NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION
STS-52

PRESS KIT
OCTOBER 1992

LASER GEODYNAMICS SATELLITE (LAGEOS)

STS-52 INSIGNIA

STS052-S-001 -- The STS-52 insignia, designed by the crewmembers, features a large gold star to symbolize the crew's mission on the frontiers of space. A gold star is often used to symbolize the frontier period of the American West. The red star in the shape of the Greek letter lambda represents both the laser measurements to be taken from the Laser Geodynamic Satellite (LAGEOS II) and the Lambda Point Experiment, which is part of the United States Microgravity Payload (USMP-1). The LAGEOS II is a joint Italian/U.S. satellite project intended to further our understanding of global plate tectonics. The USMP-1 is a microgravity facility which has French and U.S. experiments designed to test the theory of cooperative phase transitions and to study the solid/liquid interface of a metallic alloy in the low gravity environment. The remote manipulator and maple leaf are emblematic of the Canadian payload specialist who will conduct a series of Canadian flight experiments (CANEX-2), including the Space Vision System test.

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.

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PUBLIC AFFAIRS CONTACTS

NASA HEADQUARTERS

Office of Space Flight/Office of Space Systems Development
Mark Hess/Jim Cast/Ed Campion
(Phone: 202/453-8536)

Office of Space Science and Applications
Paula Cleggett-Haleim/Mike Braukus/Brian Dunbar
(Phone: 202/453-1547)

Office of Commercial Programs
Barbara Selby
(Phone: 202/358-1983)

Office of Aeronautics and Space Technology
Drucella Andersen/Les Dorr
(Phone: 202/453-2754)

Office of Safety & Mission Quality/Office of Space Communications
Dwayne Brown
(Phone: 202/358-0547)

Ames Research Center
Jane Hutchison
(Phone: 415/604-4968)

Ames-Dryden Flight Research Facility
Nancy Lovato
(Phone: 805/258-3448)

Goddard Space Flight Center
Susan Marucci
(Phone: 301/286-2806)

Jet Propulsion Laboratory
James Wilson
(Phone: 818/354-5011)

Johnson Space Center
James Hartsfield
(Phone: 713/483-5111)

Langley Research Center
Jean Drummond Clough
(Phone: 804/864-6122)

Lewis Research Center
Mary Ann Peto
(Phone: 216/433-2899)

Marshall Space Flight Center
June Malone
(Phone: 205/544-0054)

Stennis Space Center
Myron Webb
(Phone: 601/688-3341)

Wallops Flight Center
Keith Koehler
(Phone: 804/824-1579)

Kennedy Space Center
Lisa Malone
(Phone: 407/867-2468)

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RELEASE: 92-153 **October 1992**

COLUMBIA TO DEPLOY LAGEOS-II, SERVE AS TECHNOLOGY TESTBED

Shuttle flight STS-52 will be an ambitious mission, demonstrating the versatility of orbiter Columbia as a satellite launcher, science platform and technology testbed. Launch is planned for Oct. 15 from the Kennedy Space Center, FL. The 9-day, 20-hour and 54-minute mission is scheduled to land on Oct. 25 at the Kennedy center.

A crew of six and 11 major payloads will be aboard Columbia's 13th mission, the 51st Space Shuttle flight. Mission Commander is James Wetherbee with Michael Baker the Pilot. Mission specialists are Charles Lacy Veach, William Shepherd and Tamara Jernigan. Steve MacLean is the Payload Specialist and the third Canadian citizen to fly aboard the Shuttle.

LAGEOS 2 - Small Satellite, Big Results

Columbia will eject the LAGEOS-II satellite from the cargo bay on the second mission day. Built by the Italian Space Agency using NASA blueprints, this small, 900-pound satellite will help geologists fill in important details about the Earth. The first LAGEOS was launched in 1976. Adding a second spacecraft will enable researchers to gather twice the data.

"The satellite may be small, but the data returned is big time science," says Program Scientist Dr. Miriam Baltuck. This information will be particularly useful for monitoring regional fault movement in earthquake-prone areas.

Baltuck said geologists use this information to monitor the extremely slow movements of the Earth's crustal plates, to measure and understand the "wobble" in the Earth's axis of rotation, collect information on the Earth's size and shape and more accurately determine the length of the day.

Baltuck explained that ground-based researchers from 30 countries will participate in collecting and analyzing the data received from the satellite . The researchers will bounce laser beams off the mirror-covered spacecraft and log how long it takes the beams to make the round-trip voyage.

"We know the speed that light travels," said Baltuck. "So by plugging that into our formula, we can measure precisely the distances between stations on the Earth and the satellite."

USMP Makes Debut

A major new materials processing payload makes its debut on STS-52 -- the first United States Microgravity Payload (USMP-1). The payload consists of three experiments mounted on a new carrier, derived from the previously flown Materials Science Lab, in Columbia's cargo bay.

"This is an excellent use of the Shuttle to perform microgravity experiments that are primarily operated remotely from the ground," said Program Manager David Jarrett. This type of remote operations will help prepare the science community for Space Station Freedom prior to its permanently manned operational phase.

