NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-72

PRESS KIT
JANUARY 1996

SPACE FLYER UNIT-RETRIEVAL (SFU-RET)
OAST FLYER

STS-72 INSIGNIA

STS072-S-001 -- The STS-72 insignia depicts the space shuttle Endeavour and some of the payloads on the flight. The Japanese satellite, Space Flyer Unit (SFU) is shown in a free-flying configuration with the solar array panels deployed. The inner gold border of the patch represents the SFU's distinct octagonal shape. Endeavour will rendezvous with and retrieve SFU at an altitude of approximately 250 nautical miles. The Office of Aeronautics and Space Technology's (OAST) flyer satellite is shown just after release from the Remote Manipulator System (RMS). The OAST satellite will be deployed at an altitude of 165 nautical miles to fly free for two days gathering scientific data. The payload bay contains equipment for the secondary payloads - the Shuttle Laser Altimeter (SLA) and the Shuttle Solar Backscatter Ultraviolet Instrument (SSBUI). There are two space walks planned to test hardware for assembly of the International Space Station. The stars represent the hometowns of the crewmembers in the United States and Japan.

The NASA insignia design for space shuttle flights is reserved for use by the astronauts and for other official use as the NASA Administrator may authorize. Public availability has been approved only in the form of illustrations by the various news media. When and if there is any change in this policy, which we do not anticipate, it will be publicly announced.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

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RETRIEVAL OF TWO RESEARCH SATELLITES, TWO SPACEWALKS HIGHLIGHT NASA'S FIRST SHUTTLE MISSION OF 1996

In the first Space Shuttle mission of 1996, six astronauts aboard Endeavour will retrieve a Japanese satellite, deploy and retrieve a NASA science satellite and conduct two spacewalks to demonstrate and evaluate techniques to be used in the assembly of the International Space Station.

The STS-72 crew will be commanded by Brian Duffy who will be making his third Shuttle flight. Brent Jett will serve as pilot and will be making his first space flight. The four STS- 72 mission specialists aboard Endeavour will include Leroy Chiao, Mission Specialist-1, who will be making his second flight, Winston Scott, Mission Specialist-2, Koichi Wakata from the Japanese Space Agency (NASDA) serving as Mission Specialist-3, and Daniel Barry, Mission Specialist-4, all of whom will be making their first space flight. Launch of Endeavour on the STS-72 mission is currently targeted for Jan. 11, 1996, at approximately 4:18 a.m. EST from Kennedy Space Center's Launch Complex 39-B. The STS-72 mission is scheduled to last eight days, 22 hours, 36 minutes. An on- time launch on Jan. 11 would produce a landing at Kennedy Space Center's Shuttle Landing Facility on Jan. 20 at 2:54 a.m. EST.

The major activities of the mission will include retrieval of the Japanese Space Flyer Unit (SFU), which was launched March 18 aboard a Japanese H-2 rocket to conduct a variety of microgravity experiments. In addition, the STS-72 crew will deploy the OAST-Flyer, a satellite developed by NASA's former Office of Aeronautics and Space Technology, which will fly free of the Shuttle for about 50 hours. Four experiments on the science platform will operate autonomously before the satellite is retrieved by Endeavour's robot arm.

Three of Endeavour's astronauts will conduct a pair of spacewalks during the mission to test hardware and tools that will be used in the assembly of the Space Station starting in late 1997.

The STS-72 mission will be the 10th mission for Endeavour and the 74th for the Space Shuttle system.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Television Transmission

NASA television is available through the Spacenet-2 satellite system. Spacenet-2 is located on Transponder 5, at 69 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, and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer database service requiring the use of a telephone modem. A voice update of the television schedule is available daily at noon Eastern time.

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 prior to 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

The NASA Headquarters Public Affairs Internet Home Page provides access to the STS-74 mission press kit and status reports. The address for the Headquarters Public Affairs Home Page is: **http://www.nasa.gov/hqpao/hqpao_home.html.**

Informational materials, such as status reports and TV schedules, also are available from an anonymous FTP server at ftp.hq.nasa.gov/pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their e-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure.

Pre-launch status reports from KSC are found under **ftp.hq.nasa.gov/pub/pao/statrpt/k**sc, and mission status reports can be found under **ftp.hq.nasa.gov/pub/pao/statrpt/jsc**. Daily TV schedules can be found under **ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked**.

Access by fax

An additional service known as fax-on-demand will enable users to access NASA informational materials from their fax machines. Users calling (202) 358-3976 may follow a series of prompts and will automatically be faxed the most recent Headquarters news releases they request.

STS-72 QUICK LOOK FACTS

Launch Date/Site:	Jan. 11, 1996/KSC Launch Pad 39-B
Launch Time:	4:18 AM EST
Launch Window:	1 hour
Orbiter:	Endeavour (OV-105), 10th flight
Orbit Altitude/Inclination:	250 nautical miles/28.45 degrees
Mission Duration:	8 days, 22 hours, 36 minutes
Landing Date:	Jan. 20, 1996
Landing Time:	2:54 AM EST
Primary Landing Site:	Kennedy Space Center, FL
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites - Ben Guerir, Morocco Abort-Once Around - Edwards Air Force Base, CA
Crew:	Brian Duffy, Commander (CDR) Brent Jett, Pilot (PLT) Leroy Chiao, Mission Specialist 1 (MS 1) Winston Scott, Mission Specialist 2 (MS 2) Koichi Wakata, Mission Specialist 3 (MS 3) Daniel Barry, Mission Specialist 4 (MS 4)
EVA Crewmembers:	Leroy Chiao (EV1), Dan Barry (EV2) for EVA 1 Leroy Chiao (EV1), Winston Scott (EV2) for EVA 2
Cargo Bay Payloads:	Space Flyer Unit (after retrieval) OAST-Flyer SSBUV EDFT-03 SLA-01/GAS
In-Cabin Payloads:	NIH-R STL/.NIH-C PCG-STES CPCG

Developmental Test Objectives/Detailed Supplementary Objectives

DTO 301D:	Ascent Structural Capability Evaluation
DTO 305D:	Ascent Compartment Venting Evaluation
DTO 306D:	Descent Compartment Venting Evaluation
DTO 307D:	Entry Structural Capability
DTO 312:	ET TPS Performance
DTO 414:	APU Shutdown Test
DTO 415:	Water Spray Boiler Electrical Heater Capability
DTO 664:	Cabin Temperature Survey
DTO 667:	Portable In-Flight Landing Operations Trainer
DTO 668:	Advanced Lower Body Restraint Test
DTO 671:	EVA Hardware for Future Scheduled EVA Missions
DTO 672:	EMU Electronic Cuff Checklist
DTO 700-5:	Trajectory Control Sensor
DTO 700-8:	Global Positioning System Development Flight Test
DTO 805:	Crosswind Landing Performance
DTO 833:	EMU Thermal Comfort and EVA Worksite Thermal Evaluation
DTO 1210:	EVA Operations Procedures Training DTO

DSO 330:	In-Flight Evaluation of Urine Monitoring System
DSO 483:	Back Pain in Microgravity
DSO 487:	Immunological Assessment of Crewmembers
DSO 489:	EVA Dosimetry Evaluation
DSO 491:	Characterization of Microbial Transfer Among Crewmembers
DSO 492:	In-Flight Evaluation of a Portable Clinical Blood Analyzer
DSO 493:	Monitoring Latent Virus Reactivation and Shedding in Astronauts
DSO 494:	Influence of Microgravity and EVA on Pulmonary Oxygen Exchange
DSO 603:	Orthostatic Function During Entry, Landing and Egress
DSO 604:	Visual-Vestibular Integration as a Function of Adaptation
DSO 802:	Educational Activities
DSO 901:	Documentary Television
DSO 902:	Documentary Motion Picture Photography
DSO 903:	Documentary Still Photography

STS-72 CREW RESPONSIBILITIES

Payloads	Prime	Backup
Space Flyer Unit Systems	Scott	Wakata
OAST-Flyer Systems	Scott	Wakata
PARE/NIH-R	Barry	Scott
STL/NIH-C	Scott	------
SSBUV	Barry	------
PCG-STES	Wakata	Jett
CPCG	Chiao	Wakata
Getaway Special Canisters	Barry	------
Shuttle Laser Altimeter	Jett	------

Other Activities

Remote Manipulator System	Wakata	Jett
Earth Observations	Duffy	Chiao
EVA 1	Chiao (EV 1)	Barry (EV 2)
EVA 2	Chiao (EV 1)	Scott (EV 3)
Intravehicular Crewmember	Scott (EVA 1)	Barry (EVA 2)
Rendezvous	Jett	Chiao

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes for STS-72 include:

- Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with the orbital maneuvering system engines.

- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit of the Earth before landing at the Kennedy Space Center, FL.

- TransAtlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at Ben Guerir, Morocco.

- Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, and without enough energy to reach a TAL site, would result in a pitch around and thrust back toward Kennedy until within gliding distance of the Shuttle Landing Facility.

PAYLOAD AND VEHICLE WEIGHTS

	Pounds
Orbiter (Endeavour) empty and 3 SSMEs	152,755
Space Flyer Unit	7,885
OAST-Flyer	2,643
Remote Manipulator System	994
Commercial Protein Crystal Grow	70
PARE/NIH-R	197
Detailed Test/Supplementary Objectives	483
PCG/STES	70
Space Tissue Loss	66
Shuttle Laser Altimeter/GAS Canisters	4484
Shuttle System at SRB Ignition	4,514,966
Orbiter Weight at Landing	217,000

MISSION SUMMARY TIMELINE

Flight Day 1
Launch/Ascent
OMS-2 Burn
Remote Manipulator System Checkout
SFU Retrieval Rendezvous Burn

Flight Day 2
Secondary Payload Activation
EMU Checkout
SFU Retrieval Rendezvous Burns

Flight Day 3
SFU Rendezvous, Retrieval and Berthing
Cabin Depress
Orbital Adjustment Maneuvers

Flight Day 4
Secondary Payload Experiments
OAST-Flyer Deployment and Separation Maneuvers

Flight Day 5
EVA 1 (6 1/2 hours)
OAST-Flyer Rendezvous Burns

Flight Day 6
OAST-Flyer Rendezvous, Retrieval and Berthing

Flight Day 7
EVA 2 (6 1/2 hours)
Cabin Repress

Flight Day 8
Off-Duty Time (4 hours)
DSOs
Secondary Payload Experiments

Flight Day 9
Flight Control System Checkout
Reaction Control System Hot-Fire
Crew News Conference
Experiment Deactivation
Cabin Stow

Flight Day 10
Deorbit Prep
Deorbit Burn
Entry
KSC Landing

STS-72 ORBITAL EVENTS SUMMARY

(Based on a Jan. 11, 1996 Launch)

Event	MET	Time of Day (EST)
Launch	0/00:00	4:18 AM, Jan. 11
OMS-2	0/00:43	5:01 AM, Jan. 11
EMU Checkout	1/00:00	4:18 AM, Jan. 12
Space Flyer Unit Retrieval	2/00:35	4:53 AM, Jan. 13
OAST-Flyer Deploy	3/02:25	6:43 AM, Jan. 14
EVA-1 Begins	3/19:45	12:03 AM, Jan. 15
EVA-1 Ends	4/01:45	6:03 AM, Jan. 15
OAST-Flyer Retrieval	5/00:32	4:50 AM, Jan. 16
EVA-2 Begins	5/19:15	11:33 PM, Jan. 16
EVA-2 Ends	6/01:15	5:33 AM, Jan. 17
Crew News Conference	7/20:00	12:18 AM, Jan. 19
Deorbit Burn	8/21:36	1:54 AM, Jan. 20
KSC Landing	8/22:36	2:54 AM, Jan. 20

SPACE FLYER UNIT-RETRIEVAL (SFU-RET)

Endeavour's rendezvous and retrieval of the Space Flyer Unit satellite begins with the Shuttle's precisely timed launch, putting the orbiter on a course that will continually close in on the Japanese satellite during the following 48 hours.

Almost immediately after reaching orbit, Mission Specialist Koichi Wakata will perform a checkout of Endeavour's mechanical arm to ensure it is ready for the capture of the SFU. During the next two days, periodic engine firings by Endeavour will adjust the rate at which the Shuttle is closing in on the SFU, aiming to reach a point about eight nautical miles behind the satellite on Flight Day 3, the starting point for the final phase of rendezvous.

About three hours before the planned capture of SFU, Commander Brian Duffy will fire Endeavour's engines, performing a Terminal Initiation (TI) burn that will bring Endeavour the final distance to the SFU during the next orbit of Earth. As Endeavour traverses the final eight nautical miles to the satellite, the Shuttle will enable its rendezvous radar system to lock onto the spacecraft. The radar will provide Endeavour with constant updates of the range to SFU and the rate at which the Shuttle is closing in on the satellite. Also, just after the TI burn is completed, Wakata will again power up the mechanical arm and extend it above Endeavour's payload bay in a position ready for the capture.

Endeavour will have the opportunity to perform four, small Mid-Course Correction (MCC) engine firings as it approaches the SFU, although some or all of the firings may not be necessary depending on the accuracy of the Shuttle's navigation. The Shuttle will perform what flight controllers refer to as an R- Bar approach to the SFU, approaching from underneath the satellite. When Endeavour reaches a point almost a half mile directly below the spacecraft, about one and a half hours before the planned capture, Duffy will take over manual control of the Shuttle to fly the final distance to the satellite.

Duffy will brake Endeavour's approach toward the SFU using jets that fire in the direction of the satellite until reaching a point about 600 feet below the spacecraft. At that point, Duffy will switch the Shuttle's steering jet system to a mode called Low Z, a mode that uses offset jets on the nose and tail to brake Endeavour's approach rather than those pointing directly at the SFU. The Low-Z mode guards against inadvertently contaminating the SFU with exhaust from the Shuttle jets. During the manual approach, information on the distance to SFU and closing rate of Endeavour provided by the rendezvous radar, will be supplemented by a handheld ranging device operated by Mission Specialist Leroy Chiao. In addition, graphics and data from the payload bay laser will be provided to Duffy on a laptop computer display, called the Rendezvous and Proximity Operations Program (RPOP), to aid with the approach.

Duffy will continue to slow Endeavour and align the Shuttle and SFU until reaching a point about 150 feet below the satellite, where he will stationkeep. As Duffy approaches the stationkeeping point, Japanese flight controllers for the SFU will send commands to retract the solar arrays in preparation for the retrieval. Then, as Endeavour remains stationary, solar array retraction will be completed and the SFU will be commanded to the proper orientation for retrieval. The satellite's reaction control system thrusters will be turned off as the Shuttle begins its final approach.

Duffy will continue the approach to SFU after about 45 minutes of stationkeeping, when the SFU commanding and safing has been successfully completed. As Endeavour approaches the final feet toward SFU, Duffy will perform a small yaw maneuver to align with the satellite. Using views from a camera mounted at the end of the mechanical arm, Duffy and Wakata will refine Endeavour's orientation with the grapple fixture mounted on the SFU.

Wakata will then move the mechanical arm to grab the fixture and lock onto the satellite. Once captured, Wakata will use the arm to lower the SFU into Endeavour's middle rear cargo bay, eventually locking it in place by closing four payload retention latches.

OAST FLYER/SPARTAN PROJECT

SPARTAN PROJECT

The Spartan Project is designed to provide easy and inexpensive access to Earth orbit via the Space Shuttle for science experiments that need to take measurements in orbit but away from the Shuttle.

