	18	00	N2 transfer
Fri 10:46 AM	03	19	00	Joint STS/ISS crew meal
Fri 11:46 AM	03	20	00	PCG-STES transfer to ISS
Fri 11:46 AM	03	20	00	Logistics transfers begin
Fri 11:46 AM	03	20	00	Tool configuration
Fri 12:46 PM	03	21	00	Soyuz suits/seatliner preps
Fri 01:26 PM	03	21	40	EVA camera setup
Fri 02:01 PM	03	22	15	STEL SYS cross transfer
Fri 02:56 PM	03	23	10	PAO event: MS1/MS2/MS3
Fri 03:46 PM	04	00	00	EVA-2: Procedures review
Fri 04:46 PM	04	01	00	ISS daily planning conference
Fri 05:01 PM	04	01	15	ISS crew off duty time
Fri 05:31 PM	04	01	45	Joint STS/ISS crew meal
Fri 07:46 PM	04	04	00	STS/ISS crew sleep begins
10/12/02				
Sat 03:46 AM	04	12	00	STS crew wakeup
Sat 04:16 AM	04	12	30	ISS crew wakeup
Sat 05:56 AM	04	14	10	EVA prep begins
Sat 06:16 AM	04	14	30	ISS daily planning conference
Sat 07:16 AM	04	15	30	Reboost config 3
Sat 07:31 AM	04	15	45	Quest airlock depress to 10.2 psi
Sat 08:16 AM	04	16	30	Logistics transfers resume
Sat 08:46 AM	04	17	00	EVA-2: EMU purge
Sat 08:51 AM	04	17	05	Quest airlock repressurized to 14.7 psi
Sat 09:01 AM	04	17	15	EVA-2: Oxygen pre-breathe
Sat 09:36 AM	04	17	50	RMS powerup
Sat 10:01 AM	04	18	15	EVA-2: Airlock depressurization

TIME	DD	HH	MM	EVENT
Sat 10:31 AM	04	18	45	EVA-2: Airlock egress
Sat 10:46 AM	04	19	00	EVA-2: Sortie setup
Sat 11:16 AM	04	19	30	EVA-2: EV1: Z-P6 and PVR SPDS
Sat 11:16 AM	04	19	30	EVA-2: EV2: Z1-lab loop A
Sat 11:46 AM	04	20	00	EVA-2: EV2: Connect ATA umbilical
Sat 12:01 PM	04	20	15	EVA-2: EV1: CETA cart launch locks
Sat 12:26 PM	04	20	40	EVA-2: EV1/EV2: Lab camera installation
Sat 01:41 PM	04	21	55	EVA-2: EV1/EV2: SPD install RBVM
Sat 03:56 PM	05	00	10	EVA-2: EV1/EV2: Launch lock release
Sat 04:11 PM	05	00	25	EVA-2: Cleanup
Sat 04:41 PM	05	00	55	EVA-2: Airlock ingress
Sat 05:01 PM	05	01	15	EVA-2: Airlock repressurization
Sat 05:26 PM	05	01	40	RMS powerdown
Sat 06:31 PM	05	02	45	ISS daily planning conference
Sat 08:46 PM	05	05	00	STS/ISS crew sleep begins
10/13/02				
Sun 04:46 AM	05	13	00	STS crew wakeup
Sun 05:16 AM	05	13	30	ISS crew wakeup
Sun 07:16 AM	05	15	30	ISS daily planning conference
Sun 07:31 AM	05	15	45	ISS crew begins TVIS repair
Sun 08:26 AM	05	16	40	EVA camera setup
Sun 08:31 AM	05	16	45	Logistics transfers resume
Sun 10:01 AM	05	18	15	Tool configuration
Sun 10:01 AM	05	18	15	PGBA transfer
Sun 11:01 AM	05	19	15	Joint STS/ISS crew meal
Sun 12:01 PM	05	20	15	Soyuz suits/seatliner preps
Sun 12:01 PM	05	20	15	Logistics transfers resume
Sun 12:01 PM	05	20	15	TVIS repair work resumes
Sun 02:01 PM	05	22	15	Joint crew photo
Sun 02:21 PM	05	22	35	Joint crew news conference
Sun 03:01 PM	05	23	15	Logistics transfers resume
Sun 03:46 PM	06	00	00	EVA-3: Procedures review
Sun 04:46 PM	06	01	00	ISS daily planning conference
Sun 07:46 PM	06	04	00	STS/ISS crew sleep begins
10/14/02				
Mon 03:46 AM	06	12	00	STS crew wakeup
Mon 04:16 AM	06	12	30	ISS crew wakeup
Mon 05:46 AM	06	14	00	ISS daily planning conference
Mon 05:56 AM	06	14	10	EVA prep begins
Mon 06:31 AM	06	14	45	Logistics transfers resume
Mon 06:31 AM	06	14	45	TVIS checkout and setup
Mon 07:06 AM	06	15	20	Reboost config 3
Mon 07:31 AM	06	15	45	Quest airlock depress to 10.2 psi
Mon 08:46 AM	06	17	00	EVA-3: EMU purge
Mon 08:51 AM	06	17	05	Quest airlock repressurized to 14.7 psi
Mon 09:01 AM	06	17	15	EVA-3: Oxygen pre-breathe
Mon 10:01 AM	06	18	15	EVA-3: Airlock depressurization
Mon 10:31 AM	06	18	45	EVA-3: Egress
Mon 10:46 AM	06	19	00	EVA-3: Sortie setup
Mon 11:16 AM	06	19	30	EVA-3: IUA R&R
Mon 12:31 PM	06	20	45	EVA-3: Connect S1-S0 FLD JP
Mon 01:56 PM	06	22	10	EVA-3: Remove port keel pin
Mon 02:36 PM	06	22	50	EVA-3: Remove starboard keel pin
Mon 03:16 PM	06	23	30	EVA-3: TRRJ SPDS
Mon 03:46 PM	07	00	00	EVA-3: EV2: SFU config

TIME	DD	HH	MM	EVENT
Mon 03:51 PM	07	00	05	EVA-3: EV1: S1/S3 clamps
Mon 04:11 PM	07	00	25	EVA-3: Sortie cleanup
Mon 04:41 PM	07	00	55	EVA-3: Airlock ingress
Mon 05:01 PM	07	01	15	EVA-3: Airlock repressurization
Mon 06:31 PM	07	02	45	ISS daily planning conference
Mon 08:46 PM	07	05	00	STS/ISS crew sleep begins
10/15/02				
Tue 04:46 AM	07	13	00	STS crew wakeup
Tue 05:16 AM	07	13	30	ISS crew wakeup
Tue 07:16 AM	07	15	30	ISS daily planning conference
Tue 07:46 AM	07	16	00	Crew off-duty time begins (four hours)
Tue 11:46 AM	07	20	00	Joint crew meal
Tue 12:46 PM	07	21	00	CGBA transfer
Tue 12:46 PM	07	21	00	EVA suit reconfig
Tue 01:46 PM	07	22	00	EMU transfer
Tue 02:01 PM	07	22	15	SAFER transfer
Tue 02:16 PM	07	22	30	Oxygen transfer line teardown
Tue 02:46 PM	07	23	00	Rendezvous tools checkout
Tue 02:46 PM	07	23	00	CCAA H2O sep R&R
Tue 03:01 PM	07	23	15	Logistics transfers resume
Tue 05:31 PM	08	01	45	ISS daily planning conference
Tue 07:46 PM	08	04	00	STS/ISS crew sleep begins
10/16/02				
Wed 03:46 AM	08	12	00	STS crew wakeup
Wed 04:16 AM	08	12	30	ISS crew wakeup
Wed 06:16 AM	08	14	30	ISS daily planning conference
Wed 07:01 AM	08	15	15	Hatch closing
Wed 07:21 AM	08	15	35	Leak checks
Wed 08:06 AM	08	16	20	ISS crew prepares PMA-2 for departure
Wed 08:31 AM	08	16	45	Group B computer powerup
Wed 08:46 AM	08	17	00	Undocking timeline begins
Wed 09:14 AM	08	17	28	UNDOCKING
Wed 09:31 AM	08	17	45	Begin flyaround
Wed 10:46 AM	08	19	00	Separation burn
Wed 11:16 AM	08	19	30	Group B computer powerdown
Wed 11:26 AM	08	19	40	SHIMMER setup and activation
Wed 11:31 AM	08	19	45	ISS midday meal
Wed 11:46 AM	08	20	00	Post undocking laptop computer config
Wed 12:26 PM	08	20	40	SHIMMER moon observations
Wed 12:41 PM	08	20	55	ISS crew off duty time begins
Wed 12:41 PM	08	20	55	ISS crew depressurizes PMA2
Wed 12:56 PM	08	21	10	SHIMMER deactivation and stow
Wed 01:36 PM	08	21	50	PAO event with Ashby, Melroy, Yurchikhin
Wed 03:16 PM	08	23	30	ISS: PMA2 leak checks
Wed 07:16 PM	09	03	30	STS crew sleep begins
10/17/02				
Thu 03:16 AM	09	11	30	STS crew wakeup
Thu 06:16 AM	09	14	30	Cabin stow begins
Thu 06:21 AM	09	14	35	SHIMMER setup and activation
Thu 06:46 AM	09	15	00	SHIMMER moon observations
Thu 07:26 AM	09	15	40	SHIMMER limb observations
Thu 07:46 AM	09	16	00	SHIMMER deactivation and stow
Thu 08:16 AM	09	16	30	Flight control system checkout
Thu 09:26 AM	09	17	40	Reaction control system hotfire

TIME	DD	HH	MM	EVENT
Thu 10:46 AM	09	19	00	On-board de-orbit review
Thu 11:16 AM	09	19	30	Crew meal
Thu 12:16 PM	09	20	30	Cabin stow resumes
Thu 12:31 PM	09	20	45	L-1 comm checks
Thu 12:46 PM	09	21	00	PAO event with entire crew
Thu 01:56 PM	09	22	10	PILOT landing practice (PLT)
Thu 02:01 PM	09	22	15	L-1 comm checks (part 2)
Thu 02:31 PM	09	22	45	PILOT landing practice (CDR)
Thu 03:46 PM	10	00	00	Ergometer stow
Thu 04:01 PM	10	00	15	PGSC stow
Thu 07:16 PM	10	03	30	STS crew sleep begins
10/18/02				
Fri 03:16 AM	10	11	30	STS crew wakeup
Fri 05:16 AM	10	13	30	Group B computer powerup
Fri 05:31 AM	10	13	45	IMU alignment
Fri 05:46 AM	10	14	00	GIRA stow
Fri 05:46 AM	10	14	00	OCAC stow
Fri 06:42 AM	10	14	56	Deorbit timeline begins
Fri 10:44 AM	10	18	58	Deorbit burn
Fri 11:46 AM	10	20	00	Landing

CBS News STS-112 Mission Overview

Atlantis carries key solar array truss segment to space station

By WILLIAM HARWOOD
CBS News

After a frustrating summer of work to fix potentially dangerous fuel line cracks, NASA is gearing up to resume shuttle flights Wednesday with launch of the Atlantis on a critical mission to deliver a 14-ton section of the international space station's main solar array truss.

Commander Jeffrey Ashby, pilot Pamela Melroy, flight engineer Sandra Magnus, cosmonaut Fyodor Yurchikhin and spacewalkers Piers Sellers and David Wolf, a Mir veteran, are scheduled to blast off on the 111th shuttle mission between 2 p.m. and 6 p.m. Wednesday.

As with all station flights, launch will be timed to coincide with the moment Earth's rotation carries pad 39B into the plane of the target's orbit. But in keeping with NASA's post Sept. 11 security procedures, the exact launch time will not be revealed until 24 hours before liftoff.

Whenever Atlantis finally takes off, armchair astronauts will enjoy a spectacular new view of the climb to space from a camera mounted on the side of the shuttle's external tank. Looking down on the orbiter and its twin solid-fuel boosters, the camera will run from launch through external tank separation after Atlantis reaches space.

"We're hoping on this flight to get some interesting, new and unique video," said lead flight director Phil Engelauf. "We will for the first time be mounting a public affairs camera on the external tank looking aft down the stack through launch.

"That camera will be activated about (15) minutes before launch and should operate through MECO (main engine cutoff) plus about six minutes," he said. "We haven't tried this before, but you've seen these kind of photographs on expendable launches in the past. This will be the first time we've tried it with the shuttle and we've very optimistic about getting some pretty dramatic video going up hill."

If all goes well, Ashby will guide Atlantis to a docking with the space station one day 20 hours after launch, between 9:38 a.m. and 1:38 p.m. on Oct. 4. Awaiting their arrival will be Expedition 5 commander Valery Korzun, Sergei Treschev and NASA biochemist Peggy Whitson.

The station's fifth full-time crew, Korzun and company were launched to the outpost June 5 aboard the shuttle Endeavour. They are scheduled to return to Earth around Nov. 20 to close out a 167-day voyage. The station has been continuously manned for 691 days as of Sept. 24.

The primary goal of Atlantis' flight is to deliver and install the first starboard side - S1 - outboard solar array truss segment, a massive 45-foot-long, 15-foot-wide component massing 28,776 pounds.

When completed, the station's nine-segment solar array truss will stretch 330 feet and carry two huge sets of solar panels on each end. Radiators inboard of the solar arrays will dissipate the heat generated by the station's electronic systems.

The central element of the truss, a $600 million component known as S0, was attached to the top of the U.S. laboratory module Destiny during a shuttle flight in April.

The Boeing-built $390 million S1 segment aboard Atlantis is the first outboard section. A virtually identical segment, known as P1, will be attached to the port, or left side of the central S0 truss during the next shuttle visit in November.

S1 is scheduled for attachment to S0 the day after Atlantis docks with the station. Whitson and Magnus, operating the station's Canadarm2 space crane, plan to pull S1 from the shuttle's cargo bay and to carefully position it so a powerful, remotely operated claw at the end of S0 can engage a capture bar on the near end of S1.

After the claw pulls the two segments together, motorized bolts at the four corners of the truss interface will drive in to lock the two segments firmly together.