Experiments on USMP-1 will explore using the unique space environment to do research that is not possible on Earth. The science, while basic in nature, could impact applications on Earth in areas such as computer memory, metals and semiconductors. Another experiment will measure the Shuttle's vibrations, information critical to scientists understanding the current experiments and planning future experiments.

Canada Provides Variety of Experiments

Canadian Payload Specialist MacLean will perform a bevy of experiments called CANEX-2. Many of these experiments are extensions of work carried out by Dr. Marc Garneau as part of the CANEX group of experiments that flew in 1984.

CANEX-2 is actually 10 separate investigations. Results from CANEX-2 have potential applications in machine vision systems for use with robotic equipment in space and in environments such as mines and nuclear reactors. Other potential applications relate to the manufacturing of goods, the development of new protective coatings for spacecraft materials, improvements in materials processing, and a better understanding of Earth's stratosphere which contains the protective ozone layer.

Greater knowledge of human adaptation to microgravity is another objective of the CANEX-2 payload. MacLean will conduct experiments on back pain, body water changes and the effect of weightlessness on the vestibular system.

Columbia, An Orbiting Testbed

Columbia will be turned into an orbiting test-bed for other STS-52 experiments. One, called the Attitude Sensor Package built by the European Space Agency, will gather information on the performance and accuracy of new sensors. Space is the best place to test these sensors. The data returned could be used in the design of sensors for future spacecraft.

Other space technology experiments will examine how very cold liquids behave in space, the use of heat pipe technology for temperature control, and the effects of atomic oxygen on different materials -- technologies that may have important contributions to the design of future spacecraft.

Commercial Office Payloads

Major payloads, sponsored by NASA's Commercial Programs Office, will examine a compound for possible use in combating diseases which involve loss of bone mass; thin-film membrane research which has potential application in the biotechnology and pollution control field; and a new facility for growing semiconductor crystals which permits interaction from the crew to achieve optimum growth.

A commercial protein crystal growth facility will fly on STS-52. Scientists hope the new facility will result in more crystals that are better ordered, larger and more uniform in size than their ground-based counterparts.

With the exception of the Canadian Payload Specialist, there are no "rookie" astronauts on this flight. STS-52 will mark Wetherbee's second Shuttle flight. He was the Pilot on the STS-32 Columbia mission. Baker also will be making his second flight, but his first as a Pilot. Baker was a mission specialist on STS-43.

Veach, Shepherd and Jernigan are Shuttle veterans. Veach previously flew on STS-39, and Shepherd has two previous flights, STS-27 and -41. Jernigan last flew on STS-40, a Columbia mission devoted to life sciences research.

MacLean is one of six Canadian astronauts selected in December 1983. In addition to his CANEX-2 duties, he is the Program Manager for the Advanced Space Vision System experiment.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 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, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; 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 data base service requiring the use of a telephone modem. A voice recording of the television schedule is updated 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 news center.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, change-of-shift briefings by a flight director and the science team will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-52 QUICK LOOK

Launch Date and Site:	Oct. 15, 1992 Kennedy Space Center, FL -- Pad 39B
Launch Window:	11:10 a.m. EDT (1510 GMT) to 1:37 p.m. EDT (1737 GMT)
Orbiter:	Columbia's 13th Flight
Orbit/Inclination:	160 x 163 n.m. (LAGEOS)/ 28.45 degrees 110 x 111 n.m. (CANEX)/ 28.45 degrees
Landing Date:	October 25
Landing Time:	8:04 a.m. EDT (1204 GMT)
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites: Return To Launch Site Abort: Transatlantic Abort Landing	Kennedy Space Center, Fla. Banjul, The Gambia -- Prime Ben Guerir, Morocco -- Alternate Moron Spain -- Alternate
Abort-Once-Around:	Edwards AFB, Calif. -- Prime KSC, Fla./White Sands, N.M. -- Alternates
Crew:	James Wetherbee - Commander Michael Baker - Pilot Charles Lacy Veach - MS1 William Shepherd - MS2 Tamara Jernigan - MS3 Steven MacLean - PS1
Cargo Bay Payloads:	Laser Geodynamics Satellite (LAGEOS) U.S. Microgravity Payload (USMP-1) Canadian Experiments (CANEX-2) Attitude Sensor Package (ASP) Tank Pressure Control Experiment. (TPCE)
Middeck Payloads:	Commercial Protein Crystal Growth (CPCG) Commercial Materials ITA Experiment (CMIX) Crystals by Vapor Transport Experiment (CVTE) Heatpipe Performance Experiment (HPP) Physiological Systems Experiment (PSE) Shuttle Plume Impingement Experiment (SPIE)