The Spartan spacecraft is a small, rectangular, free- flying vehicle, measuring roughly 3.2 feet (1 meter) x 4.1 feet (1.25 meter) x 4.9 feet (1.5 meters). It is released from the Shuttle and picked up after several days of conducting its experiments. With the reusable carrier's flexibility, an unprecedented five Spartan missions were manifested to launch in a 22 month period beginning in September 1994 and ending in June 1996.

Initiated by the then-Office of Aeronautics and Space Technology at NASA Headquarters (OAST) and currently sponsored by the Office of Space Access and Technology (OSAT), OAST-Flyer comes near the end of this time period with a group of technology demonstration experiments located on a Spartan spacecraft.

OAST-FLYER

OAST-Flyer, the seventh Spartan to launch, is composed of four experiments: REFLEX, GADACS, SELODE, and SPRE. Two of the four experiments, REFLEX and GADACS, are sponsored by OSAT. SELODE is sponsored by the Office of Safety and Mission Assurance and the fourth experiment, SPRE, is a volunteer effort comprised of University of Maryland students, area engineers, and space industry contractors. More information on the Spartan Project and its payloads is available via the Internet at the following address:

http://sspp.gsfc.nasa.gov/home740.html

Return Flux Experiment (REFLEX)

Spacecraft can be limited in lifetime by exposure to the space environment in several ways. One is the contamination of lenses, sensors, and instruments as they get coated with tiny particles of dirt.

REFLEX is a technology experiment designed to determine if the computer-generated models, which help determine how much contamination a spacecraft might get, are accurate. The main objective of REFLEX is to investigate molecular backscattering or "return flux," associated with on-orbit spacecraft. This phenomenon occurs when spacecraft give off the tiny particles of dirt into the atmosphere which then collide with other particles and bounce back to the spacecraft. Return flux is believed to be one of the factors that scientists have been unable to calculate into their computer-generated models. REFLEX also will study the erosion of spacecraft surface coatings as a result of particles chemically reacting with the atmosphere.

Global Positioning System (GPS) Attitude Determination and Control Experiment (GADACS)

The primary objective of the GADACS experiment is to demonstrate the use of the Global Positioning System (GPS) technology in space. During the flight, this experiment will use GPS to determine the attitude of the Spartan, the location and velocity of the spacecraft, and provide accurate timing for one portion of the Spartan mission. GADACS will use the GPS data to calculate the Spartan orientation and fire thrusters to point the spacecraft in different directions. This will be the first time a spacecraft is controlled using GPS.

After the Spartan is released, the Shuttle will move off to a distance of about 60 miles. At the end of the Spartan mission, the Shuttle will fly back to retrieve the Spartan. Through cooperation with researchers at the NASA Johnson Space Center in Houston, a GPS receiver will also be flown on the Space Shuttle to allow the team to determine the distance and velocity between the two vehicles. This unique portion of the experiment will remain active until the spacecraft is retrieved by the Shuttle.

Until GADACS, spacecraft used costly gyroscopes, star trackers, or Sun or Earth sensors to determine their attitude. The experiments planned on GADACS will pave new trails for lighter, less costly missions of the future.

Solar Exposure to Laser Ordnance Device (SELODE)

Pyrotechnic devices are used in numerous applications on space vehicles. Frequently they are used to separate different parts of a vehicle, such as the explosive bolts and nuts that are used to connect and then separate the Space Shuttle Orbiter from the External Tank. Today, most pyrotechnic devices are fired with electricity, but, this presents a number of problems. One major area of difficulty is sensitivity to accidental firing from stray electrical energy sources such as radio transmitter signals or the same kind of static electricity produced by shuffling your feet across a carpet on a dry day.

A new family of pyrotechnic devices is being developed that uses a laser pulse traveling through a fiber optic cable to trigger the explosive charge. This eliminates the concern of accidental firing from stray electrical energy sources.

SELODE was developed to test the safety and reliability of five different types of laser ordnance devices. The primary investigation centers on the effects of direct and concentrated sunlight in the space environment on different explosives and design methods. Flight testing will evaluate accidental firing levels, and post-flight testing will examine the effects of exposure on the chemical stability of the explosives.

SPARTAN PACKET RADIO EXPERIMENT (SPRE)

The Spartan Packet Radio Experiment (SPRE) is an amateur radio (HAM radio) communications experiment. The primary mission is to test satellite tracking using amateur packet radio and a GPS. SPRE was developed and built by the University of Maryland Amateur Radio Association with assistance from NASA, volunteer engineers, and software professionals. The primary mission of SPRE will be to relay ground station positions and transmit telemetry containing the GPS location of the spacecraft and housekeeping data. This type of technology has many applications in both the amateur radio and commercial world. Low cost Low Earth Orbit satellites could be used to track storms, weather balloons, boats at sea, trucks, etc. The satellite could collect the location data from ground targets and download it to a central ground control station or many remote stations. Schools requiring more information can send requests via electronic mail to Ken McCaughey at: **kenneth@w3eax.umd.edu**

OAST-Flyer Deploy and Retrieval Activities

The Office of Aeronautics and Space Technology-Flyer (OAST-FLYER) satellite will be deployed by Endeavour on the fourth day of the mission and will spend about 48 hours flying free from the Shuttle before it is retrieved on Flight Day 6.

The OAST-FLYER experiments are mounted on a standard Shuttle Pointed Autonomous Research Tool for Astronomy (SPARTAN) carrier platform. STS-72 will be the sixth Shuttle flight to deploy and retrieve a SPARTAN platform, a satellite system that operates autonomously once released. SPARTAN normally has no communications with either the ground or Shuttle in flight. However, on STS-72, an amateur-radio based experiment, called the SPARTAN Packet Radio Experiment, will be tested as a method of communications with one of the OAST-FLYER experiments, the REFLEX. Still, no communications regarding the general operations of SPARTAN will be available.

Following a thorough in-bay checkout of the experiments aboard the OAST-FLYER, three latches holding the satellite in Endeavour's cargo bay, two on either side and one underneath, will be released. While Astronaut Jett temporarily turns off Endeavour's steering jets to avoid any disturbances, Wakata will lift the OAST-FLYER from the bay using the mechanical arm.

With the robot arm extended high above the bay, Wakata will release the satellite. Following release, the SPARTAN platform will perform a small maneuver to confirm its health before Jett backs Endeavour away.

During the two days the spacecraft is flying free, Endeavour will perform occasional engine firings to maintain a distance of about 90 nautical miles between the two spacecraft.

Endeavour will perform a rendezvous and approach to the OAST-FLYER on Flight Day 6 similar to the one for the SFU retrieval. At the conclusion of its science operations, SPARTAN will automatically maneuver into the proper orientation for retrieval and await the Shuttle's arrival.

The final phase of the OAST-FLYER rendezvous begins from a point about eight nautical miles behind the satellite, when Endeavour's engines are fired in the Terminal Initiation (TI) burn about two hours before the planned capture. The TI burn will put Endeavour on a course to intercept the OAST-FLYER over about one orbit of Earth, performing an R-Bar approach from underneath the satellite. Endeavour's rendezvous radar system and a handheld laser will be used during the approach to provide information on the distance and closing rate between the Shuttle and the satellite.

Duffy will take over manual control of the approach when Endeavour reaches a point almost one-half mile directly below the OAST-FLYER, about 45 minutes before the planned capture. Duffy will fire Endeavour's thrusters facing toward the OAST- FLYER to brake the Shuttle's approach until reaching a distance of about 200 feet from the satellite. At that point, Duffy will switch the thrusters to a Low-Z mode, firing thrusters offset to the OAST-FLYER to slow Endeavour and avoid contaminating the satellite with exhaust from the Shuttle steering jets.

As Endeavour moves to within 35 feet of the OAST-FLYER, Wakata will align the arm with the grapple fixture on the SPARTAN platform, lock onto the satellite, reberth it in the cargo bay and latch it in place for its return to Earth.