While the attachment process is winding up, Wolf and Sellers will exit the station's Quest airlock module for the first of three planned spacewalks to connect electrical cables, ammonia coolant lines and data links between S1 and S0 and to install fittings to prevent fluid line connectors from sticking together. During the first spacewalk, however, Wolf and Sellers will focus on making critical electrical connections and deploying a new S-band antenna.

"I think the tasks being performed on these EVAs are comparable to what we've done on other missions," said station flight director Andrew Algate. "Many of the tasks are similar. We're hooking up ammonia QDs (quick-disconnect fittings), which we've done before, we're mating electrical umbilicals, all the tasks we're doing on these EVAs have been done on previous missions."

Even so, no one takes the work lightly.

"We don't want to cause any damage out there," Wolf said. "We need to be very careful. It's a delicate, in some ways, space station. Lots of antennas, no-touch areas, so we'll be very cognizant of those."

S1 and P1 will provide the cooling needed for the space station's electrical systems. The two truss segments each feature three huge folding radiator arrays made up of eight panels each that will extend 75 feet into space to dissipate up to 72,000 watts of heat, enough to cool eight 2,000-square-foot homes.

S1 and P1 house independent computers to operate and monitor internal systems, ammonia tanks, pump assemblies and nitrogen pressurization systems for the coolant loops. Each segment features 15 miles of electrical wiring, a third of a mile of fiber optic cabling and 426 feet of stainless steel tubing to route ammonia coolant between the radiators and heat exchangers mounted on S0 and elsewhere.

S1 also features an S-band antenna and electronic gear to provide a redundant satellite communications path to the ground, a video system that will aid in future assembly operations and a small cart that future spacewalkers can use to move equipment and tools to different work sites.

Heat rejection is provided by two independent ammonia coolant loops. The extendable radiator wings are mounted at right angles to a rectangular framework that can be rotated through 105 degrees to point the radiators toward the cold of deep space.

"It's hard to convey in words what we're really doing," said station program manager Bill Gerstenmaier. "The thing that's challenging about this is this is the first time we've ever attached two truss segments together.

"Then you have all the connectors and fluid lines that have to be mated between the two truss pieces," he added. "Then there's all the electrical stuff, there are new computers out there that have to interface with the other computers on the station, so we had to get that software synched up.

"There's now a thermal rotary joint. This thing rotates and all the ammonia has to flow through this rotating joint (to and from the radiators) and that's a very complex mechanical design. Overall, it's almost mind boggling what we're doing putting this thing together."

If all goes well, Atlantis will return to Earth Oct. 13. Two weeks later, on Oct. 28, the Russians plan to launch a fresh Soyuz lifeboat to the lab complex. The two-man taxi crew will return to Earth Nov. 7 aboard the Soyuz currently docked to the station.

Soyuz spacecraft are certified for six months in space and they must be periodically replaced.

The taxi crew's departure will clear the way for the year's final shuttle mission, launch of Endeavour on Nov. 10 to deliver the P1 solar array truss segment.

"I anticipate that there will be a lot of great moments," Ashby said in a NASA interview. "I think the two greatest things for me will be when we dock and first open the hatch and greet our friends that are there on board the space station. I know that's a very, very memorable moment.

"And, the second one that I know will be very special is when we undock and start to fly around and look back on the space station with S1 attached and realize that we've successfully completed our little part of the construction of space station."

A TRYING SUMMER FOR NASA

NASA originally planned to follow the June flight of Endeavour by launching the original shuttle Columbia in July on a 16-day microgravity research mission featuring the first Israeli astronaut. Atlantis was to follow suit Aug. 22 with Endeavour delivering P1 in mid October.

But during routine inspections of the shuttle Atlantis on June 17, engineers discovered a small crack in a liner inside the 12-inch-wide liquid hydrogen feed line leading to main engine No. 1. Two more cracks in the same flow liner were found the next day.

Similar cracks then were found aboard Discovery and then Columbia, at which point shuttle program manager Ronald Dittemore suspended work to ready Columbia for the July flight. Cracks then were found in flow liners aboard Endeavour and the shuttle fleet was grounded.

The concern was that if a crack worsened in flight and a piece of debris broke off, it could get sucked into a main engine turbopump at high velocity, triggering a catastrophic failure.

"My concern from a safety point of view has been diminished because of (tests and analyses) over the past several weeks," Dittemore said during a news briefing on July 12. "That's not to say I'm ready to go fly. I still need to understand more about these cracks and I still need to understand more about the potential for these cracks to grow."

Until then, he said, "we will not fly."

Eleven cracks were found in all, three each aboard Atlantis, Discovery and Columbia and two aboard Endeavour. Seven of the cracks were found in flow liners leading to a shuttle's No. 1 main engine, the one located directly under the ship's vertical stabilizer. The other four cracks were found in liners leading to the No. 2 engine position.

Six cracks were circumferential a five were axial. Five were discovered visually, two by ultrasound and four using eddy currents, an electrical test that can find areas of weakness in an alloy.

Here's the breakdown (all measurements in tenths of an inch):

ORBITER	DATE FOUND	LOCATION	SIZE	DIRECTION	INSPECTION
Atlantis	06/17/02	SSME1/LH2	.2"	Circumferential	Visual
	06/18/02	SSME1/LH2	.2"	Circumferential	Eddy current
		SSME1/LH2	.2"	Circumferential	Eddy current
Discovery	06/24/02	SSME1/LH2	.15"	Axial	Visual
		SSME1/LH2	.20"	Axial	Eddy current
		SSME1/LH2	.10"	Axial	Eddy current
Columbia	07/03/02	SSME2/LH2	.2"	Circumferential	Visual
	07/08/02	SSME2/LH2	.2"	Circumferential	Ultrasound
		SSME2/LH2	.2"	Circumferential	Ultrasound

ORBITER	DATE FOUND	LOCATION	SIZE	DIRECTION	INSPECTION
Endeavour	07/09/02	SSME1/LH2	.25"	Axial	Visual
	07/10/02	SSME2/LH2	.3"	Axial	Visual

In addition, engineers found a similar crack in a main engine test article used to test fire shuttle engine clusters many years ago at the Stennis Space Center in Mississippi.

"Even though we've found cracks, it's not age related," Dittemore said. "Whether I've flown the vehicle 16 or 17 times or 30 times, the data appear to show the cracks are present and relatively about the same size."

He said the cracks could be the result of stress when the flow liners were initially installed or the result of some as-yet-unknown environmental factor that is present when the engines are running and supercold liquid hydrogen is flowing through the lines.

In the end, Dittemore approved a plan to repair the cracks using a welding technique and to polish out tiny defects that could evolve into cracks over time. The weld repair was approved during a meeting Aug. 1. At another meeting two days later, Dittemore formally approved a revised shuttle launch schedule that called for launching Atlantis Sept. 28 and Endeavour around Nov. 2.

Columbia's microgravity research flight ultimately slipped to mid January while Atlantis was delayed to Oct. 2 because of problems with NASA's crawler transporters used to haul shuttles from the Vehicle Assembly Building to the launch pad.

"From the operational standpoint, ascent will look just as it always has," Engelauf said of Atlantis' repaired flow liners. "We haven't changed the instrumentation of the vehicle in any way, shape or form. (But) I think from an engineering standpoint, there will be an increased amount of attention on engine performance and post-flight inspections."

For their part Ashby and Melroy had nothing but praise for the way NASA handled the fuel liner crack issue.

"I personally was very impressed with the way NASA approached it, with very little pressure to get back on a launch schedule, but giving the crew, the team that worked it, plenty of time to properly work through the fault analysis, to decide what had happened and where to go from there," Ashby said. "From what I saw, it was a very professionally completed process and I feel very comfortable that we're better than we were a few months ago as far as those engines."

Said Melroy, who flew to the Cape at one point to meet the welders: "They were unbelievably professional. ... Those people really know what they're doing."

RENDEZVOUS AND DOCKING

The international space station currently is made up of four main habitable modules and two airlock modules - one Russian and one American. Think of the four main modules as a train moving through space. The U.S. laboratory module Destiny is in front, followed by a multi-hatch node called Unity that serves as a gateway to the Russian segment of the outpost.

Connected to the node on the opposite side from Destiny is a pressurized mating adapter, or PMA, leading into the Russian-built NASA-financed Zarya propulsion and storage module. Zarya, in turn, is connected to the Zvezda command module. The Russian Pirs docking and airlock module is attached to Zvezda's downward-facing, or nadir, port.

Russian Progress supply ships typically dock at Zvezda's aft port while Soyuz lifeboats can be docked at Pirs or a nadir port on the Zarya module. When Atlantis arrives, the Progress 9 cargo ship will be docked to Zvezda's aft port while the current Soyuz lifeboat will be docked to Zarya's nadir port.

Facing forward, the U.S. Quest airlock module is attached to Unity's right-side, or starboard, hatch. The Z1 truss, containing the lab's four massive U.S.-built gyroscopes, is bolted to Unity's upward-facing, or zenith, port. Mounted on top of Z1 is the P6 solar array, a huge set of electricity producing panels that ultimately will be moved to the port side of the solar array truss currently under construction.

The P6 array truss also includes a thermal control system to provide cooling until the main truss is completed. The solar wings stretch 240 feet from tip to tip, towering 90 feet above the main body of the station.

Atlantis's launching, like all flights to the space station, is timed to coincide with the moment Earth's rotation carries the launch pad into the plane of the station's orbit. That plane is tilted 51.6 degrees to Earth's equator.

The shuttle has enough power to launch five minutes to either side of the moment the pad is "in plane" with the station. For technical reasons, NASA only uses five minutes of that 10-minute launch window, taking off when the pad is essentially directly in the plane of the station's orbit.

Once in space, the plane of the shuttle's orbit cannot be significantly altered. Altitude, however, is another matter and the lower the altitude, the higher the spacecraft's velocity. Atlantis will launch into the station's plane but orbit at an initially lower altitude.

After a series of rocket firings to fine-tune the shuttle's approach, Ashby will begin the terminal phase of the rendezvous with Atlantis trailing the station by about 9.2 statute miles. From there, Ashby and Melroy will oversee a series of computer-controlled rocket firings designed to place the shuttle at a point 600 feet or so directly below the space station.

At about that point, Ashby will take over manual control and pilot Atlantis in a slow loop up to a point 300 to 400 feet directly in front of the lab complex as both spacecraft race through space at five miles per second.

Positioned directly in front of the station's long axis, Ashby will manually guide Atlantis in so the docking system in the shuttle's cargo bay can mate with its counterpart on a pressurized mating adapter attached to Destiny's forward hatch. After hooks and latches engage, the two spacecraft will be locked together.

In pre-flight NASA interviews, Ashby did not discuss the terminal rendezvous sequence. But Kenneth Cockrell, Endeavour's commander for NASA's most recent shuttle flight in June, provided a good description of the final series of steps.

"It's really a fun piloting task," Cockrell said. "It's like driving a ship. You make very small inputs that take a long time to occur; but once they occur, they're very hard to stop. So it's something you need to do very precisely and it takes a lot of practice.

"So we go in very slowly and gradually, we slow down at about 30 feet away from the docking port and just look through a zoomed-in camera at the target. The target has a little set of alignment guides on it and we make sure that we're all lined up, that the two vehicles are exactly in plane.

"And then, from 30 feet in, we just hold a steady rate and we crash into the station," he joked. "That's a very slow crash. It's one-tenth of a foot per second. It's as slow as a snail would crawl."

After leak checks, hatches between the two spacecraft will be opened and station commander Korzun and his two Expedition 5 crewmates will welcome Atlantis' six astronauts on board. After a safety briefing, the combined crews will get down to work.

Along with installing the S1 truss, the shuttle crew plans to deliver about 1,000 pounds of supplies and equipment, along with a few tasty treats for the station's crew.

"They're looking forward to getting some apples and oranges and things of that nature," Magnus said at a pre-flight briefing. "There's a pecan pie that we're trying to get up there to them. But that's a secret, don't let them know, that's going to be a surprise!"

INSTALLING THE S1 TRUSS

The day after docking - flight day four - the combined crews will face the busiest day of Atlantis' mission: Installation of the S1 truss and, during a planned six-and-a-half-hour spacewalk by Wolf and Sellers, initial connection of the electrical cables and data lines needed to bring the truss to life.

Three spacewalks will be required to complete the job.

"We're going to go out three times and in rough order of importance what we're going to try and do is to make all the electrical connections between the new piece of the station we're putting on there, the truss, and the existing station," said Sellers. "And this is to keep all the heaters alive and the brains of the new components alive, the electrical power.

"The next thing we're going to do is put a new comm device on there, which will be used for communications between the crew and the station," he said. "Next important is fluid connections, we want to make the coolant loops that exist on station connect with the cooling radiators that are on the S1 truss. And the fourth thing that, I think, is going to be fun is to activate the CETA cart, which is this little railway cart that trundles up and down the front face of S1."

The truss completely fills Atlantis' cargo bay and it is a marvel of complexity.

"The electrical utilities consist of 22 different types of wire, totaling 79,241 feet, or 15 miles of wire," said Ronald Torcivia, STS-112 launch package manager. "Another way to look at it is to say that for every foot of the 45-foot-long truss there is a third of a mile of wire. The electrical system has 103 separate harnesses with 8,020 contacts housed in 718 connections.

"In addition, there is over a third of a mile of fiber optic cable used to carry video information. The fluid system provides all the utilities needed to transfer ammonia and nitrogen within the thermal control system as well as transferring it to the adjoining structures.

"The fluid system consists of 426 feet of rigid stainless steel tubing terminating in 59 EVA-operable connections, or QDs (quick-disconnect fittings)," Torcivia said. "Fifty six of these QDs are used to transfer ammonia while three are used to transfer nitrogen. The ammonia lines are used for cooling and the nitrogen lines are used to maintain pressure within the ammonia system at 3,000 psi.

Throw in the complex rotary joint that allows the radiators to be properly oriented, the S-band antenna system, the CETA cart and the segment's computer system and even the casual observer begins to realize the truss is more than a simple, if massive, structural element.

"S1 is essentially a full spacecraft," said Gerstenmaier. "The only thing it's lacking is propulsion and some attitude control determination. It has computers on board, multiplexers and de-multiplexers, it has a communications antenna system, it has integral thermal control system, it has radiators, a very large ammonia tank, a crew translation aid. It's a very, very complex spacecraft."