STS-52 SUMMARY OF MAJOR ACTIVITIES

Day One	Launch/Post Insertion LAGEOS Checkout
Day Two	LAGEOS Deploy Robot Arm (RMS) Checkout Heatpipe Performance Experiment (HPP)
Day Three	Lower Body Negative Pressure (LBNP) Space Vision Systems Operations (CANEX) HPP
Day Four	HPP Commercial Protein Crystal Growth (CPCG)
Day Five	LBNP/HPP
Day Six	LBNP/CPCG/HPP Phase Partitioning in Liquids (CANEX) Crystals by Vapor Transport Experiment Setup/Activation
Day Seven	LBNP/CPCG Phase Partitioning in Liquids
Day Eight	LBNP Material Exposure in Low Earth Orbit (CANEX) Attitude Sensor Package Maneuvers
Day Nine	LBNP/SVS Operations Material Exposure in Low Earth Orbit (MELEO) Orbiter Glow Experiment (OGLOW)
Day Ten	Canadian Target Assembly Release Control Surface Checkout Reaction Control System Hotfire Cabin Stow
Day Eleven	Deorbit Preparation Deorbit Burn and Landing at Kennedy Space Center

STS-52 VEHICLE AND PAYLOAD WEIGHTS

	Pounds
Orbiter Columbia Empty and three SSMEs	181,502
Laser Geodynamics Satellite (LAGEOS)	5,512
LAGEOS Support Equipment	2,214
U.S. Microgravity Payload (USMP-1)	8,748
Attitude Sensor Package (ASP)	632
Canadian Experiments (CANEX-2)	301
Commercial Protein Crystal Growth (CPCG)	63
Heatpipe Performance Experiment (HPP)	100
Physiological Systems Experiment (PSE)	142
Detailed Supplementary Objectives (DSO)	96
Total Vehicle at Solid Rocket Booster Ignition	4,511,341
Orbiter Landing Weight	214,289

STS-52 TRAJECTORY SEQUENCE OF EVENTS

Event	Elapsed Time (d/h:m:s)	Velocity (fps)	Mach	Altitude (ft)
Launch	00/00:00:00			
Begin Roll Maneuver	00/00:00:10	188	0.17	799
End Roll Maneuver	00/00:00:14	299	0.26	1,956
SSME Throttle To 67 Percent	00/00:00:29	692	0.62	8,573
Max. Dynamic Pressure (Max Q)	00/00:01:00	1,371	1.36	34,977
SSME Throttle Up (104 Percent)	00/00:01:06	1,576	1.63	42,771
SRB Separation	00/00:02:04	4,111	3.84	151,131
Main Engine Cutoff (MECO)	00/00:08:31	24,512	22.73	363,666
Zero Thrust	00/00:08:37	24,509		362,770
Fuel Tank Separation	00/00:08:50			
OMS-2 Burn	00/00:39:55			
Deorbit Burn (orbit 158)	09/19:54:00			
Landing at KSC (orbit 159)	09/20:54:00			

Apogee, Perigee at MECO: 156 x 35 nautical miles
Apogee, Perigee after OMS-2: 163 x 160 nautical miles

SPACE SHUTTLE ABORT MODES

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

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

- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at either Edwards Air Force Base, Calif., White Sands Space Harbor, NM, or the Shuttle Landing Facility (SLF) 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 either Banjul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

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

STS-52 contingency landing sites are Edwards Air Force Base, the Kennedy Space Center, White Sands Space Harbor, Banjul, Ben Guerir and Moron.

STS-52 PRELAUNCH PROCESSING

With three other vehicles at various processing stages, the KSC's Shuttle team began work on July 10 to ready Columbia for its 13th voyage into space - the day after its unscheduled landing at KSC. Columbia was towed to Orbiter Processing Facility (OPF) bay 1 where post-flight inspections and tests were accomplished.

In August, technicians installed the Shuttle orbiter main engines. Engine 2030 is in the number 1 position, engine 2015 is in the number 2 position and engine 2028 is in the number 3 position.

Following completion of space vehicle assembly and associated testing, the Terminal Countdown Demonstration Test with the STS-52 flight crew was scheduled for late September.

A standard 43-hour launch countdown is scheduled to begin 3 days prior to launch. During the countdown, the orbiter's fuel cell storage tanks and all orbiter systems will be prepared for flight.

About 9 hours before launch, the external tank will be filled with its flight load of a half million gallons of liquid oxygen and liquid hydrogen propellants. About 2 and one-half hours before liftoff, the flight crew will begin taking their assigned seats in the crew cabin.

Columbia's end-of-mission landing is planned at Kennedy Space Center's Shuttle Landing Facility. KSC's landing and recovery team will perform convoy operations on the runway to safe the vehicle and prepare it for towing to the OPF.

Columbia's next flight, STS-55, targeted for early next year, is a 10-day mission with the German Spacelab D-2 module.

LASER GEODYNAMICS SATELLITE (LAGEOS) II

The Laser Geodynamics Satellite (LAGEOS) II, like its predecessor launched in 1976, is a passive satellite dedicated exclusively to laser ranging. Laser ranging involves sending laser beams from Earth to the satellite and recording the round-trip travel time. This measurement enables scientists to precisely measure the distances between laser ranging stations on the Earth and the satellite.

LAGEOS is designed to provide a reference point for laser ranging experiments that will monitor the motion of the Earth's crust, measure and understand the "wobble" in the Earth's axis of rotation, collect information on the Earth's size and shape and more accurately determine the length of the day. The information will be particularly useful for monitoring regional fault movement in earthquake-prone areas such as California and the Mediterranean Basin.