SHUTTLE SOLAR BACKSCATTER ULTRAVIOLET (SSBUV)

In late 1989, the Space Shuttle Atlantis carried the first flight of the Goddard Space Flight Center's Shuttle Solar Backscatter Ultraviolet (SSBUV) instrument. Since then, SSBUV has made six additional flights and has become known as Goddard's "frequent flyer." SSBUV is scheduled to fly for the eighth and last time aboard STS-72.

Mission

The SSBUV instrument is designed to measure ozone concentrations by comparing solar ultraviolet radiation with radiation scattered back from the Earth's atmosphere. SSBUV results are compared with the observations of several ozone measuring instruments, both past and present, aboard NASA's Nimbus-7 and the National Oceanic and Atmospheric Administration's (NOAA) NOAA-9, NOAA-11 and NOAA-14 satellites, the Russian Meteor-3/TOMS satellite, NASA's Upper Atmosphere Research Satellite (UARS), and the European Space Agency's ERS- 2 satellite, which was launched in April 1995. The SSBUV data are used to calibrate the instruments to ensure the most accurate readings possible for the detection of atmospheric ozone trends.

SSBUV undergoes rigorous calibration before and after flight. Consequently, it provides the best opportunity to help determine the reliability of ozone data gathered by other satellite instruments. The SSBUV uses the Space Shuttle's orbital flight path to assess this performance by the direct comparison of data from identical instruments aboard the NOAA spacecraft as the Space Shuttle and the satellites pass over the same Earth location within an hour. These orbital coincidences can occur 17 times a day.

The NOAA SBUV/2 instrument and NASA's SSBUV instruments estimate the amount and height distribution of ozone in the upper atmosphere by measuring the incident solar ultraviolet radiation and ultraviolet radiation backscattered from the Earth's atmosphere. The SSBUV measures these parameters in 12 discrete wavelength channels in the ultraviolet. Because ozone absorption is a strong function of wavelength, the ozone column amount and its height distribution can be derived from these measurements.

SSBUV's value lies in its ability to provide highly accurate ozone measurements. The instrument is calibrated to a laboratory standard before flight, then is recalibrated during and after flight to ensure its accuracy. These laboratory standards are calibrated routinely at the National Institute of Standards and Technology. The rigorous calibration has been maintained since the beginning of the SSBUV flight series.

Previous Flights

The seven previous SSBUV flights occurred on STS-34 in October 1989, STS-41 in October 1990, STS-43 in August 1991, STS-45/ATLAS-1 in March 1992, STS-56/ATLAS-2 in April 1993, STS-62 in March 1994, and STS-66/ATLAS-3 in November 1994. After SSBUV's flight in November 1994, the instrument was checked out at the Kennedy Space Center, FL, to make certain the instrument continued to function properly. The payload was returned to Goddard where the instrument was checked out, recalibrated and re-qualified with plans to return it to Kennedy in early September. Concurrently, data from previous flights were processed and examined by SSBUV scientists and analysts.

Results

SSBUV's impact on NASA's ability to detect ozone trends accurately was realized after four flights. Data from the first flight in combination with information from an earlier satellite already have been used to estimate ozone trends in the upper stratosphere since 1980. These results show a depletion of about eight percent over 10 years, which is consistent with predictions of ozone depletion.

SSBUV has achieved one of its primary objectives using data from the first three flights flown in 1989, 1990 and 1991. These data were used to update the calibration of the NOAA-11 SBUV/2 ozone instrument, which had been operating in orbit since late 1988. The NOAA ozone data have been reprocessed with a refined algorithm and new calibration factors based on SSBUV and SBUV/2 in-flight calibration data. The reprocessing covers the period 1989 to 1993. The reprocessed data have been checked against ground-based ozone observations, and these comparisons show very good agreement. There also is excellent consistency between the refined NOAA-11 SBUV/2 data and the Nimbus-7 SBUV/TOMS data set, which goes back to 1978. The combined 15-year data set represents an excellent resource for ozone climate and trend studies.

SSBUV has detected and verified a significant decrease in the amounts of total Northern Hemisphere ozone levels between the STS-45/ATLAS-1 (March 1992) and STS-56/ATLAS-2 (April 1993) missions. The depletion also was detected simultaneously by satellites and ground-based observations. Indications are that total ozone decreased during the same period on the order of 10 to 15 percent at mid-latitudes in the Northern Hemisphere. Scientists believe that this significant depletion results from the combined residual effects of Mt. Pinatubo aerosols in the stratosphere and cold stratosphere temperatures during the winter of 1992-93 with the by-products of CFCs in the stratosphere.

During the ATLAS-3 mission (SSBUV-7) on STS-66, several coordinated experiments were conducted among the ATLAS and UARS instruments to determine the accuracy of space-borne stratospheric ozone and solar irradiance measurements in the wavelength range important to atmospheric chemistry and climate. The ozone measurements agreed to better than 10 percent while the solar irradiance measurements agreed to better than two percent. These accurate measurements will be the baseline for studies of ozone and solar changes into the next century.

Operation

The SSBUV instrument and its flight support electronics, power, data and command systems are mounted in the Space Shuttle's payload bay in two flight canisters that, together, weigh 900 pounds (410 kilograms). The instrument canister holds the SSBUV instrument, its aspect sensors and in-flight calibration system. Once in orbit, a motorized door assembly opens the canister, allowing the SSBUV to view the Sun and Earth. The canister closes, providing contamination protection, while SSBUV performs in-flight calibrations. The support canister contains the avionics, including the power, data and command systems.

SSBUV obtains power from the Space Shuttle and receives real-time ground commands and data acquisition. This allows enhanced SSBUV data gathering capabilities and an ability to coordinate measurements with NOAA's SBUV/2 and ESA's GOME, as well as the UARS instrument complements. SSBUV command and data acquisition will be conducted from the Payload Operations Control Center (POCC) at the Goddard Space Flight Center.

Ernest Hilsenrath, Goddard Space Flight Center, is the principal investigator, and Joe Cerullo, of the Aerospace Engineering Group of IDEA Inc., is the mission manager. SSBUV is managed by Goddard for NASA's Office of Mission to Planet Earth, Washington, DC.

SHUTTLE LASER ALTIMETER PAYLOAD

The Shuttle Laser Altimeter-01 (SLA-01) is the first of four planned remote sensing flights to precisely measure the distance between the Earth's surface and the Space Shuttle.

The SLA-01 works by transmission of a series of short laser pulses from the payload in the Shuttle cargo bay and by the subsequent reception of weak, laser pulse echoes from the Earth's surface. Primary data will be obtained on each laser pulse's time-of-flight and the pulse distortion and pulse broadening caused by reflection from the Earth's surface. Measurable pulse echoes are expected from land surfaces, vegetation, ocean surfaces, and cloud-tops. Each laser pulse is approximately the size of a football field by the time it strikes the Earth's surface and exactly ten pulses are transmitted each second of SLA-01 operation. Data from the pulse echoes have wide applications in a variety of Earth- science disciplines ranging from topography studies to measurement of tree heights and cloud tops.

The SLA-01 flight has two primary objectives: [1] acquire samples of land topography and vegetation data; and [2] provide an in-space engineering testbed for future space flight laser sensors. The SLA-01 distance measurements will be combined with Space Shuttle orbit and pointing angle analysis electronics, and power conditioning modules for SLA-01. Both payload canisters are filled with inert nitrogen gas and remain pressurized throughout the flight.

The SLA instrument is being developed by Goddard's Laboratory for Terrestrial Physics and is sponsored by NASA Headquarters' Mission to Planet Earth, Flight Systems Division. The payload manager is Jack Bufton of Goddard.

Thermal Energy Storage-2 (TES-2)

The Thermal Energy Storage (TES-2) experiment will fly on a GAS Bridge (Getaway Special Bridge) located in Endeavour's payload bay. The TES-2 payload is designed to provide data for understanding the long duration behavior of thermal energy storage fluoride salts that undergo repeated melting and freezing in microgravity. These salts are used in advanced solar dynamic power systems which use heat to produce electricity.