While Wolf and Sellers, assisted by Melroy, begin preparations for their first spacewalk, Whitson and Magnus will use the station's robot arm to slowly lift S1 from Atlantis' cargo bay. Ashby will assist by positioning the shuttle's robot arm to provide different television views of the operation.

"This is a major transition in the assembly sequence of the station," said Melroy. "At the beginning, the work area was all very close to the shuttle. It was a pretty small station. We were attached to it. We could use the shuttle robotic arm, which, by the way, we have a lot of experience on and feel very comfortable using. We could do all of our assembly tasks very close to the shuttle.

"Well, we're moving into a situation now, and the S1 truss is a classic example of it, it's way too far out there! It's on the other side of the shuttle from the robotic arm. There's just no way you can get it over there. So, we've transitioned to using the station arm for the assembly task. Reaching into the payload bay, pulling the S1 truss out, and putting it into position."

The truss will be pulled straight up from the payload bay and then maneuvered over the starboard side of the orbiter until it is roughly lined up with S0. Canadarm2 will carefully position S1 so that its capture bar is within reach of the motorized claw at the end of S0.

"When we bring S1 into the proper area of that claw, we have sensors around the truss that tell the system that we're in the proper position to begin latching," Torcivia said. "This claw begins to close and it pulls the two trusses together. Once they're together, we have a system called a bus bolt controller and they're located at the four corners of the truss. They are electrically driven screws that drive the structure together. And they can exert anywhere from 8,000 to 16,000 pounds of force on each corner."

Wolf and Sellers will be cleared to exit the Quest airlock module once the initial attachment procedure is complete. But they could exit early if there are problems getting S0 and S1 connected.

"If there's a problem lining things up, Dave and I will go out there and help guide things in," Sellers said. "Then, if the motorized bolts don't work that tie the new truss to the station, Dave and I have a pocket full of bolts to manually put in there and tie the two together."

In a worst case scenario, Wolf and Sellers could use retention straps to ratchet the two truss segments together.

"We're trying to make sure if everything else fails, we still have a way to do the primary objective, which is installing this thing," Ashby said. "Providing the station arm is working well enough to at least get it up close, then we can install this thing."

But assuming no such problems develop, Wolf and Sellers will begin their excursion after S1 has been bolted to S0. The primary goal of the first spacewalk is to hook up electrical connectors between S1 and S0 to route power into the new truss segment.

The connectors are located in two utility trays, one on the upward, or zenith, side of S1 and the other on the nadir side. One tray has seven connectors and the other, eight. The astronauts will begin with the zenith tray.

"The crew starts out by connecting up the first set of power and data umbilicals to the S1 truss segment," said Algate. "After that's complete, they'll be getting the S-band antenna from its stowed location and installing it on the truss and hooking up its power and data cables. Once this system is up and connected, a little later in the mission we'll be testing out this second string of communications gear."

While Wolf and Sellers are working through their initial tasks, ground controllers will begin powering up internal truss systems, activating its computers and turning on critical heaters. The spacewalkers then will unlatch launch locks that held the CETA cart firmly in place during Atlantis' climb to space.

CETA is NASA-ese for "crew EVA translation aid."

"We know that there are going to be times when things break down," Melroy said in a NASA interview. "They do, just like they do in your house. So, you have to go out and you have to replace parts. And to do that, you have to do spacewalks. ... The designers of the station took this into consideration, and what's neat is there's this little railroad cart that runs along the bottom of the truss. And, it goes all the way out, in both directions.

"(It) kind of makes me think of one of those little railroad carts that you kind of see them in TV and cartoons. But in fact what the crew will do is they pull themselves along hand-over-hand with their feet stuck in the cart, and that's how they move it from place to place. So, this cart will be a part of the, we're taking up one of these carts on the S1 truss, and we'll be basically getting it ready.

"It's cinched down, bolted down very tightly for launch," Melroy said. "You don't want this thing wiggling around or moving. So, the EVA crew will go outside. They will take all these bolts out. They will set the parking brake. They're going to practice moving it back and forth. It's the first time we've used it. We're very excited about it!"

After releasing launch locks holding the rotating radiator array framework in place, Wolf and Sellers plan to close out the first spacewalk by hooking up the second set of power and data umbilicals located in the nadir utility tray. Until both sets are connected, the truss is not considered in a safe configuration.

The spacewalkers also will mount a video camera on one of the keel assemblies that held S1 in the shuttle's cargo bay.

"There are two levels of difficulty to consider," Sellers said before launch. "One is the complexity of the task, the thing you're trying to do, and that's where Pam keeps us straight. She has the checklist, she knows where we're going and exactly what connects to what.

"The other level of difficulty has to do with can I get my arm, which is incased in this thick, heavy (spacesuit), into a place to do a connection or to throw a lever on a bale or something like that? Those things we've practiced in the pool, endlessly, and I think we're very well prepared for those, too. So in both cases, after a lot of effort by our training team and the people who supported us, I think we're ready."

The next day, flight day five, the astronauts will enjoy a bit of time off and begin transferring supplies and equipment from the shuttle's middeck to the station. Along the way, they'll review plans for the second spacewalk the next day.

PLUGGING POTENTIAL LEAKS

The primary goals of the second spacewalk are to:

- ❏ Install a video camera on the hull of the Unity node;

- ❏ Connect fluid lines leading to the S1's ammonia tank assembly; the truss has two tanks, each loaded with about 300 pounds of ammonia. Connecting these lines will permit ground controllers to run ammonia through the coolant system when it is activated next year;

- ❏ Finish removing launch locks holding the CETA cart in place;

- ❏ Install 25 of 31 "spool positioning devices," or SPDs, on all of the ammonia line quick-disconnect fittings currently aboard the station as well as the ones that will be used to connect ammonia lines between S1 and S0. The goal is to prevent potentially crippling problems on future assembly missions.

"What we determined in ground testing is that there are two seals in the fluid QDs," said lead spacewalk planner Oscar Koehler. "You can get a build-up of pressure between those QDs because if one of the seals leaks, the other seal will stop that fluid and you'll build up a pressure in there. You have to have a certain number of thermal cycles to raise that pressure to a level where it will basically lock up the QD so when you come to do maintenance later on, you can't get that QD off.

"So the work around is to basically take one of those seals out of the loop so if you have a leak - and we're talking very small leaks - you just leak past the other seal, you won't build up that pressure so when we come back to do maintenance, you can get the QD off."

The SPDs Wolf and Sellers will attach to each quick-disconnect fitting lock the handle, or bale, used to draw the two sides of a connector together so that only one of the internal seals can engage.

"They position the bale, the handle, so the valve is partly open and it's only open enough to take one of those seals out," Koehler said.

Additional SPDs will be installed on the next two shuttle missions to protect all of the station's planned coolant line quick-disconnect fittings. For this flight, 24 one-inch-wide SPDs will be installed, six 1.5-inch SPDs and one 0.5-inch SPD. All but two will be installed during the second spacewalk with the final pair installed during the crew's third excursion.

The work is important because successfully separating ammonia quick-disconnect fittings could be critical in the event of a future failure.

"If at some point we have a radiator leak or we have a radiator get damaged, we can actually remove that radiator and replace it with a new one," Koehler said. "And the QD is what allows you to disconnect your fluid lines from that ORU. Almost all the ORUs that have ammonia going to them outside have the same type of QDs."

Ammonia will not flow through S1's thermal control system until a later mission. But six QDs connecting coolant lines running between the Destiny lab module and the station's current radiators on the P6 solar array atop the Z1 truss are pressurized with ammonia.

If Wolf and Sellers have any problems installing SPDs on these connectors, they will simply press on with other tasks and astronauts on a future assembly mission will use a special tool to pry any stuck QDs apart as required.

Because of the possibility of a leak, both spacewalkers have practiced procedures to remove any residue of the chemical before re-entering the space station.

"Ammonia is the primary external coolant in the coolant loops of the space station and there is the potential for it to escape in the various operations we do," Wolf said. "First of all, it is not dangerous immediately to the space suit. The spacesuit can tolerate large amounts of ammonia. We don't want to contaminate the internal atmosphere, of course, when we come in. So it will sublimate or bake off.

"We try to get out in the sun first of all. We try to do those tasks early in the EVA so if we get contaminated there will be more time for it to bake off into the vacuum. We have some special brushes to brush it off. We even have detection techniques in the airlock."

If any residue is suspected, the astronauts will partially repressurize the airlock, take an air sample, and if necessary, depressurize the airlock again to allow additional time to bake out the chemical.

RADIATOR DEPLOY, TREADMILL REPAIR AND A FINAL SPACEWALK

On flight day seven, the day after EVA-2, the astronauts will take another break of sorts, continuing work to transfer equipment from Atlantis to the space station and preparing for the mission's third and final spacewalk the next day.

Korzun and his station crewmates plan to spend most of the day replacing components in the Zvezda module's U.S.-built treadmill while their shuttle crewmates test S1's radiator array. While no ammonia will flow through the system until next year, engineers want to make sure the framework all three radiator arrays are mounted on can, in fact, rotate as required to point them toward deep space.

To make sure the wings can unfold as required, the station crew will send commands to fire six pyrotechnic squibs holding the folded central set of radiator panels in place. A motor then will drive the wing open. If the panels don't unfurl for some reason, Wolf and Sellers can crank them open with a power tool during the final spacewalk.

"We're actually going to deploy just the center of the three, just to make sure that everything is working okay," Melroy said in a NASA interview. "We're going to get a little bit of a jump on things to do that. So, we're excited about seeing that radiator unfurl out into space. I think that'll be really neat and exciting. It's a bunch of folding panels. It's almost like folding a paper doll out. It's going to look really neat."

Only one wing is being extended during Atlantis' mission because A) the station doesn't currently need any additional heat rejection; B) engineers don't want to expose the panels to possible micrometeoroid damage any earlier than necessary; and C) there is an interference issue with solar arrays on the Zarya module.

Zarya's arrays will be retracted after installation of additional Russian solar arrays later in the assembly sequence, eliminating the interference problem. But for now, they're in the way.

The third and final spacewalk of mission STS-112 is scheduled for flight day eight. The excursion has four primary objectives:

- ❏ Connection of ammonia jumpers between S0 and S1;

- ❏ Removal of two keel pin assemblies that were used to help hold S1 in the shuttle's cargo bay;

- ❏ Installation of six final SPDs;

- ❏ Repair or replacement, if necessary, of a cable cutter on Canadarm2's mobile base system, which carries the crane back and forth along the solar array truss.

Independent spool-fed power and video lines play out as required as the mobile base system cart moves along, providing power between work stations. Should a spool jam when the cart is between work stations, cable cutters are in place to cut the stuck line. That would allow the cart and the robot arm to reach the next work station where the cart could plug into a power socket.

During installation of S0 in April, a safing bolt in one of the "interface umbilical assemblies," used to prevent inadvertent activation of a cable cutter during launch, failed to back out when spacewalkers attempted to remove it.

Both of the cable cutters must be operational to complete assembly of the truss.

"If you're moving the mobile transporter and it gets stuck between work sites, cutting the cable allows you to move to the next worksite," said Koehler. "There are different failures that can cause that cable to jam in its reel. The other one would still be reeling out. So you cut the one cable, use the other one to give you power to get out to your next work site to plug in. It gives you the power you need to keep the mobile transporter alive."

Wolf and Sellers plan to use a much higher torque setting to free the stuck bolt and if that doesn't work, they will replace the entire umbilical assembly. That job, should it be necessary, would take about an hour and a half to complete.

"Whenever you're out doing a spacewalk, it's a critical environment," Wolf said. "It is very unforgiving so any tasks conducted in the spacesuit at vacuum are critical and are difficult. It's a big heavy suit, it's like wearing ski mittens and doing fairly delicate work. And so we've developed special techniques and special tools to accomplish that.

"Having said that, we have developed these tasks in a manner where the 10 to 15 tasks we're doing are of similar difficulty. I'd say putting on the interface umbilical assembly, which is under the mobile base system, is one of our more difficult tasks procedurally."

UNDOCKING, RE-ENTRY AND LANDING

With the spacewalks complete, the combined shuttle-station crew plan to take time off on flight day 10, to complete logistics transfer operations and to transfer spacesuits and other hardware back to the shuttle for return to earth.

"Sandy Magnus is our transfer queen," said Melroy. "She is very detail oriented and very organized. And so, she's going to help us. She's going to be the general on transfer days. She carries all this in her head."

The next day, flight day 11, Atlantis will undock from the international space station, following a now-standard departure profile. With Melroy at the controls, the shuttle will back away to a point about 450 feet directly in front of the station. Melroy then will guide Atlantis through a fly-around of the station for routine photo documentation before departing the area for good.

The space station will have an unusually asymmetric appearance as the shuttle pulls away, with the S1 truss sticking 45 out to one side.

The station maintains its orientation in space using control moment gyroscopes in the Z1 truss. Despite the unbalanced load represented by the S1 truss, the CMGs should have no problem compensating.

"As we build up the truss segment, we kind of have a back-and-forth situation where the truss is balanced and unbalanced," Algate said. "It is a bit more difficult to control, but our momentum management system with our control moment gyros can deal with that."

Likewise, the unbalanced load will cause no major impacts to routine procedures in which the shuttle's maneuvering jets are used to reboost the station's altitude. Two such reboost maneuvers are planned during Atlantis' mission, one on flight day five and one on flight day seven.

"On the shuttle side, looking at shuttle reboost, they did find some asymmetry in the jet firings and some of the jets get a little warmer because of the asymmetrical thrusts," Algate said. "As a result of that, in some of the reboost modes we had to cut back the maximum duration that we could do a shuttle reboost. As it turns out, for the reboost modes we're planning to use on this mission it won't have an impact."

The day after undocking, the astronauts will work through a standard pre-entry timeline, stowing equipment, testing the shuttle's entry systems and gearing up for the fiery plunge back to Earth.

"After we've undocked, we have the normal shuttle entry preparation activities, but in addition we have a secondary payload on this flight called SHIMMER," Engelauf said. "I confess, I even have to look up the name of this particular payload. It stands for 'Spatial Heterodyne Imager for Mesospheric Radicals.' It's an Air Force-sponsored payload that requires a little bit of out-the-window pointing for the shuttle to take some spectral images.