The LAGEOS II project is a joint program between NASA and the Italian space agency, Agenzia Spaziale Italiana (ASI), which built the satellite using LAGEOS I drawings and specifications, handling fixtures, dummy spacecraft and other materials provided by the Goddard Space Flight Center (GSFC), Greenbelt, MD. GSFC also tested the corner-cube retroreflectors on the surface of LAGEOS II. ASI provided the Italian Research Interim Stage (IRIS) and the LAGEOS Apogee Stage (LAS), the two upper stages that will transport LAGEOS II to its proper altitude and circularize its orbit. NASA is providing the launch aboard Space Shuttle Columbia.

The Spacecraft

The LAGEOS II satellite is a spherical satellite made of aluminum with a brass core. It is only 24 inches (60 cm) in diameter yet it weighs approximately 900 pounds (405 kg). This compact, dense design makes the satellite's orbit as stable as possible.

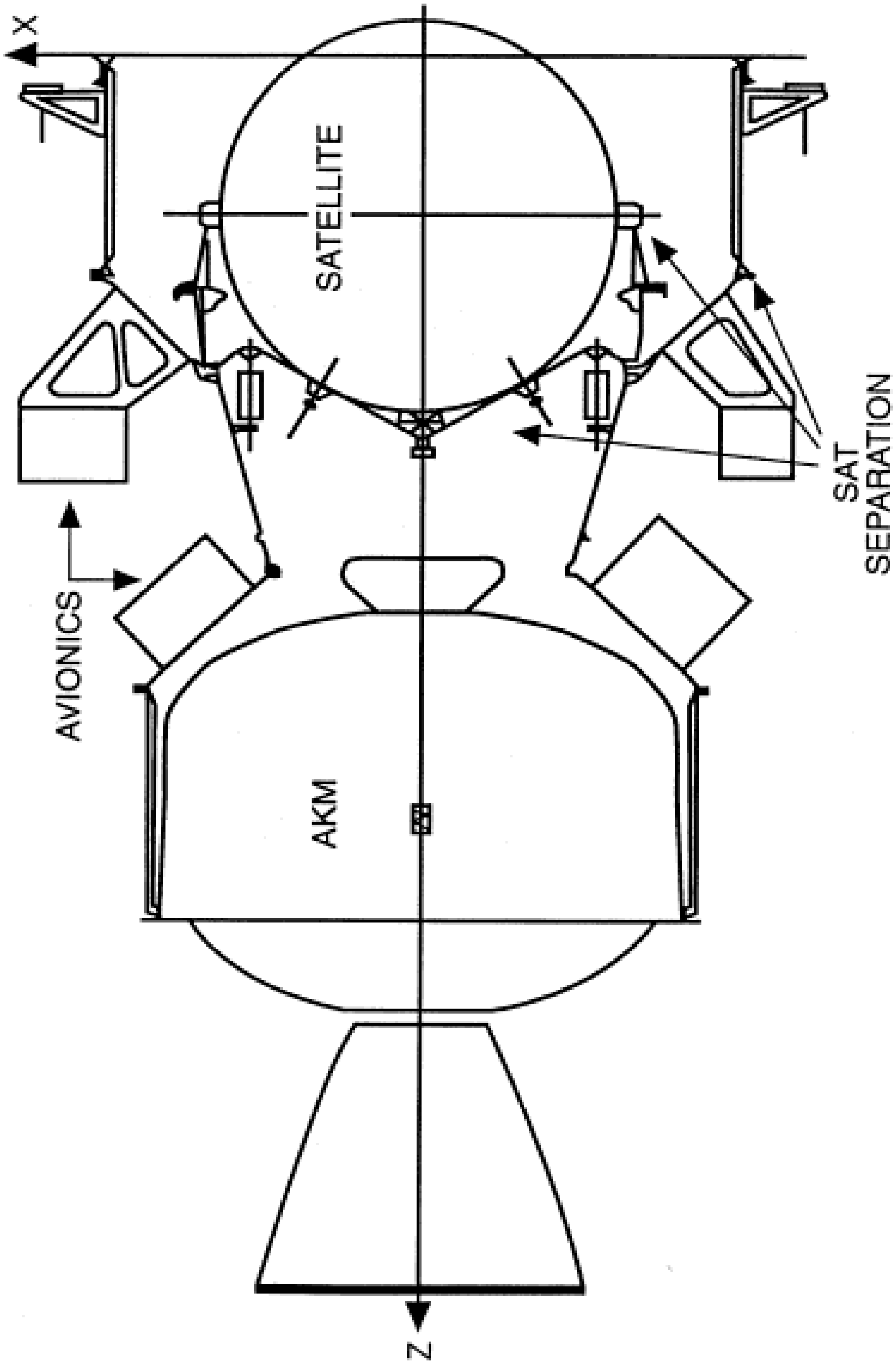
The LAGEOS design evolved from several trade-offs that proved necessary to achieve the program objectives. For example, the satellite had to be as heavy as possible to minimize the effects of non-gravitational forces, yet light enough to be placed in a high orbit. The satellite had to be big enough to accommodate many retroreflectors, but small enough to minimize the force of solar pressure.