When the thermal energy salt is melted, it expands approximately thirty percent in volume. As the thermal salt cools, it solidifies and shrinks, thus causing voids or pockets to form in the salt. This void formation affects both the heat absorption rate of the salt and the design of the heat receiver containers holding the salt. Repeated melt/freeze cycles will characterize the void formation and movement of the void in the salt. Consequently, understanding and predicting the melt/freeze behavior of the salts in the on-orbit environment will lead to an improved design for solar dynamic system heat receivers.

GET AWAY SPECIALS

G-342: The Flexible Beam Experiment 2 (FLEXBEAM 2)
Investigator: United States Air Force Academy NASA
Technical Manager: Charles Knapp, Goddard Space Flight Center
Internet address: http://sspp.gsfc.nasa.gov/gas.html

Vibrations in space are a nuisance. Since space is virtually void from any atmosphere, there is no medium to dampen structural oscillations. Oscillations can be dampened by mass and springs, reaction jets, or oscillators. However, what if the reaction jets fail, springs break, or actuators can't fit into the mission? Do we even need dampers? How long will certain materials vibrate in a microgravity, vacuum environment? These are just a few worries for designers of solar arrays and space stations in orbit.

The Flexible Beam Experiment (FLEXBEAM) investigates these questions by exciting two, Aluminum 6061 T-6, cantilevered beams. Each beam is subjected to different initial cotan to solve for the height of the Earth's surface along the ground track of the Space Shuttle. The overall measurement goal is one meter precision in determination of surface height.

The SLA-01 instrument consists of the Laser Altimeter Canister (LAC) and the Altimeter Support Canister (ASC). Both LAC and ASC canisters are separately connected to the Hitchhiker carrier electronics for power, data, and command functions. These two payload modules also are connected to each other for transfer of data and commands between the instrument controller in the ASC and the laser sensor in the LAC. The LAC is equipped with a Motorized Door Assembly and a large optical window. The door is opened only on orbit to permit laser transmission and detection through the window. The LAC contains a laser pulse transmitter and a concave mirror and detector which collects each laser pulse echo and converts it to an electronic pulse that can be analyzed. The ASC contains the instrument computer, pulse timing and shape analysis electronics resulting in exciting, different modes. Electromagnetic sensors measure the vibrations with the data being stored in a recorder.

After the FLEXBEAM is flown aboard Endeavour, the data will be modeled as a finite element analysis. From these data, the U.S. Air Force Academy hopes to represent other beam vibrations, and to analyze and predict other vibrational responses. Furthermore, the data obtained in space will be compared to previously recorded data from an Earthbound control experiment.

G-459: Protein Crystal Growth
Investigator: The Society of Japanese Aerospace Companies, Inc. NASA
Technical Manager: Charles Knapp, Goddard Space Flight Center
Internet address: http://sspp.gsfc.nasa.gov/gas.html

It is well known that the microgravity environment is suitable to make well-ordered protein crystals for X-ray diffraction analysis and three-dimensional structure determination. But, it is still unclear why microgravity is effective. In our previous microgravity experiments, we have evidence that nucleation provability of crystal forms and X-ray resolution (index of crystal order) are affected by microgravity.

In the G-459 payload, we will re-examine the effect of the microgravity environment on protein-crystal nucleation. Crystal form and size will be recorded on photographic film and analyzed after recovery of the G-459 payload. For the experiment, we have developed a hardware system to adapt to a GAS payload canister. In the system, 16 independent crystallization units are used. Each of the units can carry out crystallization experiments by one of three crystallization methods, i.e., batch, vapor diffusion, and free-interface diffusion.

The unit has two compartments: one for protein solution and the other for solution to archive salting of protein. These compartments are separated from each other by thick acrylic or thin stainless-steel plate. The crystallization process will be started by sliding out the plates linked to a triangular plate which is pulled up by ball screws and a stepping motor. A 35-mm camera will record images of crystals grown in the units for up to 120 hours.

Horse heart myoglobin and bovine pancreatic ribonuclease S will be used in the experiment. The former makes brownish colored crystals which are easy to observe and the latter shows polymorphism of crystals. Our previous microgravity experiments show nucleation provability of crystal forms is affected by microgravity, i.e., convectionless environment. We will observe which type of crystal forms is preferentially grown in the G-459 experiment.

GAS Ballast Can with Sample Return Experiment
Investigator: Peter Tsou, Jet Propulsion Laboratory, California

The ballast can has the Sample Return Experiment on the top of the canister which collects cosmic particles. Ballast payloads are flown when circumstances preclude a manifested GAS experiment from a mission and no replacement payload is readily available.

EXTRAVEHICULAR ACTIVITY DEVELOPMENT FLIGHT TEST-03 (EDFT-3)

During STS-72, two spacewalks will be performed with a total of three crew members taking part during the mission.

The Extravehicular Activities (EVAs) are part of a continuing series of spacewalks being done in preparation for the orbital construction of the international Space Station. The STS-72 spacewalks will evaluate tools, techniques and equipment involved in the planned space construction work; build spacewalking experience among the astronaut corps; and refine ground training methods for spacewalks. The STS-72 spacewalk evaluations are called the EVA Development Flight Test-3 (EDFT-3) and encompass a variety of Detailed Test Objectives.

The first spacewalk, planned to last six and a half hours, will be performed on Flight Day 5 by Mission Specialists Leroy Chiao, designated Extravehicular Crewmember 1 (EV1) and Daniel Barry, designated EV2. The second spacewalk, also six and a half hours, is planned for Flight Day 7 and will be performed by Chiao as EV1 and Mission Specialist Winston Scott as EV3. Three spacesuits will be aboard Endeavour, one fitted for each EV crew member.

During the first spacewalk, Scott will serve as the Intravehicular (IV) crewmember, serving as a coordinator for the EVA work from within Endeavour's crew cabin. Pilot Brent Jett will operate Endeavour's mechanical arm, which will be used during the spacewalk evaluations. For the second spacewalk, Barry will serve as the IV crew member while Jett again operates the mechanical arm.

On the first spacewalk, Chiao and Barry will conduct evaluations of a new Portable Work Platform (PWP), an EVA workstation for astronauts that provides an aid for temporarily restraining replacement units and equipment the spacewalker may be working with; a movable stanchion that provides stability for the astronaut and holders for tools; and a flexible foot restraint flown on previous Shuttle missions. They also will evaluate the installation of a rigid umbilical that may be used on the space station to hold various fluid and electrical umbilicals in place. The Rigid Umbilical (RU), which weighs almost 250 pounds, also will be used for evaluations of the handling of large masses while spacewalking.

The second spacewalk, conducted by Chiao and Scott, will consist mainly of evaluations of a space station Utility Box, a box designed to hold avionics and fluid line connections on the station; an on-orbit installed slidewire, a type of wire to which EVA tethers can be connected that is planned to be installed on the exterior of the space station in orbit; measurements of forces induced by various spacewalking work such as replacing station components and manipulating massive objects; and an evaluation of thermal improvements to the spacesuits.

In addition, an Electronic Cuff Checklist (ECC), a wrist- mounted portable computer planned to supplement written checklists for spacewalks, will be evaluated. The ECC will be making its fourth Shuttle flight on STS-72.

Detailed descriptions of the test equipment and evaluations include:

Portable Work Platform

The PWP is a mobile EVA worksite designed for the end of the International Space Station's mechanical arm being flight- tested for the first time on STS-72. Somewhat similar to the work platform used at the end of the Shuttle arm during past spacewalks -- such as those to service the Hubble Space Telescope on STS-61 -- the PWP offers greater flexibility of movement with a swiveling foot restraint; a storage location for tools and a temporary storage location for large space station Orbital Replacement Units (ORUs). The PWP is composed of an Articulating Portable Foot Restraint, a foot platform for spacewalkers that can be swiveled to various orientations using two foot pedals, allowing a spacewalker to reposition without dismounting from it; a Portable Foot Restraint Work Stanchion that can hold tools and equipment; and a Temporary Equipment Restraint Aid that is designed to hold large ORUs. Crewmembers will evaluate the PWP by using it mounted at the end of Endeavour's mechanical arm to perform several other tasks planned during the spacewalks.