"This payload is essentially a demonstration of a new remote sensing technique using ultraviolet wavelengths in mapping hydroxyl in density distributions, which would be useful mapping the ozone layer and the chemical hydroxyl, which is largely responsible for the breakdown ozone."

If all goes well, Ashby and Melroy will fire Atlantis' twin orbital maneuvering system braking rockets and glide to an afternoon landing at the Kennedy Space Center on Oct. 13 to close out an 11-day mission spanning 170 orbits and 4.5 million miles.

The next two shuttle flights are critical to the continued assembly of the space station. But the work is relatively straight forward. Next year, however, "when we start bringing up the outboard solar arrays, that's where things are going to get very, very challenging for us," Gerstenmaier said.

"When we get to the 2003 timeframe, we're not only doing assembly, we're doing reconfiguration," he said. "That's new for us. And by reconfiguration, we're going to pull a radiator off of P6 and it's going to be moved outboard to one of the solar arrays and attached out there. We're going to also fold up the entire P6 solar arrays and then move them out on the mobile transporter and attach them out on the end of the truss.

"Those are major activities in terms of reconfiguration, those have a lot more uncertainty in them because the hardware's been up and operating in orbit, it's not flying in a pristine condition, it's got some runtime on it, we're going to be operating out quick-disconnects and doing those things. So that's a new series of challenges for us that we're really got to stay focused on.

"The other thing that happens in that timeframe is we go from our power system now, which is essentially P6 providing us power, to where we're going to get the permanent power system," Gerstenmaier said. "It's a full two-string power system, full two-string communications system, full two-string thermal system. A lot of those systems right now are single string systems. So we have to shut off our power system and then bring up our new power system, our new thermal system, our new communications system. That also concerns me, because that's a very critical activity."

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STS-112 NASA Background Package

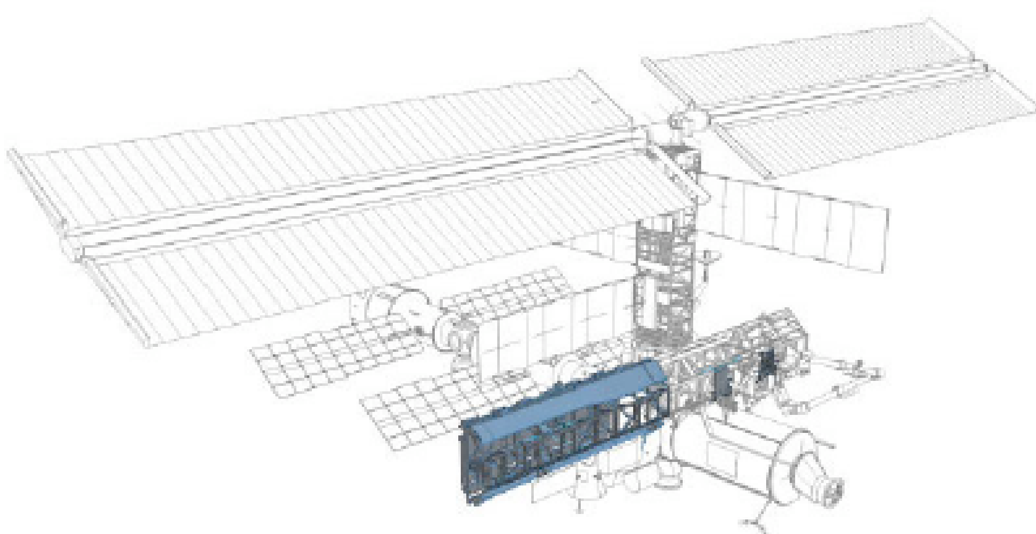
Editor's Note:
The STS-112 mission overview below is from the NASA/United Space Alliance STS-112 press kit: http://www.shuttlepresskit.com

Outboard Solar Array Truss Installation Highlights Shuttle Flight

General Mission Overview

With an eye toward expansion of the International Space Station's main backbone, Atlantis will lift off from Launch Pad 39-A at the Kennedy Space Center on the STS-112 / 9A assembly mission to the orbital outpost, the 15th shuttle flight in the construction of the massive complex. The major objective of the planned 11-day mission is the delivery of the 45-foot-long, 15- ton S-One (S1) Truss to the ISS.

The S1 Truss will be attached to the starboard side of the centerpiece truss, the S-Zero (S0) Truss, on which the Mobile Transporter (MT), Mobile Base System and the Canadarm2 robotic arm are mounted. The S1 Truss will enable the station to begin the outboard expansion of its rail system in preparation for the addition of new power and international science modules in the years to come. The large truss contains a new external cooling system for the station that will be activated next year, a second S-Band communications system to provide enhanced and extended voice and data capability, a cart which will serve as a mobile work platform for future spacewalkers, two new external television cameras and the first Thermal Radiator Rotary Joint (TRRJ), which will provide the mechanical and electrical energy for rotating the station's heat-rejecting radiators based on various system requirements. Three spacewalks will be carried out to install and activate the truss and its associated equipment.



S1 truss (in blue)

The S1 Truss is the second of 11 such truss structures that will ultimately expand the ISS to the length of a football field and increase its power through the addition of new photovoltaic modules and solar arrays. A third segment, the P-One (P1) Truss, will be installed on the port side of the S0 Truss on the STS-113 / 11A mission.

Atlantis' mission to the ISS is commanded by Jeff Ashby (Capt., USN), who will be making his third flight into space after two previous missions as a pilot, including the STS-100 mission to the station in 2001 to deliver the Canadarm2. Ashby will be joined on the flight deck by Pilot Pam Melroy (Col., USAF), who is making her second flight to the ISS after piloting the STS-92 mission that brought the Z-One (Z1) Truss to the Unity module.

First-time shuttle flier Sandy Magnus (Ph.D.) will serve as Atlantis' flight engineer and will be one of the operators of the Canadarm2 robotic arm once Atlantis reaches the ISS. The large arm will be employed for the installation of the S1 Truss and the transport of the spacewalkers as they conduct their connections of power and data cables and other external hardware to the truss itself. Magnus will be assisted in the robotics work by Expedition 5 Flight Engineer Peggy Whitson from the Destiny Laboratory of the station.

Veteran Astronaut David Wolf (M.D.) is one of two spacewalkers on STS-112, making his third flight into space, including a 119-day mission as a flight engineer on the former Russian space station Mir. Wolf conducted a spacewalk during his tenure on the Mir in 1998, collecting experiments from the exterior of the station along with his Commander, Anatoly Solovyev. Piers Sellers (Ph.D.) is making his spaceflight debut on STS-112 as the other spacewalker who will join Wolf outside Atlantis for the truss and hardware installation tasks.

The other first-time crewmember is Russian Engineer Fyodor Yurchikhin from RSC-Energia who will join Melroy as one of two spacewalk choreographers during the mission and who will work with Magnus in the transfer of experiments and payloads from Atlantis to the ISS during docked operations.

A camera mounted on the side of Atlantis' external fuel tank will provide dramatic video during the shuttle's climb to space

Two days after Atlantis is launched, Ashby will guide the shuttle to a linkup at the forward docking port of Destiny, setting the stage for the opening of the hatches and the start of seven days of joint operations between Atlantis' crew and the resident crew on the ISS, Expedition 5 Commander Valery Korzun and Flight Engineers Whitson and Sergei Treschev.

The following day, Wolf and Sellers will begin spacewalk preparations while Magnus and Whitson use the Canadarm2 from inside Destiny to grapple the huge S1 Truss, lifting it out of Atlantis' payload bay and maneuvering it for its installation at the starboard end of the S0 Truss. Capture bolts will structurally mate the two trusses after a claw-like device on the starboard side of the S0 Truss grabs a fixture on the S1 segment. The procedure will be timed so that Wolf and Sellers do not exit the station's Quest airlock to begin their first spacewalk until the mating process is complete.

For most of the first spacewalk, Wolf will ride with his feet affixed at the end of Canadarm2 while Sellers acts as the "free floater," working with Wolf to begin the connection of power, data and fluid umbilicals between the newly attached trusses. Wolf and Sellers will also deploy the station's second S-Band communications system, install the first of two external camera systems and release launch restraints on the truss' crew platform cart. Sellers will be affixed to the arm to complete the nadir tray connections. In addition, he will release 19 radiator beam launch locks, which restrained the radiators for launch. The radiator beam launch locks must be released to allow rotation of the three radiators. The final launch locks will be released near the end of the second spacewalk.

STS-112 Crew (L-R): Sandra Magnus, David Wolf, pilot Pamela Melroy, commander Jeffrey Ashby, Piers Sellers and cosmonaut Fyodor Yurchikhin

After a day of transfer activities and off duty time, Wolf and Sellers will venture outside Atlantis again on the sixth day of the flight for their second spacewalk. This time, Sellers will ride at the end of Canadarm2 like a telephone repairman at the end of a cherry picker for most of the spacewalk. The second excursion is designed to set up the second external camera system. Wolf will then be affixed to the arm to install Spool Positioning Devices (SPDs) on the Radiator Beam Valve Module and connect fluid lines between the Nitrogen Tank Assembly (NTA) and the Ammonia Tank Assembly (ATA). These devices will ensure the proper positioning of seals throughout the truss to maintain proper internal pressure where quick disconnects are located.

Another day of transfer work will take place on the seventh day of STS-112 followed by the third and final spacewalk of the mission. Sellers will ride the Canadarm2 for most of the spacewalk. The first job on the

flight's final spacewalk is removal and replacement of the Interface Umbilical Assembly (IUA). The IUA is installed with the Trailing Umbilical System (TUS) on the MT to enable the railcar to move properly up and down the truss segments. A bolt for a backup cable cutter on the IUA did not seat properly when the MT was activated during the STS-110 mission and now will be corrected with the installation of the replacement hardware. Wolf and Sellers then move to a point at the junction of S0 and S1 for the next activity, a one-hour, 25-minute installation of fluid jumpers to enable ammonia coolant to flow through S1 radiators to provide station cooling when the system is activated on a later mission. The next task for the spacewalkers is to remove and stow the S1 port and starboard keels and drag links to allow translation of the MT/Mobile Base System onto the S1 Truss.

Another task for the final scheduled spacewalk is Installation of SPDs onto the TRRJ stringer Quick Disconnects. All three spacewalks are expected to last about 6 to 6.5 hours. The next day, Flight Day 9, the shuttle and station crews will complete some additional transfer work and get-ahead tasks for future assembly flights before saying goodbye to one another on Flight Day 10 as the hatches are closed between the vehicles. Melroy will be at the controls as Atlantis undocks from the ISS. She will back the orbiter away from the station to a point about 400 feet in front of the complex before initiating a flyaround of the outpost to enable her crewmates to conduct photo and television documentation of the newly expanded facility.

After a day devoted to packing up gear, Atlantis' six crewmembers will glide to a landing at the Kennedy Space Center to wrap up the orbiter's 26th mission and the 111th in shuttle program history.

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Mission Objectives

These major tasks, listed in order of International Space Station Program priority, are to be performed during this flight:

* Perform critical water transfer from shuttle to International Space Station

* Transfer, using the Space Station Remote Manipulator System, install and safe the Integrated Truss Segment (ITS) S1 to ITS S0 starboard side

* Deploy and safe the S1 S-Band Antenna Structural Assembly

* Transfer critical items per Flight 9A Transfer Priority List

* Perform mandatory daily maintenance for powered middeck and U.S. lab payloads

* Transfer remaining items per Flight 9A Transfer Priority List

* Install critical Spool Positioning Devices

* Complete S1 remaining Zenith and Nadir tray utility connections

* Perform Thermal Radiator Rotary Joint checkout

* Deploy S1 central radiator

* Disconnect the Squib Firing Units harness reposition to the radiator beam line heaters and activate S1 fluid line secondary heaters

* IUA remove and replace

* Connect S0 to S1 fluid jumpers

* Connect Ammonia Tank Assembly nitrogen and ammonia lines

* Install second group of Spool Positioning Devices

* Configure inboard section of the MT/CETA translation path

* Release CETA cart

* Complete additional ISS consumables transfer

* Configure outboard section of the MT/CETA translation path

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Timeline Overview

Flight Day 1

❑ Following launch, crew performs minimal activities before going to sleep.
❑ International Space Station crew has off duty and sleep shifts in preparation of shuttle docking.

Flight Day 2

❑ Shuttle crew performs middeck ISS payload status checks, checkouts of the shuttle robotic arm, spacewalkers' spacesuits, rendezvous tools and prepares for transfer.
❑ The shuttle RMS is left powered on in preparation of the S1 installation activities on Flight Day 4.
❑ The secondary payload SHIMMER is checked out and DTO 700-14/MAGR is set up.
❑ The shuttle crew goes to bed two hours earlier in support of tomorrow's rendezvous activities.
❑ ISS crew has off duty and completes any sleep shifting required.

Flight Day 3

❑ A shuttle wastewater dump is scheduled in the crew morning before the start of rendezvous activities.
❑ Docking occurs in the crew's afternoon. Hatches are opened about two hours after docking.
❑ The first two CWCs are filled after the hatches are open. The CWCs used for water transfer are from ISS, so no CWC fills can be done before hatch opening.
❑ The spacesuits and airlock are prepared for tomorrow's EVA activities.
❑ A setup of the shuttle oxygen configuration for the EVA pre-breathe protocol is scheduled late in the crew day.
❑ An SSRMS tag-up is scheduled between MS2 and FE-1 to allow SSRMS operators preparation time for tomorrow morning's S1 Truss installation. The shuttle CDR will participate as time is available to him.
❑ An EVA procedure review is scheduled for all crewmembers before pre-sleep. The procedure review gives the crew time to review tomorrow's EVA plan.

Flight Day 4

❑ The shuttle crew has two hours of post-sleep scheduled before the start of S1 installation activities and EVA preparation.
❑ During EVA preparation, the S1 Truss is installed by the SSRMS with the shuttle RMS used for viewing purposes.
❑ ISS power (channel) must be powered down before the EVA crew connects the zenith side power umbilicals. MCC-H powers channel on and channel 2/3 is

powered down before the EVA crew connects the nadir side umbilicals. A checkout will be performed by MCC-H after each string is powered on. Channel will be checked out before channel 2/3 is powered off.
❏ The EVA crew will deploy the S-band antenna while MCC is checking out channel and powering down string 2.
❏ Other EVA tasks performed this day are release of the radiator beam launch locks, SASA deploy, ETVCG outboard nadir installation and release of the CETA cart launch locks.
❏ The shuttle RMS is powered off after EVA 1 and will remain off until Flight Day 6.