Aluminum would have been too light for the entire body of the sphere. Design engineers finally decided to combine two aluminum hemispheres bolted together around a brass core. They selected the materials to reduce the effects of the Earth's magnetic field. LAGEOS II should remain in orbit indefinitely.

LAGEOS II has the dimpled appearance of a large golf ball. Imbedded into the satellite are 426 nearly equally spaced, cube-corner retroreflectors, or prisms. Most of the retroreflectors (422) are made of suprasil, a fused silica glass. The remaining four, made of germanium, may be used by lasers of the future. About 1.5 inches (3.8 cm) in diameter, each retroreflector has a flat, circular front-face with a prism-shaped back.

The retroreflectors on the surface of LAGEOS II are three-dimensional prisms that reflect light, in this case a laser beam, directly back to its source. A timing signal starts when the laser beam leaves the ground station and continues until the pulse, reflected from one of LAGEOS II's retroreflectors, returns to the ground station.

Since the speed of light is constant, the distance between the station and the satellite can be determined. This process is known as satellite laser ranging (SLR). Scientists use this technique to measure movements of the Earth's surface up to several inches per year. By tracking the LAGEOS satellites for several years, scientists can characterize these motions and perhaps correlate them with Earth dynamics observed on the ground.


X
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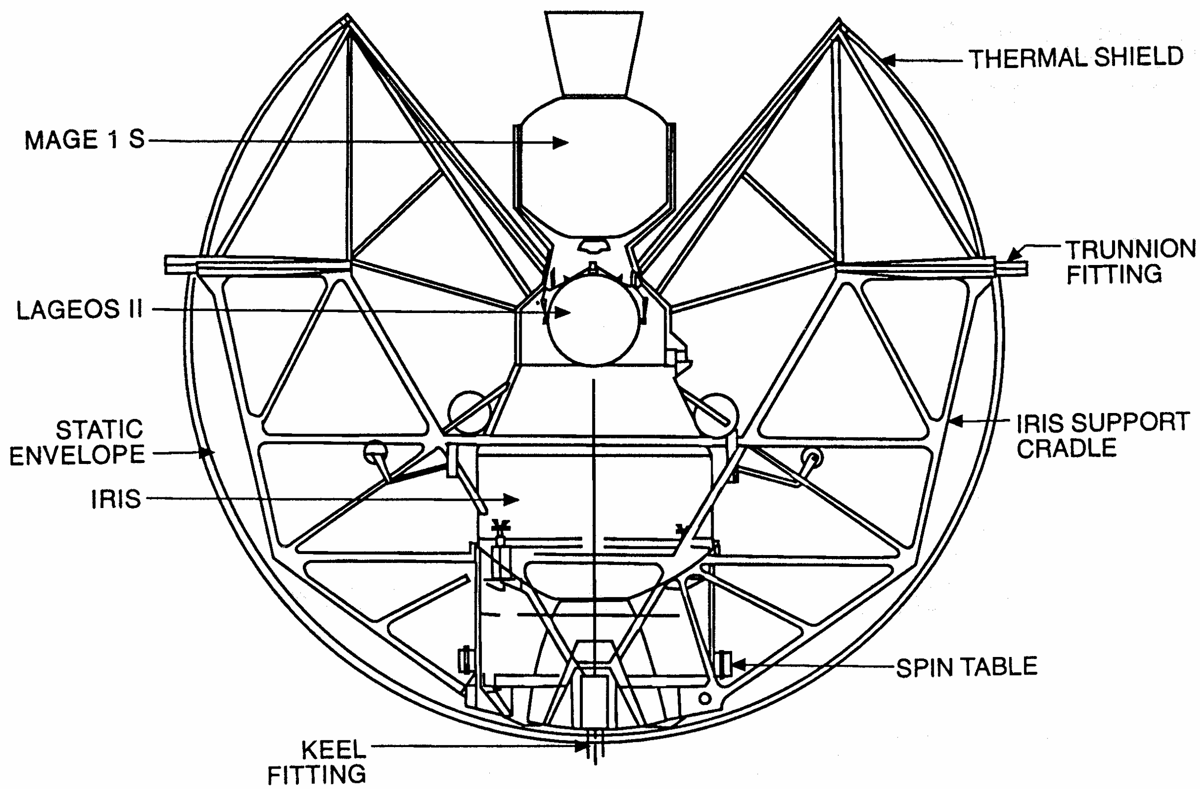
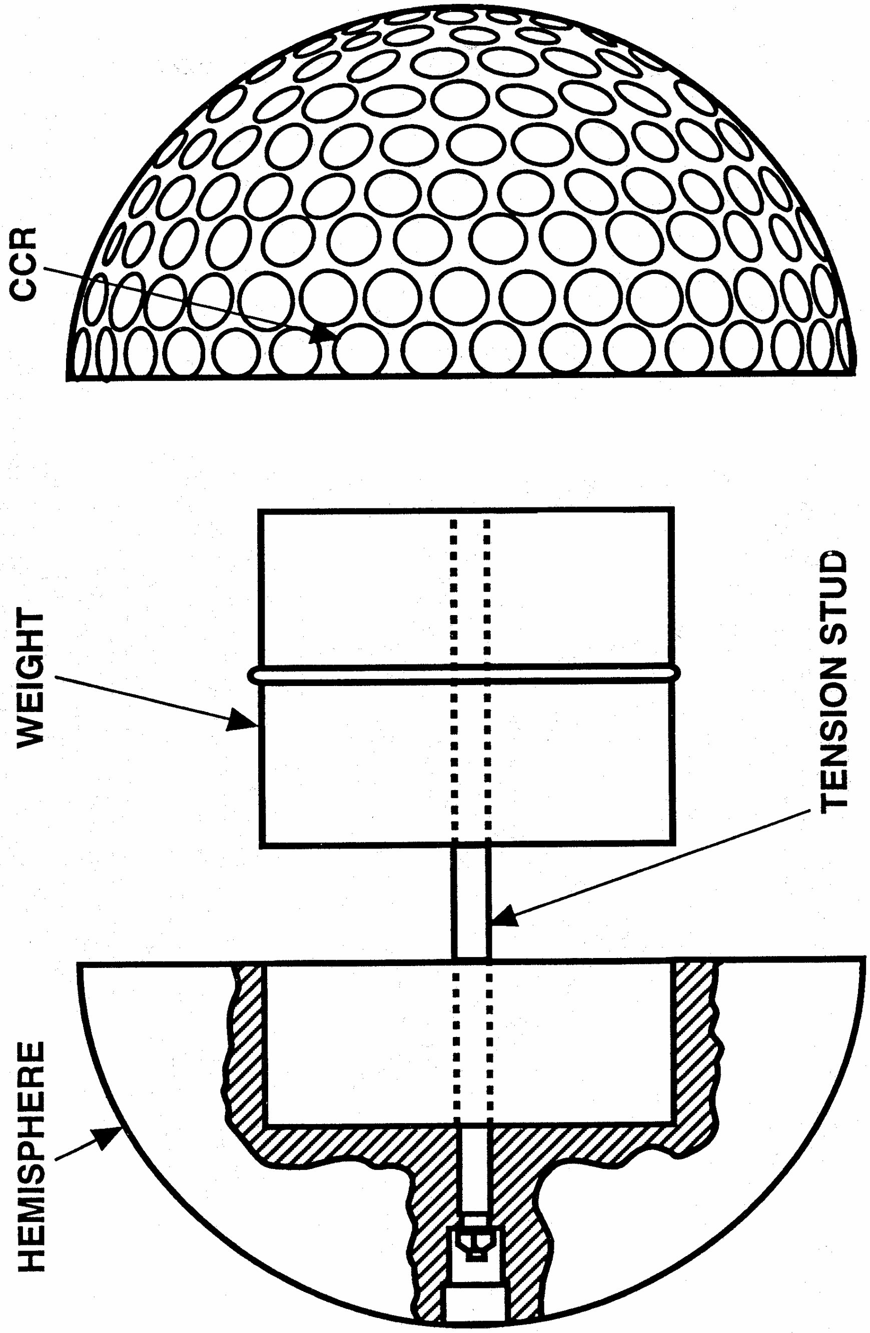
**LAGEOS II —
LAUNCH CONFIGURATION**