Rigid Umbilical

The RU simulates an umbilical designed to link space station modules to the truss structure and to other modules. It simulates a type of cable tray holding a variety of avionics and fluid lines that will run between the various station structures. Exactly as is planned during station construction, the RU is launched folded and will be unfolded during the STS- 72 EVA to its full 17.5-foot length. A crewman in the PWP on the mechanical arm will detach the eight-foot long folded RU from the left side of the cargo bay and mate one end to a connector on the left side of the bay, called the Port Rigid Umbilical Mount. The crew then will unfold the RU and mate the other end to a connector on the right side of the bay. Five electrical connections and two fluid line connections will be performed at the right end, simulating the work planned for the station. The connections are actual station components, but carry no electricity or fluid. In addition, several partial unfolding evaluations of the RU will be performed, simulating various positions planned for the attachment on the space station. The RU also will be used for mass handling evaluations during the spacewalk to simulate the characteristics of moving large station ORUs in weightlessness. The RU is being flight-tested for the first time on STS-72.

Utility Box

Located on the left side of Endeavour's cargo bay, the Utility Box simulates similar boxes planned to house connections of fluid lines and avionics lines on segments of the Space Station truss structure. The crew will connect nine electrical connectors and three fluid line connectors of varying sizes. Several design variations, such as stiffness of cables, retaining clamps for cables and the size of fluid lines are built into the box to be evaluated by the crew. The crew also will evaluate using a variety of methods to restrain themselves while working. The lines and connections are actual station hardware, but carry no electricity or fluid.

Cable Caddy

The Cable Caddy is a small carrier device planned to hold replacement electrical line for the Space Station. During the spacewalk, the crew will simulate running a replacement line by unrolling 20 feet of cable from the device and making connections at each end.

On-Orbit Installed Slidewire

The On-Orbit Installed Slidewire is a wire to be used for attaching EVA tethers while moving from one location to another, similar to permanently mounted wires running down the sides of the Shuttle's cargo bay that serve the same purpose. Several slidewires will be installed on the exterior of station segments after the sections have been launched, allowing the exterior of the segments to have fewer protrusions during launch and be more compact. To install the wire, the crew will unclip it from its holder, attach one end to a special attachment fitting in the cargo bay, unwind the wire and attach the other end to a similar fitting, and adjust a bolt that will tighten the wire.

Spacesuit Thermal Modifications

Thermal improvements to the spacesuits first tested on Shuttle mission STS-69 are again being evaluated on STS-72. However, on STS-72, the crewmember will not be at the end of the mechanical arm for the evaluations but rather in a foot restraint mounted inside the cargo bay. The crew will maneuver the Shuttle to an orientation that provides temperatures similar to the previous tests, ranging as low as minus 135 degrees Fahrenheit. Such cold conditions are expected during some construction work on the International Space Station due to its planned orientation in orbit.

The spacesuit modifications include gloves with electrically warmed fingers. The heating elements, powered by battery packs mounted above the wrists, are located on the back of the fingertips and do not impede the dexterity available with the gloves. Thermal socks, thermal toe caps inserted in the spacesuit boots, and new, adjustable thermal mittens that can fit over the spacesuit gloves also will be worn. In addition, the spacesuits allow a spacewalker to completely shut off cooling water to the Liquid Cooling and Ventilation Garment, thus providing maximum warmth.

Body Restraint Tether

A Body Restraint Tether (BRT), designed to hold a spacewalker steady when clamped to a handrail, was first flown on STS-69 but will be further evaluated on STS-72. The BRT is planned to provide a quick method of supplying stability for a spacewalker in a variety of locations where a foot restraint is not available. The tether essentially seeks to provide the astronaut with a third hand to add stability while working. On STS-72, it will be one method of restraint used during the evaluation of the Utility Box; it also will provide stability for the crew during assembly of the PWP.

Rigid Tether

The Rigid Tether, a device flown on two previous Shuttle flights, also will be further evaluated during STS-72. The Rigid Tether is used to allow astronauts to more easily carry large objects, such as a foot restraint, with them while they move from site to site. It hooks the equipment to their spacesuit and prevents it from swinging about.

On-Orbit Installed Handrail

The On-Orbit Installed Handrail is designed for installation on the exterior of the Space Station. It was flown previously on STS-69 and will be further tested during STS-72. It is secured by two sliding latches that will lock it into position.

Caution and Warning Labeling

Several of the designs planned for warning labels to be mounted on the exterior of the space station will be evaluated during STS-72. The caution labels are affixed to the exterior of equipment boxes to be used during the EVAs.

NIH-R3

NIH-R3 is a collaborative project developed by NASA and the National Institutes of Health (NIH). This study will use microgravity as a research tool to understand early development. This research is the beginning of experiments proposed for the 1998 Shuttle Neurolab mission. This test is essential because nursing neonatal rats with adult female rats or dams have not been flown previously in space, and healthy neonates and dams are essential for future space flight developmental studies.

The first three weeks of life are a period of tremendous development for newborn rats. The animals are transformed from small newborns focused on obtaining nourishment from their mother into young independent rats. The nervous system undergoes dramatic development during this period. Understanding how this development occurs in rats will give great insight into how normal neurological development occurs on Earth.

The rats will be housed in a modified Animal Enclosure Module system, called the AEM-Nursing Facility, which was designed to support nursing rats and neonates. The three nursing facilities each will house two adult lactating female rats, (each female will fly with a litter of 10 neonates).

The animal module flies in a middeck locker in the Shuttle and provides food and water, airflow, air filtration, light- dark cycles, temperature recording, and odor and waste containment systems.

Another goal of this hardware demonstration flight experiment is to validate the suitability of space-flown lactating female rats and neonates for research planned for Neurolab. Two of the Neurolab principal investigators (Dr. Danny Riley, Medical College of Wisconsin, and Dr. Kerri Walton, New York University) will perform post-flight analysis of animals to begin the planned Neurolab experiments.

The goal of Riley's study is to understand the influence of gravity on spinal cord and muscle development of terrestrial mammals, including humans.

Walton will use behavioral measures as a tool in examining the influence of the environment on the postnatal development of specific and critical brain/body systems. Gravity provides an ideal model since it is perhaps the only factor that has been present throughout evolution and can be altered in a non- invasive way.

For NIH-R3, rats will experience weightlessness at three ages, postnatal days 5 to 14, 8 to 17 and 15 to 24. This will allow evaluation of three overlapping periods of development; two groups of rats will experience their "sensitive" period and the eldest group will experience the final period of vestibular system development in the near weightlessness of microgravity.

Since all their major systems (nervous, muscular, cardiovascular, respiratory, renal, gastrointestinal and mineral metabolism) are rapidly developing, neonate rats are much more sensitive than adult rats to changes in gravity. Thus, for young rats, days spent under conditions of microgravity during a critical period of development is probably the equivalent of months of exposure for an adult.

NIH.C5

The NIH.C5 experiment continues the collaboration between NASA and the NIH. It is a middeck-locker experiment that will repeat and augment previously flown experiments investigating the effect of spaceflight on musculoskeletal development at the cellular level.

The experiment payload consists of two biomedical studies sponsored by NASA and NIH. These experiments will use a computerized tissue culture incubator known as the Space Tissue Loss Culture Module. The module was developed at the Walter Reed Army Institute of Research, Washington, DC, to study cells in microgravity.

The experiments will study the effects of space flight on muscle and bone cells from chicken embryos. The experiments on STS-72 will augment data from the flight of the module in November 1994. Results of this research may lead to development of measures to maintain the strength of muscles and bones during long-duration space voyages and possibly on Earth.