Flight Day 5

❏ Shuttle crew off duty is scheduled.
❏ Shuttle nitrogen transfer to ISS is started in late morning and will be terminated on Flight Day 9.
❏ MSFC payloads, PCG-STES 007 and 008 and the STELSYS CBOSS, are transferred this day.
❏ The EVA crewmembers perform activities in preparation for EVA 2 such as Extravehicular Mobility Unit (EMU) water recharge, tool configuration and airlock preparation.
❏ An EVA procedure review is scheduled for both crews before pre-sleep this evening.

Flight Day 6

❏ A one-hour shuttle reboost is scheduled during EVA prep.
❏ EVA 2 activities include Z1 to P6 and PVR SPDS, Z1 to Lab loop A umbilicals, ATA umbilical, ETVCG starboard installation, SPD installation on RBVM and the last of the launch lock release bolts.
❏ Two CWCs and a PWR (for spacesuit water recharge) are filled and transferred to the ISS.
❏ The ISS crew will perform the MSFC payload ZCG activities this day. ZCG has a microgravity constraint for 24 hours once activated.
❏ Overnight the MCC will check out the starboard ETVCG that was installed during EVA 2.

Flight Day 7

❏ The shuttle crew reconfigures and initiates an oxygen transfer to the high-pressure gas tanks on Quest in the morning. Oxygen will be transferred for about eight hours.
❏ The ISS crew will perform the ISS TVIS Remove and Replace most of the day.
❏ The EVA crew performs EVA 3 preparation activities in the morning and transfer in the afternoon.
❏ The MSFC payload PGBA is transferred to the ISS by the shuttle crew.
❏ The crew photo and conference are scheduled in the afternoon.
❏ Once the oxygen transfer is completed, a reconfiguration to the shuttle oxygen prebreather protocol is done late in the afternoon.
❏ A few hours after the TRRJ pointing checkout is completed, MCC will deploy the S1 radiator. The MS4 will take pictures of the radiator during the deployment.
❏ An EVA procedure review is scheduled for all crewmembers before pre-sleep.

Flight Day 8

❏ Oxygen from the shuttle will be used for the pre-breathe activity.
❏ A one-hour shuttle reboost is scheduled during the EVA prep timeframe.
❏ EVA 3 tasks include IUA R&R, S1 to S0 fluid jumper connections, removal of port and starboard keel pins, last of the TRRJ SPDs, TRRJ bolts and S1 to S1 clamps.
❏ Three CWCs are filled and transferred to the ISS. The total number of CWCs filled and transferred including the three from this day are 14.

Flight Day 9

❏ The shuttle crew has four hours of off duty scheduled.
❏ The last of the transfer items are taken over to the ISS including the shuttle SAFERs.
❏ The EMUs are reconfigured in support of leaving a good EMU suit for an ISS crewmember. Once the EMUs are reconfigured, one will be left on the ISS and the other brought back on the shuttle.
❏ The MSFC payload CGBA is transferred to the ISS.
❏ The last two CWCs and PWR are filled and transferred to the ISS. A total of 16 CWCs are transferred to the ISS.
❏ A rendezvous tools checkout is scheduled. The checkout is done in preparation for undock the next day.
• A teardown of the shuttle oxygen configuration for the EVA pre-breathe protocol is scheduled late in the crew day.

Flight Day 10

❏ The hatches are closed and the undock activities are completed.
❏ After flyaround of the ISS by the shuttle, the shuttle crew will perform SHIMMER data takes.
❏ A wastewater and condensate CWC water dump are scheduled.
❏ A shuttle crew only PAO event is scheduled in the afternoon.

Flight Day 11

❏ Shuttle crew prepares for landing tomorrow by performing cabin stow and end-ofmission checkouts.
❏ SHIMMER data takes are scheduled in the morning and a PAO event is in the afternoon.

Flight Day 12

❏ DTO 700-14/MAGR entry setup is completed before deorbit prep.
• Shuttle lands.

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Rendezvous and Docking

Atlantis' rendezvous and docking with the International Space Station begins with the precisely timed launch of the shuttle on a course for the station. During the first two days of the mission, periodic engine firings will gradually bring Atlantis to a point about 9.2 statute miles behind the station, the starting point for a final approach to the station.

About 2.5 hours before the scheduled docking time on Flight Day 3, Atlantis will reach that point, about 50,000 feet behind the ISS. There Atlantis' jets will be fired in a Terminal Intercept (TI) burn to begin the final phase of the rendezvous. Atlantis will close the final miles to the station during the next orbit.

As Atlantis closes in, the shuttle's rendezvous radar system will begin tracking the station and providing range and closing rate information to the crew. During the final approach, Atlantis can do as many as four small mid-course corrections at regular intervals. Just after the fourth correction is completed, Atlantis will reach a point about half a mile below the station. There, about an hour before the scheduled docking, Commander Jeff Ashby will take over manual control of the approach.

Ashby will slow Atlantis' approach and fly to a point about 600 feet directly below the station, from which he will begin a quarter-circle of the ISS, slowly moving to a position in front of the complex, in line with its direction of travel. Pilot Pamela Melroy will help Ashby in controlling Atlantis' approach. Mission Specialist

Dave Wolf also will play key roles in the rendezvous, using a handheld laser ranging device and operating the docking mechanism to latch the station and Atlantis together after the two spacecraft make contact. Mission Specialist Sandra Magnus will be backup on the docking system and Mission Specialist Piers Sellers will fill the backup role with the handheld laser ranging device.

Ashby will fly the quarter-circle of the station while slowly closing in on the complex, stopping at a point a little more than 300 feet directly in front of the station. From there, he will begin slowly moving Atlantis toward the station at about a tenth of a mile per hour. Using a view from a camera mounted in the center of Atlantis' docking mechanism as a key alignment aid, Ashby will precisely center the docking ports of the two spacecraft.

Ashby will fly to a point where the docking mechanisms are 30 feet apart, and pause to check the alignment. For Atlantis' docking, Ashby will maintain the shuttle's speed relative to the station at about one-tenth of a foot per second (though both spacecraft are traveling at about 17,500 mph), and keep the docking mechanisms aligned to within a tolerance of three inches. When Atlantis makes contact with the station, preliminary latches will automatically attach the two spacecraft. Immediately after Atlantis docks, the shuttle's steering jets will be deactivated to reduce the forces acting at the docking interface. Shock absorber-type springs in the docking mechanism will dampen any relative motion between the shuttle and the station.

Once that motion between the spacecraft has been stopped, Wolf will secure the docking mechanism, sending commands for Atlantis' docking ring to retract and to close a final set of latches between the shuttle and station.

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Payload Overview

The primary cargo element to be delivered on Mission 9A is the second truss segment, Starboard 1 (S1), of the main International Space Station Integrated Truss Structure (ITS). The ITS will eventually be used to support the four power-generating Photo- Voltaic Modules (PVMs) of the ISS, the permanent External Active Thermal Control Subsystem (EATCS).

The ITS will also provide a translation path for the Mobile Servicing System (MSS) along specially designed truss rails. The truss rails allow the Space Station Remote Manipulator System (SSRMS) to be positioned at various locations along the truss for performing maintenance tasks, element installations, and providing EVA assistance.

Integrated within the S1 truss segment are various hardware components and their associated cabling for powering and controlling the starboard side systems of the ITS. S1 contains almost all of the hardware components for Loop A of the EATCS, which will be activated during Mission 12A.1 to replace the Early External Active Thermal Control Subsystem (EEATCS). Once operational, the EATCS will provide a permanent system of thermal control for all U.S. On-Orbit Segment Internal Active Thermal Control Subsystem (IATCS) water loops and a number of external truss avionics.

The EATCS equipment on S1 includes a Pump Module (PM) Assembly, an Ammonia Tank Assembly (ATA), a Nitrogen Tank Assembly (NTA), three radiator Orbital Replacement Units (ORUs), six Radiator Beam Valve Modules (RBVMs), a Thermal Radiator Rotary Joint (TRRJ), and numerous ammonia fluid lines, junction boxes, heaters and coldplates.

S1 also contains the second string of the S-Band communications subsystem (actually referred to as string-1 or S-Band-S) including an S-Band Antenna Support Assembly (SASA), transponder and Baseband Signal Processor (BSP). Additional hardware preintegrated within the S1 truss segment includes two standard Space Station Multiplexer/Demultiplexer (SSMDMs), one external DC-to-DC Converter Unit (DDCU-E), two Secondary Power Distribution Assemblies (SPDAs), two Rotary Joint Motor Controllers (RJMCs), one passive Segment-to-Segment Attach System (SSAS), one active SSAS with two Bus Bolt Controllers

(BBCs), one Crew and Equipment Translation Aid (CETA) cart, four accelerometers, and two Video Camera Support Assemblies (VCSAs—also referred to as “stanchions”).

The middeck of Atlantis will be filled with various ISS assembly-related hardware, logistics and payloads on Mission 9A. This includes EVA tools and equipment, CETA lights, two External Television Cameras Groups (ETVCGs) and lights (may be moved to Mission UF- 2), Portable Computer System (PCS) items, Crew Health Care System (CheCS) items, photo/TV equipment, water transfer equipment and a number of powered and unpowered ISS utilization payloads.

Unpowered ISS utilization payloads launched on Mission 9A (ascent) will include:

* Plant Generic Bioprocessing Apparatus—Stowage (PGBA-S)

* PGBA Muffler

* Two Cellular Biotechnology Operating Science System (CBOSS) Cryodewars (StelSys Experiment)

* Human Research Facility Resupply (HRF-Res)

* Zeolite Crystal Growth—Sample Stowage (ZCG-SS) Powered ISS utilization payloads launched on Mission 9A (ascent) will include:

* Commercial Generic Bioprocessing Apparatus (CGBA)

* PGBA

* Protein Crystal Growth Single-locker Thermal Enclosure System-7 (PCG-STES-7) Unpowered ISS utilization payloads returning on Mission 9A (descent) will include:

* EarthKAM—Experiment Unique Equipment (EarthKAM-EUE)

* Advanced Astroculture—Growth Chamber (ADVASC-GC)

* ADVASC—Sample (ADVASC-S2D)

* ADVASC—Sample (ADVASC-S3D)

* ZCG—SS

* HRF—Increment 4 samples/data

* Microencapsulation Electrostatic Processing System (MEPS-S10)

* ZCG—Stowage

* Two CBOSS Cryodewars (StelSys Experiment) Powered ISS utilization payloads returning on Mission 9A (descent) will include:

* PCG-STES-9

* PCG-STES-10

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Secondary Payloads

The Spatial Heterodyne Imager for Mesospheric Radicals (SHIMMER) consists of a telescope, interferometer, imaging optics, and Charge Coupled Device (CCD) camera all housed in a single enclosure. The SHIMMER will be used to evaluate a powerful new technique for Ultraviolet (UV) remote sensing referred to as Spatial Heterodyne Spectroscopy (SHS). The SHIMMER instrument will make global maps of the vertical density distribution of the atmospheric trace gas hydroxyl (OH) in the altitude region between 40 and 90 km. The SHIMMER hardware is stowed in two standard middeck lockers for launch and entry and is removed for on-orbit operations. The SHIMMER will be mounted to the orbiter side hatch window during on-orbit operations using a payloadprovided mounting bracket and light baffle.

Payloads of Opportunity

The objective of the Ram Burn Observation (RAMBO) payload is to help calibrate the RAMBO satellite. This requires retrograde, posigrade, and out-of-place burns. The location of the RAMBO satellite is classified.

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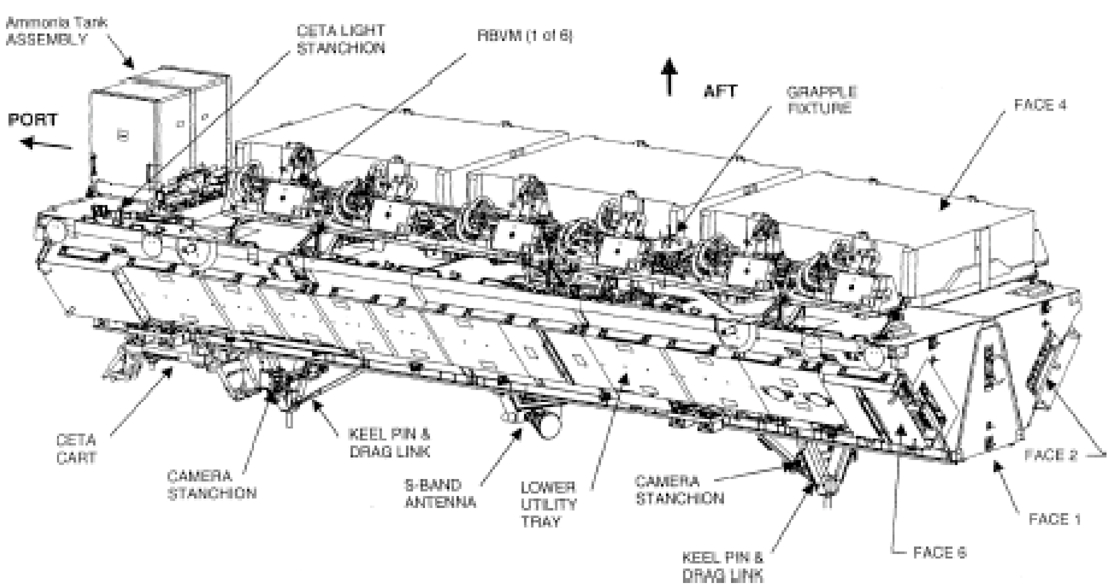
S1 Truss Extends International Space Station Backbone

The Starboard One (S1) Truss is slated for launch to the International Space Station aboard space shuttle Atlantis from Kennedy Space Center, Fla. The truss is the next major addition to the space station's Integrated Truss Structure that will eventually span more than 300 feet to carry power, data and environmental services for the orbital outpost. When completed, the ends of the truss structure will also house the station's solar arrays.