LAGEOS II SATELLITE



LAUNCH, ORBIT INSERTION AND DATA COLLECTION

After the Shuttle releases LAGEOS II, two solid-fuel stages, the Italian Research Interim Stage (IRIS) and the LAGEOS Apogee Stage (LAS), will engage. The IRIS will boost LAGEOS II from the Shuttle's 184-mile (296 km) parking orbit to the satellite injection altitude of 3,666 miles (5,900 km). The LAS will circularize the orbit. This will be the first IRIS mission and will qualify the IRIS, a spinning solid fuel rocket upper stage, for use in deploying satellites from the Space Shuttle cargo bay.

LAGEOS II's circular orbit is the same as that of LAGEOS I, but at a different angle to the Earth's equator: 52 degrees for LAGEOS II and 110 degrees for LAGEOS I. The complementary orbit will provide more coverage of the seismically active areas such as the Mediterranean Basin and California, improving the accuracy of crustal-motion measurements. It also may help scientists understand irregularities noted in the position of LAGEOS I, which appear to be linked to erratic spinning of the satellite itself.

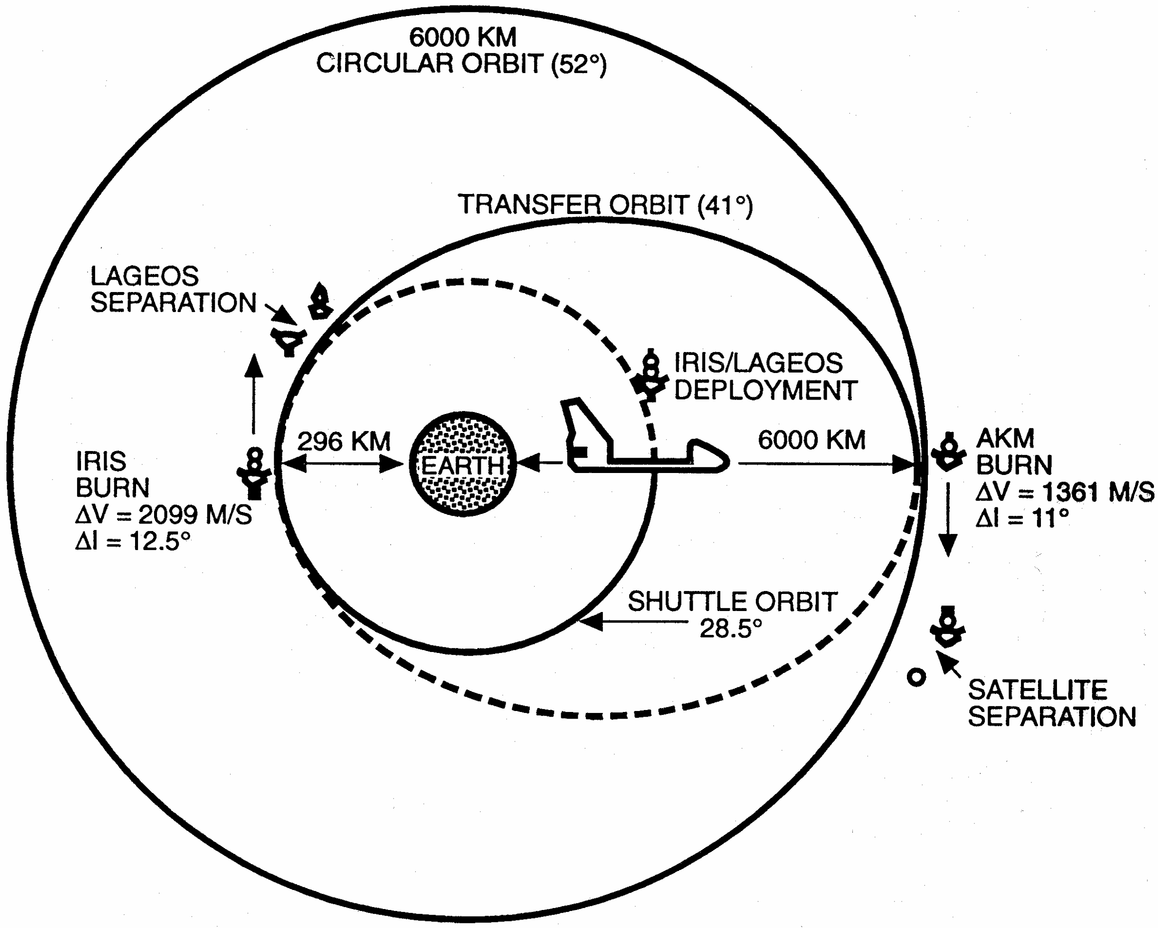
LAGEOS II will undergo a very intensive tracking program in its first 30 days of flight. This will allow laser ranging stations to precisely calculate and predict the satellite's orbit. By the end of the 30 days, full science operations will have begun.

NASA operates 10 SLR stations. Four are Transportable Laser Ranging Systems (TLRS), built to be moved easily from location to location. Four Mobile Laser Ranging Systems (MOBLAS) are in semi-permanent locations in Australia and North America, including GSFC. The University of Hawaii and the University of Texas at Austin operate the other two NASA systems.

NASA and ASI have selected 27 LAGEOS II science investigators from the United States, Italy, Germany, France, the Netherlands and Hungary. The investigators will obtain and interpret the scientific results that come from measurements to the satellite. By tracking both LAGEOS I and LAGEOS II, scientists will collect more data in a shorter time span than with LAGEOS I alone.

Data from LAGEOS II investigations will be archived in the Crustal Dynamics Data and Information System (CDDIS) at GSFC. It will be available worldwide to investigators studying crustal dynamics.

LAGEOS II ORBIT SCHEMATIC



U.S. MICROGRAVITY PAYLOAD 1 (USMP)

The first U.S. Microgravity Payload (USMP-1) will be launched aboard Space Shuttle Columbia for a 10-day mission. The USMP program is a series of NASA missions designed for microgravity experiments that do not require the "hands-on" environment of the Spacelab. The Marshall Space Flight Center (MSFC), Huntsville, Ala., manages USMP for NASA's Office of Space Science and Applications.

The USMP-1 payload will carry three investigations. The Lambda-Point Experiment (LPE) will study fluid behavior in microgravity. The Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit, (Materiel pour l'Etude des Phenomenes Interessant la Solidification sur Terre et en Orbite, or MEPHISTO) will study metallurgical processes in microgravity. The Space Acceleration Measurement System (SAMS) will study the microgravity environment onboard the Space Shuttle.

In orbit, the crew will activate the carrier and the experiments, which will operate for about 6 days during the mission. Science teams at MSFC's Payload Operations Control Center will command and monitor instruments and analyze data.

Two Mission-Peculiar Equipment Support Structures (MPESS) in the Shuttle cargo bay make up USMP-1. Carrier subsystems mounted on the front MPESS provide electrical power, communications, data-handling capabilities and thermal control. MSFC developed the USMP carrier.

Lambda-Point Experiment (LPE)

Principal Investigator: Dr. J. A. Lipa, Stanford University, Stanford, Calif.
Project Manager: R. Ruiz, Jet Propulsion Laboratory, Pasadena, Calif.