The scientific objectives of the NASA/NIH collaboration are to investigate fundamental biological processes governing cell action, independent of the effects of gravity, and to study the effects of microgravity on the cellular functions of both muscle and bone cells. Dr. Adele Boskey of the Hospital for Special Surgery in New York will examine the effects of space flight on calcification and cellular activity in maturing cartilage cells.

Dr. Herman Vandenburgh of the Miriam Hospital and Brown University will study the effects of space flight on muscles to determine if microgravity induces damage or loss of muscle fibers using special markers of cell damage, growth assays, measurements of muscle size and multiple biochemical assessments.

PROTEIN CRYSTAL GROWTH (PCG)

Principal Investigator: Dr. Larry DeLucas University of Alabama at Birmingham

STS-72 will introduce an enhanced version of the Protein Crystal Growth Vapor Diffusion Apparatus. The original apparatus has been used for over 20 Shuttle experiments and has been successful in producing highly ordered crystals of selected proteins for analysis on Earth. The second-generation apparatus is designed to improve the mixing of experiment solutions, especially certain solutions which are too viscous to be adequately mixed in the original hardware. Better mixing is expected to result in the formation of larger, higher quality protein crystals.

The new design introduces a triple-barreled syringe, which replaces the double-barreled syringe of the original apparatus, to improve mixing of experiment solutions. On STS-72, four apparatus trays will be housed in a single-locker thermal enclosure system installed in place of a Shuttle middeck locker. Each tray contains 20 experiment chambers, for a total of 80 chambers. Candidate proteins for the protein crystal growth experiment on STS-72 are under review.

Proteins are important, complex biological substances which serve a variety of functions in all living organisms. Determining the three-dimensional structures of protein molecules leads to a greater understanding of how various proteins function in plants and animals. This knowledge also provides the potential for design of better agricultural products and new pharmaceuticals to treat a wide variety of diseases and disorders. Since the specific functions of essentially all biological molecules are determined by their three-dimensional structures, growing crystals of those proteins for structural analysis plays a central role in all the biomedical sciences.

Crystals produced in the gravity environment of Earth are often too small and may have internal defects that make crystallographic analysis difficult or impossible. As demonstrated on Space Shuttle missions since 1985, some protein crystals grown in space are not only larger, but also have fewer defects than their Earth-grown counterparts. This is because crystals produced in microgravity do not settle to the bottom of the growth solution droplets and clump together -- and because fluid flows, which can cause defects in growing protein crystals on Earth, are reduced in low gravity.

A number of protein structures have been defined using space grown crystals to a significantly higher resolution than can be obtained with their Earth-grown counterparts. In addition, these space experiments promote a better understanding of the fundamentals of crystal growth phenomena.

Commercial Protein Crystal Growth - 8 (CPCG-8)

The CPCG payload to be flown on STS-72 will be a protein crystal growth experiment using batch temperature-induction crystallization methodology to produce crystals of a new form of recombinant human insulin. Temperature induction allows protein saturation and subsequent crystal growth to proceed slowly in a predetermined manner in order to maximize crystal size and quality. This methodology is particularly effective in space because, in the unique environment of microgravity, disruptive convection currents resulting from temperature change are minimized.

One objective of this flight is to fly protein sample containers of different volumes and geometries in order to investigate the effect of various temperature gradients on protein crystal growth in microgravity. A part of that objective is to test containers of volumes smaller than the current smallest volume of 50 milliliters. These smaller volumes should make this space processing flight hardware more attractive to industry partners and academic collaborators who are limited in the amount of protein available for their microgravity programs. Smaller volumes provide an opportunity to test a relatively large number of samples rather than the four currently possible in one Shuttle middeck locker. It is expected that this new hardware will provide greater flexibility in temperature gradients and sample sizes.

The protein sample to be processed on the first flight of this new hardware will be a new form of recombinant human insulin whose parent molecule, insulin, is used for the treatment of type I diabetes ("juvenile-onset"). The microgravity grown crystals will be used for X-ray diffraction studies and refined structural determination to facilitate the ability of the corporate partner, Eli Lilly, to understand the mode of action of this new form of insulin.

STS-72 CREWMEMBERS

STS072-S-002 **--** *These six astronauts are in training for NASA's STS-72 mission scheduled aboard the space shuttle Endeavour later this year. Astronauts Brian Duffy (right front) and Brent W. Jett (left front) are mission commander and pilot, respectively. Mission specialists (back row, left to right) are Winston E. Scott, Leroy Chiao, Koichi Wakata and Daniel T. Barry. Wakata is an international mission specialist representing Japan's National Space Development Agency (NASDA) based at the Johnson Space Center (JSC).*

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

BIOGRAPHICAL DATA

BRIAN DUFFY (Colonel, USAF)

Birthplace and date: Born June 20, 1953, in Boston, MA. His mother, Mrs. Anne C. Duffy, resides in Hingham, MA. His father, Mr. Daniel E. Duffy, is deceased.

Physical description: Brown hair; brown eyes; 6 feet; 175 pounds.

Education: Graduated from Rockland High School, Rockland, MA, in 1971; received a bachelor of science degree in mathematics from the U.S. Air Force (USAF) Academy in 1975, and a master of science degree in systems management from the University of Southern California in 1981.

Marital Status: Married to the former Janet M. Helms of West Lafayette, IN. Her parents, Mr. & Mrs. John J. Helms, reside in Ft. Myers, FL.

Children: Shaun Patrick, Jan. 25, 1981; Shannon Marie, Nov. 3, 1982.

NASA experience: Selected by NASA in June 1985, Duffy became an astronaut in July 1986. Since then, he has participated in the development and testing of computer software to be used on Shuttle flights, served as Technical Assistant to the Director of Flight Crew Operations, developed displays and flight crew procedures used during the ascent phase, served as spacecraft communicator (CAPCOM) in Mission Control during numerous Space Shuttle missions, and also worked on Space Station issues. A veteran of two space flights, he has logged over 453 hours in space. Duffy was the pilot on STS-45 (March 24 to April 2, 1992), the first of the ATLAS series of missions to address the atmosphere and its interaction with the Sun. He also was the pilot on STS-57 (June 21 to July 1, 1993). Mission highlights included retrieval of the European Retrievable Carrier with the Shuttle's robotic arm, a spacewalk by two crew members, and an assortment of experiments in the first flight of the Spacehab middeck augmentation module.

BRENT W. JETT Jr. (Lieutenant Commander, USN)

Birthplace and date: Born Oct. 5, 1958, in Pontiac, MI, but considers Ft. Lauderdale, FL, to be his hometown. His parents, Mr. & Mrs. Brent W. Jett, Sr., reside in Ft. Lauderdale, FL.

Physical description: Blond hair; green eyes; 6 feet 1-1/2 inches; 165 pounds.

Education: Graduated from Northeast High School, Oakland Park, FL, in 1976; received a bachelor of science degree in aerospace engineering from the U.S. Naval Academy in 1981; a master of science degree in aeronautical engineering from the U.S. Naval Postgraduate School in 1989.

Marital Status: Married to Janet Leigh Lyon of Patuxent River, MD. Her mother, Mrs. Mary Patricia Lyon, resides in Fredericksburg, VA. Her father, Mr. James Richard Lyon, Sr., is deceased.

NASA experience: Selected by NASA in March 1992, Jett reported to the Johnson Space Center in August 1992. After completing one year of initial training, Jett was assigned to work technical issues for the Operations Development Branch of the Astronaut Office. He later served as the ascent/entry CAPCOM in Mission Control for STS-64 and STS-63.

BIOGRAPHICAL DATA

LEROY CHIAO (Ph.D.)

Birthplace and date: Born Aug. 28, 1960, in Milwaukee, WI, but considers Danville, CA, to be his hometown. His parents, Mr. & Mrs. Tsu Tao Chiao, reside in Fairfield, CA.

Physical description: Black hair; brown eyes; 5 feet 8 inches; 170 pounds.