During Atlantis' mission, spacewalkers assisted by the ISS robotic arm, will attach S1 to the S0 (Starboard Zero) truss already in place aboard the U.S. laboratory module Destiny. Astronauts will make three spacewalks to complete installation and assembly. Space shuttle Atlantis delivered S0 to the ISS in April 2002. Space shuttle Endeavour delivers S1's mirror image, the P1 (Port One) truss, and attaches it to the other side of S0 in an upcoming flight.

The 27,717 lb. S1 Truss is primarily an aluminum structure that is 45 feet long, 15 feet high and 6 feet wide. The structure along with one CETA (Crew and Equipment Translation Aid) cart costs about $390 million.

Boeing began construction of the truss in May 1998 in Huntington Beach, Calif., and completed the work in Huntsville, Ala., in March 1999. The S1 moved to Kennedy Space Center, Fla., in October 1999 for flight processing. Boeing delivered the S1 to NASA in June 2002 for final preparations and preflight checks.

Both S1 and eventually P1 provide structural support for the Active Thermal Control System, the Mobile Transporter, a CETA cart and antennas. The S1 has an S-band system; the P1 a UHF system. Both trusses also have mounts for cameras and lights.

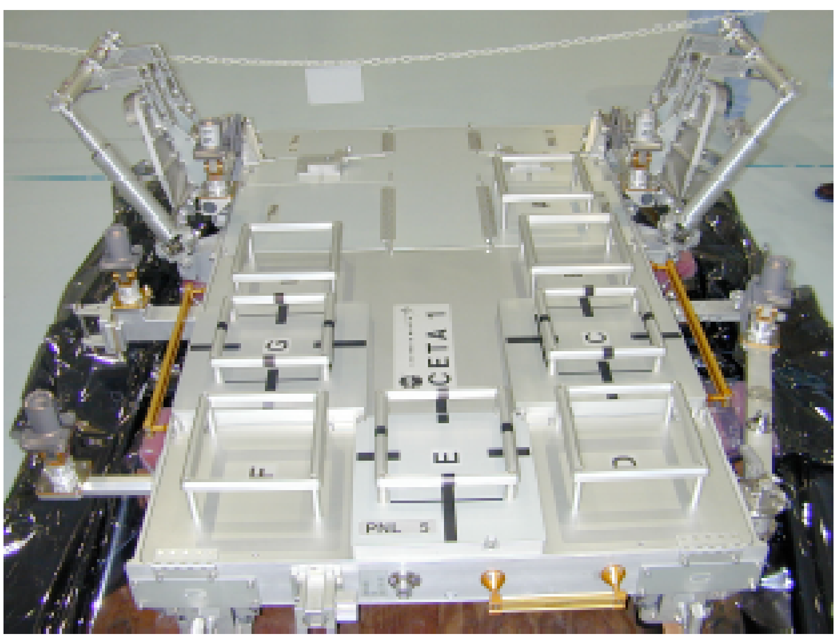
Additionally, both S1 and P1 carry one radiator each as part of the space station’s cooling and heating system. The radiators are deployed in orbit and use 99.9 percent pure ammonia. The radiator assembly also rotates to keep itself in the shade and away from the sun. Each radiator has 18 launch locks securing the assembly during launch. The locks will be removed during a spacewalk before deploying the radiators.

The addition of S1 also extends the Mobile Transporter (MT) rail line. The MT car travels along the length of the truss structure and carries spacewalkers, tools, construction items and the space station robotic arm.

Flying aboard S1 is one of two CETA carts that move spacewalkers along the MT rails to worksites along the truss structure. The cart is manually operated by a spacewalker and can also be used as a work platform. S1 and P1 carry one cart each. The P1 Truss differs slightly from S1 and could be considered a mirror image. It has the same capabilities as the S1 except that P1 carries a UHF antenna. The P1 also carries a second CETA cart.

Crew and Equipment Translation Aid (CETA)

What happens when Lockheed Martin and NASA CTSD team members engineer a solid, roughly 2,500-pound block of aluminum and transform it into a 142-pound frame assembled with more than 1,100 parts? You get the Crew and Equipment Translation Aid (CETA), a complex, dynamic mechanical translation device – NASA’s equivalent of a flatbed truck.



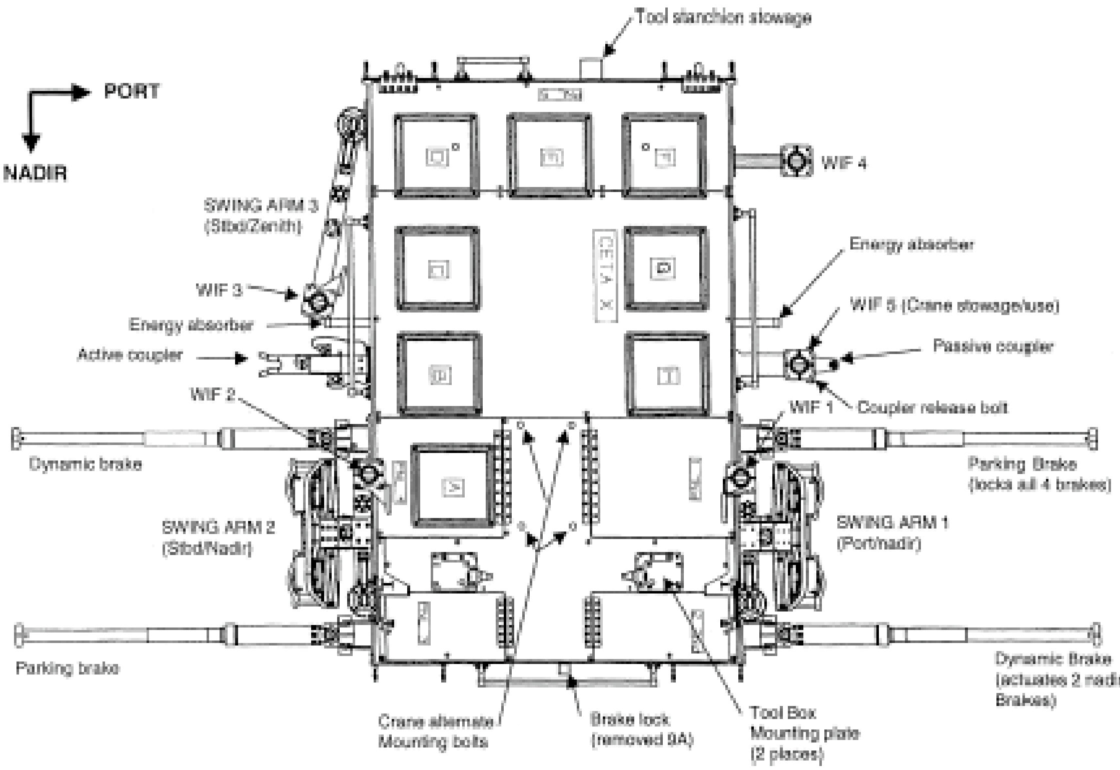
CETA Cart

The first of two CETAs will launch this fall on STS-112, station assembly flight 9A. CETA, one of the largest pieces of extravehicular activity (EVA) equipment built for the International Space Station (ISS), will

accompany the first starboard truss, called S1, to orbit. This truss will become the backbone of the four solar wing assemblies and will incorporate many orbital replaceable units (ORUs).

Installation and maintenance of these ORUs – for example batteries, the DC-to-DC converter, the Remote Power Controller Module, and the multiplexer/demultiplexer – is critical. At this time, NASA uses spacewalking crewmembers or robotics to repair or replace those units.

The need for a work platform that could also provide the crew with a means of transporting themselves, the necessary tools and ORUs safely and easily along the truss became crucial. The SEATengineered CETA fulfills those requirements.



CETA Cart Schematic

The CETAs are launched as integrated parts of the S1 and P1 Truss segments. Once deployed on orbit, crewmembers can propel themselves and accompanying hardware manually along the Mobile Transporter (MT) rails. On orbit, the two CETA carts will be located one on each side of the MT for usage flexibility. If required, a cart may be moved to the other side of the MT to complement the other cart.

The CETA has attachment points for other EVA hardware such as the ORU Transfer Device (OTD), also known as the Space Crane; Articulating Portable Foot Restraint (APFR); EVA Tool Stowage Device (ETSD); and a host of other small crew and equipment restraining tools.

During ISS assembly operations, crewmembers will also use CETA as a work platform to reach 90 percent of the worksites safely. When not in use, the CETAs will attach to the MT for stowage and become part of a "train" that allows the Space Station Remote Manipulator System (the station's robotic arm) to move freely along the truss. CETA is made of many components, including the following major subassemblies:

* A main frame;

* Launch restraints to ensure CETA is secured to the truss segment;

* A wheel/brake subsystem to move along the truss;

* A dynamic brake for speed control and a parking brake for use at worksites;

* Energy absorbers to reduce the impact of a hard stop;

* Three swing arms to provide access to structures along side the truss; and

* An ORU transfer flat bed for attaching ORUs.

The second CETA is scheduled for launch on STS-113, station assembly flight 11A.

Key Data:

Size: 99 in. x 93 in. x 35 in.
Weight: 623 lb
Number on Space Station: 2
Volume: 468.48 cu ft

CETA Toolbox

The Crew and Equipment Translation Aid (CETA) toolboxes provide central stowage locations for high-use Extravehicular Activity tools. The toolboxes will be located on the Z1 truss prior to installation on the CETA carts.

Weight: 126 lb
Number on Space Station: 2

Thermal Radiator Rotary Joint

The Thermal Radiator Rotary Joint (TRRJ) Orbital Replacement Unit (ORU) provides mechanical and electrical energy for rotating the ISS heat rejection radiators for varying heat rejection rates responding to system requirements. The TRRJ rotational capabilities are controlled by the Rotary Joint Motor Controllers (RJMC), which also power the Drive Lock Assemblies (DLA). The RJMC receives signal control from the rotary joint MDMs. The TRRJ is installed into the S1 and P1 truss segments before launch on Flights 9A and 11A.

Size: 3.4 ft. x 4.5 ft. x 5.2 ft
Weight: 992 lb
Number on space station: 2

Components: Primary structure is made of aluminum and the drive and rotational elements are steel; the flex hoses are corrugated corrosion resistant steel interfacing with corrosion resistant steel tubing and aluminum quick disconnects. Primary structure includes a Flex Hose Rotary Coupler, the Bearing Assay, the DLA and RJMC. There are EVA handholds to assist in EVA operations for electrical and fluid interconnects during on-orbit assembly.

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International Space Station S1 and P1 Truss Summary

The Starboard One, Port One (S1 and P1) trusses will be attached to the S0 Truss aboard the International Space Station. The trusses provide structural support for the Active Thermal Control System, Mobile Transporter, CETA cart (Crew and Equipment Translation Aid), camera/light operations, and S-band and UHF communications.

Once in orbit, the S1 end bulkheads will be used as attachment points for the S0, P3 and S3 truss segments. The CETA cart moves spacewalkers along the Mobile Transporter rails to work sites along the

truss structure. The cart is manually operated by a spacewalker and can also be used as a work platform. S1 and P1 carry one cart each.

Differences between S1 and P1: There are very few differences between the S1 and P1 elements. The primary structure (bulkheads and longerons) of both S1 and P1 are mirror images of each other. Consequently, Boeing had to design and fabricate different parts (they are all coated with the same optical anodized surface preparation). Another unique attribute of the two elements is their communication capability.

The S1 launches with an S-band antenna system, whereas P1 has a UHF capability. There are “ports” or locations on the P1 to allow an S-band antenna boom to be placed via EVA. Both trusses house the Active Thermal Control System. This system acts like the cooling system on a car radiator except this system uses 99.9 percent pure ammonia (compared to 1 percent in household products).

Facts in brief:

* Manufacturer: Boeing

* Dimensions: 45 ft. x 15 ft. x 6 ft.

* Weight: 27,717 lbs. (S1); 30,871 lbs. (P1)

* Cost: $390 million each (one CETA cart launched on each truss element)

* Structure: Primarily aluminum

* Major components: Primary structure is made of aluminum and includes seven bulkheads per segment, four longerons per segment, heat transport subsystem, radiator support beam(s), trailing umbilical system, on-orbit video camera, electrical equipment, S-band antenna support equipment

* Purpose: To carry power, data and environmental services along the integrated truss structure. Also to provide active thermal protection to electrical components throughout the station.

* Construction: Started assembly at Boeing plant in Huntington Beach, Calif., in May 1998; moved to Boeing facility in Huntsville, Ala., in March 1999 for completion and then to Boeing Florida Operations at Kennedy Space Center, Fla., in October 1999 for flight processing. S1 handed off to NASA in June 2002.

* Major subcontractors: Lockheed Martin, Honeywell, Allied Signal, Hamilton Standard and ITT Cannon.

* Installation: S1 to be installed during mission STS-112/9A, P1 to be installed during STS-113/11A.

* Radiator assembly: The entire radiator beam assembly (upper portion of the elements) rotates to keep the radiators in the shade. There are 18 launch locks that keep this radiator beam assembly together during launch – all removed/stowed by EVA (special training for astronaut Piers Sellers on flight 9A).

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STS-112 Extravehicular Activity

Three spacewalks are scheduled for the STS-112 (9A) mission of Atlantis to the International Space Station. The spacewalks will be performed on alternate days, on the crew's flight days four, six and eight. Atlantis Mission Specialists David Wolf and Piers Sellers will perform all three.

Wolf, EV 1 (for Extravehicular Activity crewmember #1) will wear the spacesuit marked with solid red stripes, while Sellers, EV 2 (Extravehicular Activity crewmember #2), will wear an all-white spacesuit. Atlantis Pilot Pam Melroy will be the prime intravehicular (IV) crewmember, offering advice and coordinating spacewalking activities. Russian Mission Specialist Fyodor Yurchikhin will back up Melroy in this role.

The prime Canadarm2 station robotic arm operator during the spacewalks will be Atlantis Mission Specialist Sandra Magnus, with help from Expedition 5 Flight Engineer Peggy Whitson. Atlantis Commander Jeff Ashby will assist Melroy in the positioning of the shuttle's robotic arm, providing video and documentation support during the spacewalks.