Education: Graduated from Monte Vista High School, Danville, CA, in 1978; received a bachelor of science degree in chemical engineering from the University of California, Berkeley, in 1983, and a master of science degree and a doctorate in chemical engineering from the University of California, Santa Barbara, in 1985 and 1987, respectively.

Marital Status: Single.

NASA experience: Selected by NASA in January 1990, Dr. Chiao became an astronaut in July 1991. He is qualified for assignment as a mission specialist on future Space Shuttle flight crews. His technical assignments to date include: Space Shuttle flight software verification in the Shuttle Avionics Integration Laboratory (SAIL); crew equipment, Spacelab, Spacehab and payloads issues for the Astronaut Office Mission Development Branch; Training and Flight Data File issues.

Dr. Chiao served as a mission specialist on STS-65. The seven-member crew aboard Space Shuttle Columbia launched from Kennedy Space Center in Florida on July 8, 1994, and returned there on July 23, 1994, setting a new flight duration record for the Space Shuttle program. The STS-65 mission flew the second International Microgravity Laboratory (IML-2). During the 15-day flight, the crew conducted more than 80 experiments focusing on materials and life sciences research in microgravity. The mission was accomplished in 236 orbits of the Earth, traveling 6.1 million miles. With the completion of his first mission, Dr. Chiao has logged 353 hours and 55 minutes in space.

WINSTON E. SCOTT (Captain, USN)

Birthplace and date: Born Aug. 6, 1950, in Miami, FL. His father, Alston Scott, resides in Miami, FL. His mother, Rubye Scott, is deceased.

Physical description: Black hair; brown eyes; 6 feet 1 inch; 165 pounds.

Education: Graduated from Coral Gables High School, Coral Gables, FL, in 1968; received a bachelor of arts degree in music from Florida State University in 1972; a master of science degree in aeronautical engineering from the U.S. Naval Postgraduate School in 1980.

Marital Status: Married to the former Marilyn K. Robinson. Her parents, Albert and Josephine Robinson, reside in Chipley, FL.

Children: Winston II, March 13, 1976; Megan, Aug. 21, 1978.

NASA experience: Scott was selected by NASA in March 1992, and reported to the Johnson Space Center in August 1992. He was initially assigned to the Astronaut Office Mission Support Branch, serving with the Astronaut Support Personnel team supporting Space Shuttle launches and landings at the Kennedy Space Center in Florida.

BIOGRAPHICAL DATA

KOICHI WAKATA (NASDA)

Birthplace and date: Born Aug. 1, 1963, in Omiya, Saitama, Japan. His parents, Mr. and Mrs. Nobutaka Wakata, are residents of Omiya, Saitama, Japan.

Physical description: Black hair; brown eyes; 5 feet 7 inches; 138 pounds.

Education: Graduated from Urawa High School, Saitama, in 1982; received a bachelor of science degree in aeronautical engineering from Kyushu University in 1987; and a master of science degree in applied mechanics from Kyushu University in 1989.

Marital Status: Single.

NASA experience: Selected by NASDA, the National Space Development Agency of Japan, in April 1992, Wakata reported to the Johnson Space Center in August 1992. He completed one year of training and is qualified for assignment as a mission specialist on future Space Shuttle flight crews. Wakata's technical assignments to date include: payload science support for the Astronaut Office Mission Development Branch (April 1993 to date); Space Shuttle flight software verification testing in the Shuttle Avionics Integration Laboratory (SAIL) (April to October 1994).

DANIEL T. BARRY (M.D., Ph.D.)

Birthplace and date: Born Dec. 30, 1953, in Norwalk, CT, but considers South Hadley, MA, to be his hometown. His mother, Mrs. Albeus E. Barry, resides in Catonsville, MD.

Physical description: Brown hair; green eyes; 6 feet 3 inches; 175 pounds.

Education: Graduated from Bolton High School, Alexandria, LA, in 1971; received a bachelor of science degree in electrical engineering from Cornell University in 1975; a master of engineering degree and a master of arts degree in electrical engineering/computer science from Princeton University in 1977; a doctorate in electrical engineering/computer science from Princeton University in 1980; and a doctorate in medicine from the University of Miami in 1982.

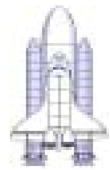
Marital Status: Married to the former Susan R. Feinstein. Her parents, Mr. & Mrs. Malcolm Feinstein, reside in Stamford, CT.

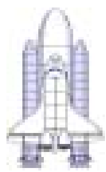
Children: Jennifer and Andrew.

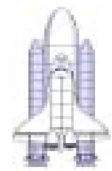
NASA experience: Selected by NASA in March 1992, Dr. Barry reported to the Johnson Space Center in August 1992. He completed one year of training and is qualified for assignment as a mission specialist on future Space Shuttle flight crews. Dr. Barry initially worked on primary payloads for the Mission Development Branch of the Astronaut Office. Other assignments included work in the Shuttle Avionics Integration Laboratory (SAIL), portable computing issues for Space Shuttle, and Chief of Astronaut Appearances.

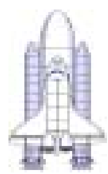
SHUTTLE FLIGHTS AS OF JANUARY 1996

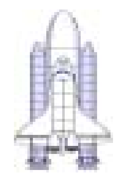
73 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 48 SINCE RETURN TO FLIGHT











OV-102 Columbia (18 flights)	OV-099 Challenger (10 flights)	OV-103 Discovery (21 flights)	OV-104 Atlantis (15 flights)	OV-105 Endeavour (9 flights)
		STS-70 07/13/95 - 07/22/95		
		STS-63 02/03/95 - 02/11/95		
		STS-64 09/09/94 - 09/20/94		
STS-73 10/20/95 - 11/05/95		STS-60 02/03/94 - -2/11/94		
STS-65 07/08/94 0 07/23/94		STS-51 09/12/93 - 09/22/93		
STS-62 03/04/94 - 03/18/94		STS-56 04/08/83 - 04/17/93		
STS-58 10/18/93 - 11/01/93		STS-53 12/02/92 - 12/09/92	STS-74 11/12/95 - 11/20/95	
STS-55 04/26/93 - 05/06/93		STS-42 01/22/92 - 01/30/92	STS-71 06/27/95 - 07/07/95	
STS-52 10/22/92 - 11/01/92		STS-48 09/12/91 - 09/18/91	STS-66 11/03/94 - 11/14/94	
STS-50 06/25/92 - 07/09/92		STS-39 04/28/91 - 05/06/91	STS-46 07/31/92 - 08/08/92	
STS-40 06/05/91 - 06/14/91		STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92	
STS-35 12/02/90 - 12/10/90	STS-51L 01/28/86	STS-31 04/24/90 - 04/29/90	STS-44 11/24/91 - 12/01/91	
STS-32 01/09/90 - 01/20/90	STS-61A 10/30/85 - 11/06/85	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91	STS-69 09/07/95 - 09/18/95
STS-28 08/08/89 - 08/13/89	STS-51F 07/29/85 - 08/06/85	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91	STS-67 03/02/95 - 03/18/95
STS-61C 01/12/86 - 01/18/86	STS-51B 04/29/85 - 05/06/85	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90	STS-68 09/30/94 - 10/11/94
STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	STS-51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90	STS-59 04/09/94 – 04/20/94
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	STS-51G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89	STS-61 12/02/93 - 12/13/93
STS-4 06/27/82 - 07/04/82	STS-41B 02/03/84 - 02/11/84	STS-51D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89	STS-57 06/21/93 - 07/01/93
STS-3 03/22/82 - 03/30/82	STS-8 08/30/83 - 09/05/83	STS-51C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88	STS-54 01/13/93 - 01/19/93
STS-2 11/12/81 - 11/14/81	STS-7 06/18/83 - 06/24/83	STS-51A 11/08/84 - 11/16/84	STS-61B 11/26/85 - 12/03/85	STS-47 09/12/92 - 09/20/92
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-41D 08/30/84 - 09/05/84	STS-51J 10/03/85 - 10/07/85	STS-49 05/07/92 - 05/16/92