David Wolf

All the spacewalks focus on installation and hookup of the S-One (S1) segment, the 45-foot-long component, which is the second part of the station's Integrated Truss Structure (ITS) to the S-Zero (S0) Truss, the center of the ITS. The ITS eventually will have 11 segments and stretch 356 feet from end to end. It will support four virtually identical solar array assemblies, including the one now atop the P6 Truss of the ISS, along with radiators to cool the station. The truss, sometimes called the backbone of the station, also will support experiments and already houses a railroad track with a mobile base for Canadarm2.

All the spacewalks will be conducted from the station's Joint Airlock Quest. Before each excursion, Wolf and Sellers will use the ISS Exercise EVA Protocol. Designed to purge nitrogen from the body, the protocol involves breathing pure oxygen while exercising vigorously. It eliminates the need to spend many hours at reduced cabin pressure and allows hatches between the shuttle and the station to remain open. The protocol was first used during STS-104 during the first spacewalk from the Joint Airlock installed earlier during that mission. The backup spacewalker for the first EVA will be Expedition 5 Commander Valery Korzun. Whitson will be the backup for the second and third spacewalks, if required.

Spacewalk No. 1, Flight Day Four

Objectives: Connect power, data and fluid umbilicals between S0 and S1, release radiator beam launch locks, deploy the S-Band Antenna Support Assembly, release launch restraints on the Crew and Equipment Translation Aid and install the first of two External TV Camera Groups.

Before Wolf and Sellers emerge from the airlock, Magnus and Whitson will use the station's robotic arm to grapple S1, remove it from Atlantis' cargo bay and move it to the end of S0. After a claw and then bolts attach the ends of the two segments, Wolf and Sellers will emerge from the Joint Airlock and begin setting up for the first spacewalk.

Toward the end of that process, Wolf will attach and enter a foot restraint on the end of the station's Canadarm2. Magnus will maneuver him to the cable tray atop S1. Once he is clear, Sellers will move to the forward side of S1, where he will release the five radiator launch locks nearest the S0 connection. Meanwhile, Wolf will open thermal covers over cable trays atop S0 and S1, then demate connectors on the S0 side from temporary attachment points and connect their free ends to receptacles on S1. Sellers will open a circuit breaker, then close it once Wolf completes those connections.

Piers Sellers

After those 50-minute tasks, Wolf and Sellers will collaborate to deploy the S-Band Antenna Support Assembly (SASA). That task is expected to take about an hour and 15 minutes. The new component will increase the S-band data and voice communications capability from the ISS to ground controllers. Wolf, at the end of Canadarm2, will be maneuvered to SASA's launch position at the center of truss between the two keel pin assemblies of S1. There he will use a Pistol Grip Tool (PGT) to release four launch bolts and two mast bolts. He and Sellers will remove the SASA from its launch position and Wolf will carry it, while Magnus maneuvers him on the arm to the installation site near the inboard end of S1. Sellers, meanwhile, will move to the installation site and release two clamps.

Wolf will soft dock the SASA to its support bracket, then tighten a stanchion bolt about nine turns until it drops out of its launch position. Still using the PGT, he will tighten that bolt about 21 more turns until it reaches a hard stop, completing the SASA physical installation. The next task for Wolf is to demate the ends of four connectors and install them to provide power and data links to the SASA. Sellers will then remove a shroud covering the antenna, bundle it and temporally stow it. Finally, Wolf will release four SASA gimbal locks with the PGT and rotate them away from SASA's high-gain antenna. Then Sellers will hand Wolf the shroud bundle, and Wolf will take it with him on the arm to the launch position of the Crew and Equipment Translation Aid (CETA).

The CETA is a kind of handcar for the truss' rail line, with which spacewalkers eventually will be able to push themselves and equipment along much of the 356-foot length of the completed main truss. Wolf will release a brake shaft launch lock with the PGT and then use it to release two portside brake handle launch clamp bolts. He will deploy dynamic and parking brake handles and lock sliders. That complete, he will release four bolts that will free two portside launch handle brackets, and put the brackets in a trash bag.

After setting the CETA parking brake, Wolf will turn his attention to its main launch bolts. He will release four scissor bolts, break the torque on four launch restraint bolts and fully release four others, stowing them in the trash bag. Then he will release the CETA parking brake and push it along its rails to a point near the center of S0. There he will repeat the portside work on CETA's starboard side. During Wolf's 75-minute CETA activity, Sellers will first release three more radiator beam launch locks on the new S1 truss. Then he will demate the ends of a total of nine power, video and data cables from their temporary positions on S0 and mate them to receptacles on S1.

Installation of the S1's outboard nadir external camera will occupy Wolf and Sellers for about the next hour and 15 minutes. Wolf will remove the camera, launched on Atlantis' middeck, and the tilt pad cover from the camera's light before taking the camera from its large bag. He will then maneuver with the assembly to the starboard keel, where he will attach the assembly, driving its center jacking bolt about 28 turns with a PGT. Wolf will next release two camera stanchion launch restraint bolts, then slide the camera out of its keel interface and move it to its installation location. With a PGT he will tighten a stanchion bolt about nine turns until it drops out of its launch position, then tighten it about another 21 turns until it reaches a hard stop.

The spacewalkers will then mate eight connectors to take power, data and images to and from the camera. Wolf and Sellers then will temporarily remove the camera so they can install four more connectors. Wolf will reinstall it using the PGT to tighten its center-jacking bolt about 28 turns.

Near the end of the first spacewalk, Wolf will connect a series of cables linking S0 and S1 on the Utilities Nadir Tray. The spacewalkers each will release five Radiator Beam Launch Locks. After about half an hour of EVA cleanup the spacewalkers will re-enter the airlock.

Spacewalk No. 2, Flight Day Six

Objectives: Install Lab Camera, install Spool Positioning Devices (SPDs), release CETA launch locks, connect Ammonia Tank Assembly (ATA) umbilicals and release radiator beam launch locks.

For the second of the three spacewalks, Sellers will ride at the end of the arm and Wolf will free-float. After about half an hour for setup after leaving the airlock, Sellers will ride the arm to a position near the left side of the Z1 truss and its junction with the U.S. laboratory Destiny. Wolf will make his way to the aft side of the Z1-P6 truss junction.

There, both astronauts will remove insulation covers on booties covering quick disconnect (QD) fittings in ammonia lines, part of the station's thermal cooling systems. Sellers will install two one-inch “spool positioning devices” (SPDs) to better match the position of the bodies of two QDs at the base of the Z1 truss while Wolf will conduct a similar task at the Z1-P6 truss interface. The installation involves rotating the QD locking collar to the unlock position, attaching a circular section of the SPD to the QD, then adding a clamp-like device to tension it there before finally checking the SPD installation and performing a pull test on the QD. Wolf is to spend 45 minutes on that task, Sellers 30 minutes.

Next, Wolf will maneuver to the CETA cart, where he will spend about 25 minutes releasing the starboard brake system as well as the swing arm and coupler restraints. Sellers, meanwhile, will ride the arm to the ammonia tank assembly at the inboard end of S1. There he will demate two dustcaps and install the ends of two umbilicals on the Ammonia Tank Assembly (ATA). The umblicials on the Nitrogen Tank Assembly (NTA) on the outboard side of S0 are attached there with QDs, which he will use to make the new connection. He will reinstall the dustcaps he removed from the ATA on the fittings that held the QDs on the NTA.

The next task is a repeat of the camera group installation on the first spacewalk, involving both Wolf and Sellers. This installation, however, will be on the U.S. laboratory Destiny. Installation steps are virtually identical, though the players are reversed with Sellers still affixed at the end of the arm.

With the camera installation complete, Sellers will leave the arm's foot restraint and move to the CETA light stanchion to retrieve a bag of SPDs, then move to the starboard camera group he and Wolf installed two days before to temporarily stow the bag. Then he will move to the inboard end of S1 where he will begin installing SPDs on one-inch ammonia lines on Radiator Beam Valve Module (RBVM) No. 1.

The RBVM allows or prevents transfer of ammonia supply or return to or from the Radiator ORU, allows remote controlled venting of the radiator fluid loop for replacement of the Radiator ORU, and provides automatic pressure relief when the Radiator ORU is over pressurized. The RBVM also measures pressure and temperature of the fluid line, provides temperature measurements of Radiator ORU environment, provides instrumentation monitoring data, and receives valve actuation command data.

There are 12 RBVMs on the space station. Each measures 17 in. x 27 in. x 6 in. and weighs 56 lbs. Meanwhile, Wolf will replace Sellers on the arm foot restraint. Magnus will move him to the CETA light station where he will pick up his own SPD bag, then maneuver to the outboard end of S1. There, he will begin installing SPDs on one-inch ammonia line QDs at RBVM No. 6. The two spacewalkers will install a total of 24 SPDs during this 2.5-hour task.

The last task scheduled for the second spacewalk is releasing Radiator Beam Launch Locks. Both Wolf and Sellers will use pistol grip tools to release the launch locks, turning each of three bolts 60 to 62 rotations. The task is scheduled for 15 minutes. A 30-minute cleanup period will wrap up the spacewalk, with the two astronauts entering the Joint Airlock and repressurizing it to end the EVA.

Spacewalk No. 3, Flight Day 8

Objectives: Interface Umbilical Assembly (IUA) removal and replacement, fluid jumper installation, drag link/keel pin removal, Thermal Radiator Rotary Joint (TRRJ) SPD installation, S1/S3 line clamps and Segment to Segment Attachment System (SSAS) ready to latch test, and Squib Firing Unit (SFU) reconfiguration.

After the 30-minute setup period, the first job on the flight's final spacewalk is removal and replacement of the Interface Umbilical Assembly (IUA). The IUA is installed with the Trailing Umbilical System (TUS) on the Mobil Transporter (MT), the railcar that supports the base for the station's robotic arm.

The TUS incorporates a reel for the trailing umbilical, a power and data cable linking the station and the MT as it moves along the tracks on the truss. Program officials decided to replace the IUA after a bolt securing a backup cable cutter could not be removed during its initial installation on the STS-110 mission last April. Wolf and Sellers will move from the airlock to the MT, on the tracks of S0.

They first will remove the TUS cable, with Sellers keeping it under tension while being careful not to bend or crimp it. Wolf will loosen three cable connections, then remove the cable cutter before temporarily stowing the TUS cable. To remove the IUA itself, Wolf detaches four cable connections linking it to the MT. Then Sellers, using a pistol grip tool, removes four bolts attaching the IUA assembly to the MT. Finally he removes the IUA from its “soft dock” connection and hands it to Wolf.

Installation of the new IUA is basically the same operation in reverse, with Sellers soft docking the new unit and attaching it to the MT with four bolts. Wolf then makes the seven connections between the IUA, the MT and the TUS. Wolf and Sellers move to a point at the junction of S0 and S1 for the next activity, a onehour, 25-minute installation of fluid jumpers to enable ammonia coolant to flow between the two truss segments. Sellers releases two jumpers on S0, then moves into the Canadarm2 foot restraint for a ride to the jumper install position at the lower segment-to-segment utility carrier. There he will join Wolf, waiting nearby in a portable foot restraint.

Wolf will mate and install SPDs on two jumper connections on the S0 side, while Sellers performs a similar task on the S1 side. Each connection will involve a pull test and a threeminute leak check. Wolf reinstalls thermal covers while Sellers closes S1 and S0 utility tray shrouds.

Then Sellers, still on the arm, and Wolf, move on to S1's port drag link. They will work together to release that drag link, a large metal rod used as a launch restraint. Wolf will release a bolt attaching the drag link to the keel, while Sellers releases a similar bolt attaching the drag link to S1. Sellers takes the drag link to its stowage location on the S1 framework and attaches it. While Sellers attaches the drag link, Wolf moves to the port keel pin, another launch support device, first tightening two keel scissor bolts, then releasing two keel pin bolts and rotating keel pin latches free.

Once rotated Wolf reinstalls the bolt, removes two pit-pins. Sellers reinstalls the keel pin a nearby. The processes are repeated on the S1 starboard drag link and keel pin. Wolf and Sellers, now off the arm, will move to the CETA handrail cart where each will take a 1.5 -inch SPD to be installed on ammonia lines near a Thermal Radiator Rotary Joint on S0. Wolf will release bolts securing that joint in its launch position.

The last task is to perform a test of the Segment-to-Segment Attachment System (SSAS) at the outboard end of S1. The SSAS there consists of a remotely operated claw and three motorized bolt assemblies. Wolf will depress ready to latch indicators on each for several seconds. This will verify the readiness of the S1 segment to receive other starboard truss components on future flights. Finally, while Wolf does the SSAS test, Sellers will reconfigure the Squib Firing Unit (SFU) power connector. The SFU is used to release radiator panels for deployment.

A final 30-minute cleanup period will precede the entry of both spacewalkers into the airlock and its repressurization to complete the mission's final spacewalk.

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STS-112 Science Overview

Three new experiments and fresh supplies to continue research already under way on the Expedition 5 mission aboard the International Space Station will be launched on the STS- 112 mission. Four completed experiments will be returned to Earth.

Expedition 5 began on June 5 when Space Shuttle Endeavour was launched to the Station with a new crew to replace the crew of Expedition 4. New laboratory equipment, as well as new experiments, will arrive onboard the International Space Station during Expedition 5. Expedition 5 features a total of 24 new and continuing investigations – 10 human life sciences studies, six in microgravity, five in space product development, and three technology or education payloads.

NASA's Marshall Space Flight Center in Huntsville, Ala., manages all science research experiment operations aboard the station, coordination of the science mission planning work of a variety of international sources, as well as payload training for the station crew and payload operations ground personnel.

Experiments headed for the space station on STS-112 are:

Commercial Generic Bioprocessing Apparatus (CGBA)

CGBA will carry out investigations on the behavior of renal cortical cells and infectious agents, specifically yeast and salmonella, in the space environment on this shuttle flight. The experiment results will be used to help design improved bioreactor systems that optimize the ability to maintain long-term, large volume cultures on diverse cell types for pharmaceutical and medical applications. At the end of the flight, it will serve as a refrigerator to stabilize biological samples from the Plant Growth Bioprocessing Apparatus during their return to Earth for post-flight analyses.

Plant Growth Bioprocessing Apparatus (PGBA)

An evolution of a space shuttle experiment, PGBA will investigate the effects of microgravity on plants. It will test the hypothesis that metabolic pathways are altered, resulting in differing ratios of materials normally devoted to structural integrity of the plant. The alteration of structural components is important to the paper, wood and food industries. This is the first flight for the PGBA experiment and the third CGBA flight.

Protein Crystal Growth Single-locker Thermal Enclosure System (PCG-STES)

Following flights on Expeditions 2 and 4, this facility again provided a temperaturecontrolled environment for growing high-quality protein crystals of selected proteins in microgravity for analyses on the ground to determine the proteins' molecular structure. Research may contribute to advances in medicine, agriculture and other fields.

Zeolite Crystal Growth (ZCG)

The shuttle will bring fresh zeolite samples for processing in the ZCG furnace, launched to the station in April 2002, and installed in EXPRESS Rack 2. ZCG is a commercial experiment attempting to grow zeolite crystals in microgravity, which will behave more efficiently in possible applications in chemical processes, petroleum manufacturing and other applications on Earth.

Experiments returning to Earth on STS-112 are:

Advanced Astroculture (ADVASC)

A private agricultural seed company grew soybean plants in this experiment to determine if these space-grown plants produce seeds with a unique chemical composition. The major objective of the experiment was to determine whether soybean plants can produce seeds in a microgravity environment. Secondary objectives included determination of the chemical characteristics of the seeds produced in space and any microgravity impact on the plant growth cycle.

Protein Crystal Growth Single-locker Thermal Enclosure System (PCG-STES)

The completed samples processed so far during Expedition 5 will be returned to Earth for analysis by scientists located around the world.

Microencapsulation Electrostatic Processing System (MEPS)

Samples processed on board the station will be returned as part of this ongoing research. This commercial experiment is aimed at developing a process for producing large quantities of multi-layered microcapsules of drugs that could be placed in the human body. This process could provide new treatments for diseases such as cancer and drug resistant infection.

StelSys

Liver cell tissue samples cultured during Expedition 5 will be returned. One of the specialized functions of the liver is to break down drugs or toxins into less harmful and more water-soluble substances that can be excreted from the body. The StelSys experiment was designed to test this function of human liver cells in microgravity vs. the function of duplicate cells on Earth.

Zeolite Crystal Growth (ZCG)

Crystals grown during Expedition 5 will be returned for analysis. ZCG is a commercial experiment attempting to grow zeolite crystals in microgravity, which will behave more efficiently in possible applications in chemical processes, petroleum manufacturing and other applications on Earth.

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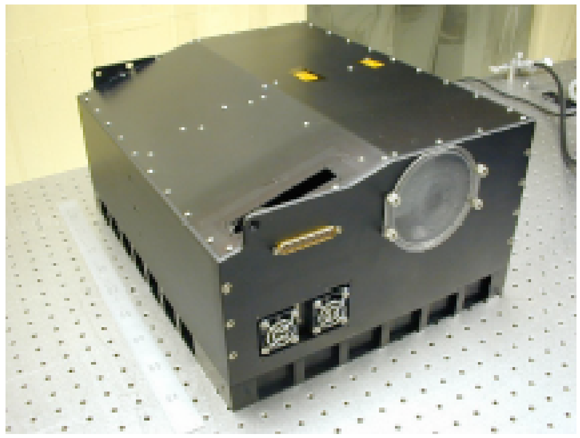
SHIMMER Poised for Flight on Space Shuttle

The Naval Research Laboratory's (NRL's) Spatial Heterodyne Imager for Mesospheric Radicals (SHIMMER), which is based on a newly developed interferometric technique called Spatial Heterodyne Spectroscopy (SHS), will embark on its maiden voyage on the space shuttle Atlantis flight STS-112. NRL Principal Investigator Joel Cardon and the SHIMMER team eagerly await what promises to be a groundbreaking test and application of this innovative new technology.

SHIMMER is the first orbital space-based scientific instrument using the SHS technique conceived by Dr. Fred Roesler of the University of Wisconsin and Dr. John Harlander of St. Cloud State University. Under the sponsorship of the DoD Space Test Program and support of NASA and NSF, they and the SHIMMER team at NRL have worked very closely in the development of the instrument over the last five years.

The primary goal of the flight will be to assess the performance of SHIMMER in measuring the ultra-violet (UV) light spectrum emitted by the Hydroxyl (OH) molecules in the 30 – 100 km (19 – 62 mi) altitude range of the atmosphere and, further, to add to the body of global OH observations acquired by NRL during flights of its highly successful Middle Atmosphere High Resolution Spectrograph Investigation (MAHRSI) spectrometer on STS-66 and STS-85.



SHIMMER

OH plays a critical role in ozone chemistry throughout the atmosphere, and participates in the only known ozone-destroying chemical process in the atmosphere above 30 miles (50 km). Also, OH observations provide an indirect measure of water vapor and temperature over a broad altitude range.

NRL’s MAHRSI produced the first global maps of OH in the middle atmosphere, uncovering several unexpected and important clues to the chemical and dynamic processes occurring there. The practical advantages of SHS for future space shuttle, satellite, and interplanetary flights are dramatic: the deskjet printer-sized SHIMMER is approximately one-seventh the weight and volume of the more conventional MAHRSI spectrometer, yet has higher wavelength resolution, is much more sensitive to UV light, and has no moving optical components.

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DSOs and DTOs

Detailed Supplementary Objectives (DSOs) are space and life science investigations. Their purpose is to:

* Determine the extent of physiological deconditioning resulting from spaceflight

* Test countermeasures to those changes and

* Characterize the environment of the space shuttle and/or space station relative to crew health.

Detailed Test Objectives (DTOs) are aimed at testing, evaluating or documenting space shuttle systems or hardware, or proposed improvements to the space shuttle or space station hardware, systems and operations.
Such experiments aboard during STS-112 are:

DSO 490-B: Bioavailability and Performance Effects of Promethazine During Space Flight

Promethazine (PMZ) is the anti-motion sickness medication of choice for treating Space Motion Sickness (SMS) during shuttle missions. The side effects associated with PMZ include dizziness, drowsiness,

sedation, and impaired psychomotor performance, which could impact crew performance of mission operations. Early anecdotal reports from crewmembers indicate that these central nervous system side effects of PMZ are absent or greatly attenuated in microgravity. The premise of this DSO is to evaluate the effects of microgravity on PMZ bioavailability, performance, side effects, and efficacy in the treatment of SMS; establish dose-response relationship of PMZ and the bioavailability of PMZ through intramuscular (IM), oral, and suppository routes of administration; and compare these results with preflight evaluations.

DSO 493: Monitoring Latent Virus Reactivation and Shedding in Astronauts

The premise of this DSO is to determine the frequency of induced reactivation of herpes viruses, herpes virus shedding and clinical disease after exposure to the physical, physiological and psychological stressors associated with spaceflight. DSO 498 Space Flight and Immune Function The premise of this DSO is to characterize the effects of space flight on selected immune elements that are important in maintaining an effective defense against infectious agents. The roles of neutrophils, monocytes, and cytotoxic cells -- important elements of the immune response -- will be studied as part of this DSO.

DSO 499: Eye Movements and Motion Perception Induced by Off-Vertical Axis Rotation (OVAR) at Small Angles of Tilt After Spaceflight

The purpose of this study is to examine changes in spatial neural processing of gravitational tilt information following adaptation to microgravity. Postflight oculomotor and perceptual responses during off-vertical axis rotation will be compared with preflight baselines to track the time course of recovery. Comparison of data from short-duration and long-duration (ISS) crewmembers will assess the effect of flight duration.

DSO 501: Effects of Short-Duration Space Flight on Type 1/Type 2 Cytokine Balance and Its Endocrine Regulation (Pre and Post Flight Only)

Stress factors of space flight will affect the immune system in vivo and change the in vitro immune response to mitogens in the presence of stress hormones such as cortisol. It is thought that chronic stress-sensitization of immunocytes in vivo may result in: 1. A higher tolerance of immunocompetent cells to "stress" challenge in vitro, or 2. Exhausting the immune system and resulting in a deeper suppression of immunocyte functions in response to mitogen in cortisol-treated culture. The purpose of the proposed study is to investigate the effect of space flight on Type 1/Type 2-cytokine balance and a role of the neuro-endocrine system in it. The investigation is designed to answer questions such as:

* Does stress alter a distribution of Type 1 and/or Type 2 T-cells?

* Does stress affect a secretion of Type 1 and/or Type 2 cytokines in cell culture?

* Are any changes that occur neuro-endocrine induced or modulated?

DSO 503-S: Test of Midodrine as a Countermeasure Against Postflight Orthostatic Hypotension

Following exposure to spaceflight, upright posture can result in the inability to maintain adequate arterial pressure and cerebral perfusion (orthostatic or postural hypotension). This may result in presyncope (lightheadedness) or syncope (loss of consciousness) during re-entry or egress. The purpose of this experiment is to evaluate a new pharmacological countermeasure for protection from postflight orthostatic hypotension. This experiment will measure the efficacy of midodrine in reducing the incidence and/or severity of orthostatic hypotension in returning astronauts. Efficacy will be evaluated with an expanded tilt test.

DSO 634: Sleep-Wake Actigraphy and Light Exposure During Spaceflight

Disruption of sleep during spaceflight, both short and long-duration, is associated with inappropriately timed (non-24 hour) or insufficiently intense light exposure. Sleep disruption and circadian misalignment will lead to subjective dissatisfaction with selfreported sleep quality and daytime alertness. Both of these conditions are associated with insomnia and associated impairment of alertness and cognitive performance that could impair mission success. This experiment will use state-of-the-art ambulatory technology to monitor sleep-wake activity and light exposure patterns obtained in-flight. This data should help better understand the

effects of space flight on sleep as well as aid in the development of effective countermeasures for both short and long-duration spaceflight.

DSO 635: Spatial Reorientation Following Space Flight

Spatial orientation is altered during and after space flight by a shift of central vestibular processing (from a gravitational frame-of-reference to an internal, head-centered frame-ofreference) that occurs during adaptation to microgravity and is reversed during the first few days after return to Earth. Discordant sensory stimuli during the postflight re-adaptive period will temporarily disorient/ destabilize the subject by triggering a shift (state change) to the previously learned, internally referenced, microgravity-adapted pattern of spatial orientation and sensorimotor control. The purpose of this DSO is to examine both the adaptive changes in the spatial reference frame used for coding spatial orientation and sensorimotor control as well as the fragility of the adaptive process and the feasibility of driving state changes in central vestibular processing via discordant sensory stimuli using balance control tests and eye movement responses to pitch-axis rotation in a short-arm centrifuge. The findings are expected to demonstrate the degree to which challenging motion environments may affect postflight adaptation or readaptation and lead to a better understanding of safe postflight activity regimens. The findings are also expected to demonstrate the feasibility of triggering state changes between sensorimotor control sets using a centrifuge device.

DTO 264: Space Station RMS Dynamic Model Validation

The purpose of DTO 264 is to assure stable Shuttle control system performance, and acceptable loads on the space shuttle remote manipulator system (SSRMS) induced by the shuttle jet firings. During planned SSRMS handling of payloads, a brief pause is requested at a specific planned SSRMS geometric configuration in the operations preplanned trajectory. At this configuration, crew inputs to SSRMS motion will be commanded followed by an SSRMS brakes on command. This will be performed three times to excite two lateral bending modes and one torsion mode of the SSRMS. The SSRMS data system in the end effector will be active to measure the SSRMS transient load response. Two flights are chosen to assess SSRMS dynamic characteristics while attached to a light space-limited payload and a heavy (airlock) payload.

DTO 700-14: Single-String Global Positioning System

The purpose of the Single-String Global Positioning System (GPS) is to demonstrate the performance and operations of the GPS during orbiter ascent, on-orbit, entry and landing phases. It uses a modified military GPS receiver processor and the existing orbiter GPS antennas. This DTO has been previously manifested on 24 flights.

DTO 805: Crosswind Landing Performance

DTO 805 is to demonstrate the capability to perform a manually controlled landing in the presence of a 90-degree, 10-15 knots steady state crosswind. This DTO has been previously manifested on 72 flights.

Ram Burn Observations (RAMBO)

Ram Burn Observations (RAMBO) is a Department of Defense experiment that observes shuttle Orbital Maneuvering System engine burns for the purpose of improving plume models. On STS-112 the appropriate sensors will observe selected rendezvous and orbit adjust burns.

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Undocking, Separation and Flyaround

Once Atlantis is ready to undock, Wolf will send a command to release the docking mechanism. At initial separation of the spacecraft, springs in the docking mechanism will gently push the shuttle away from the station. Atlantis' steering jets will be shut off to avoid any inadvertent firings during this initial separation.

Once Atlantis is about two feet from the station, with the docking devices clear of one another, Melroy will turn the steering jets back on and fire them to very slowly move away. From the aft flight deck, Melroy will manually control Atlantis within a tight corridor as she separates from the ISS, essentially the reverse of the task performed by Ashby just before Atlantis docked. Atlantis will continue away to a distance of about 450 feet, where Melroy will begin a close flyaround of the station, circling the complex almost one and a quarter times. Melroy will pass a point directly above the station, then behind, then underneath, then in front and then reach a point directly above the station for a second time.

At that point, passing above the orbiting laboratory, Melroy will fire Atlantis' jets for final separation from the station. The flyaround will be complete about an hour and 20 minutes after undocking.

STS-112 NASA Television Schedule

Editor's Note
Not available in time for this edition.

Acronyms:

REV: Orbit number
MECO: Main engine cutoff
SRTM: Shuttle Radar Topography Mission
SRTM mast: 180-foot-long telescope radar antenna boom
KU-band antenna: The shuttle's main TV and radar antenna
Blue shift: Pilot Dom Gorie, Janice Voss, Mamoru Mohri
Red shift: Commander Kevin Kregel, Gerhard Thiele, Janet Kavandi
PAO: NASA public affairs
NASDA: Japanese Space Agency
ESA: European Space Agency
FCS checkout: Flight control system test prior to landing
RCS hotfire: Maneuvering jet test firing prior to entry

REV	EVENT	MET	ET	GMT