The Lambda-Point Experiment will study liquid helium as it changes from normal fluid to a superfluid state. In the superfluid state, helium moves freely through small pores that block other liquids, and it also conducts heat 1,000 times more effectively than copper. This change occurs at liquid helium's "lambda point" (-456 degrees Fahrenheit or 2.17 degrees Kelvin). Because the transition from one phase to another causes the organized interaction of large numbers of particles, it is of great scientific interest.

The transition from fluid to superfluid state can be studied more closely in microgravity than on Earth. Gravity causes a sample of liquid helium to have greater pressure at the bottom than at the top, in turn causing the top of the sample to become superfluid at higher temperatures.

Onboard USMP, a sample of helium cooled far below its lambda point will be placed in a low-temperature cryostat (an apparatus used to keep something cold, such as a thermos bottle). During a series of 2-hour runs controlled by an onboard computer, the helium's temperature will be raised through the transition point by a precision temperature- control system. Sensitive instruments inside the cryostat will measure the heat capacity of the liquid helium as it changes phases. The temperature of the helium sample will be maintained to within a billionth of degree during the experiment.

Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO)

Principal Investigator: Dr. J. J. Favier, Commissariat a' l' Energie Atomique, Grenoble, France
Project Manager: G. Cambon, Centre National d'Etudes Spatiales, Toulouse

MEPHISTO is a joint American-French cooperative program. The definition and development of the flight hardware has been led by CNES (French Space Agency) and CEA (French Atomic Energy Commission). This mission will be the first of a series of six flights, about 1 per year, provided by NASA on the USMP carrier.

MEPHISTO will study the behavior of metals and semiconductors as they solidify to help determine the effect gravity has during solidification at the point where solid meets liquid, called the solid/liquid interface. Data gathered from MEPHISTO will be used to improve molten materials. For example, more resilient metallic alloys and composite materials could be designed for engines that will power future aircraft and spacecraft.

The cylindrical-shaped MEPHISTO furnace experiment will contain three identical rod-shaped samples of a tin-bismuth alloy. MEPHISTO will process the samples using two furnaces, one fixed and one moving. As a run begins, the mobile furnace will move outward from the fixed furnace, melting the samples. The mobile furnace then moves back toward the fixed furnace, and the sample resolidifies. The fixed furnace contains a stationary solid/liquid interface to be used as a reference for studying the mobile solid/liquid interface.

MEPHISTO has been designed to perform quantitative investigations of the solidification process by using several specific diagnosis methods. During the experiment runs, a small electrical voltage will constantly measure the temperature changes at the interface to verify solidification rates. During the last experimental run, electrical pulses will be sent through one sample, "freezing" the shape of the interface for post-mission analysis.

The MEPHISTO apparatus allows many cycles of solidification and remelting and is particularly well-adapted for long-duration missions. During the mission, scientists will compare the electrical signal to data from a SAMS sensor to see if the Shuttle's movement is disturbing the interface. They then can make adjustments to the experiments if necessary. Post-mission analysis of the space-solidified sample will allow correlation between the electrical measurements and changes in the sample.

Space Acceleration Measurement System (SAMS)
Scientific Investigator: Charles Baugher, MSFC, Huntsville, AL
Project Manager: R. De Lombard, Lewis Research Center, Cleveland, OH

The Space Acceleration Measurement System (SAMS) is designed to measure and record low-level acceleration during experiment operations. The signals from these sensors are amplified, filtered and converted to digital data before it is stored on optical disks and sent via downlink to the ground control center.

USMP-1 will be the first mission for two SAMS flight units in the cargo bay configuration. The two units each will support two remote sensor heads. Two heads will be mounted in the Lambda Point Experiment (LPE) and the other two heads will be mounted to the MPESS structure near the MEPHISTO furnace.

Some of the data will be recorded on optical disks in the SAMS units, while other data will be down-linked to the Marshall Space Flight Center's Payload Operations Control Center.

The down-linked SAMS data will be utilized during experiment operations by the principal investigators (PI) involved with LPE and MEPHISTO. The SAMS data also will be monitored by the SAMS project team.

The PIs will look for acceleration events or conditions that exceed a threshold where the experiment results could be affected. This may be, for example, a frequency versus amplitude condition, an energy content condition or simply an acceleration magnitude threshold. Experiment operations may be changed based on the observed microgravity environment.

SAMS flight hardware was designed and developed in-house by the NASA Lewis Research Center and Sverdrup Technology Inc. project team. The units have flown on STS-40, STS-43, STS-42, STS-50 and STS-47 missions.

ATTITUDE SENSOR PACKAGE (ASP)

STS-52 will carry the third Hitchhiker payload to fly in space. Hitchhikers are a part of Goddard Space Flight Center's (GSFC) Shuttle Small Payloads Project (SSPP). Hitchhiker provides quick-response, economical flights for small attached payloads that have more complex requirements than Get Away Special experiments.

The STS-52 Hitchhiker payload carries one foreign reimbursable experiment, the Attitude Sensor Package (ASP) experiment. This experiment was prepared by the In-Orbit Technology Demonstration Programme of the European Space Agency (ESA).

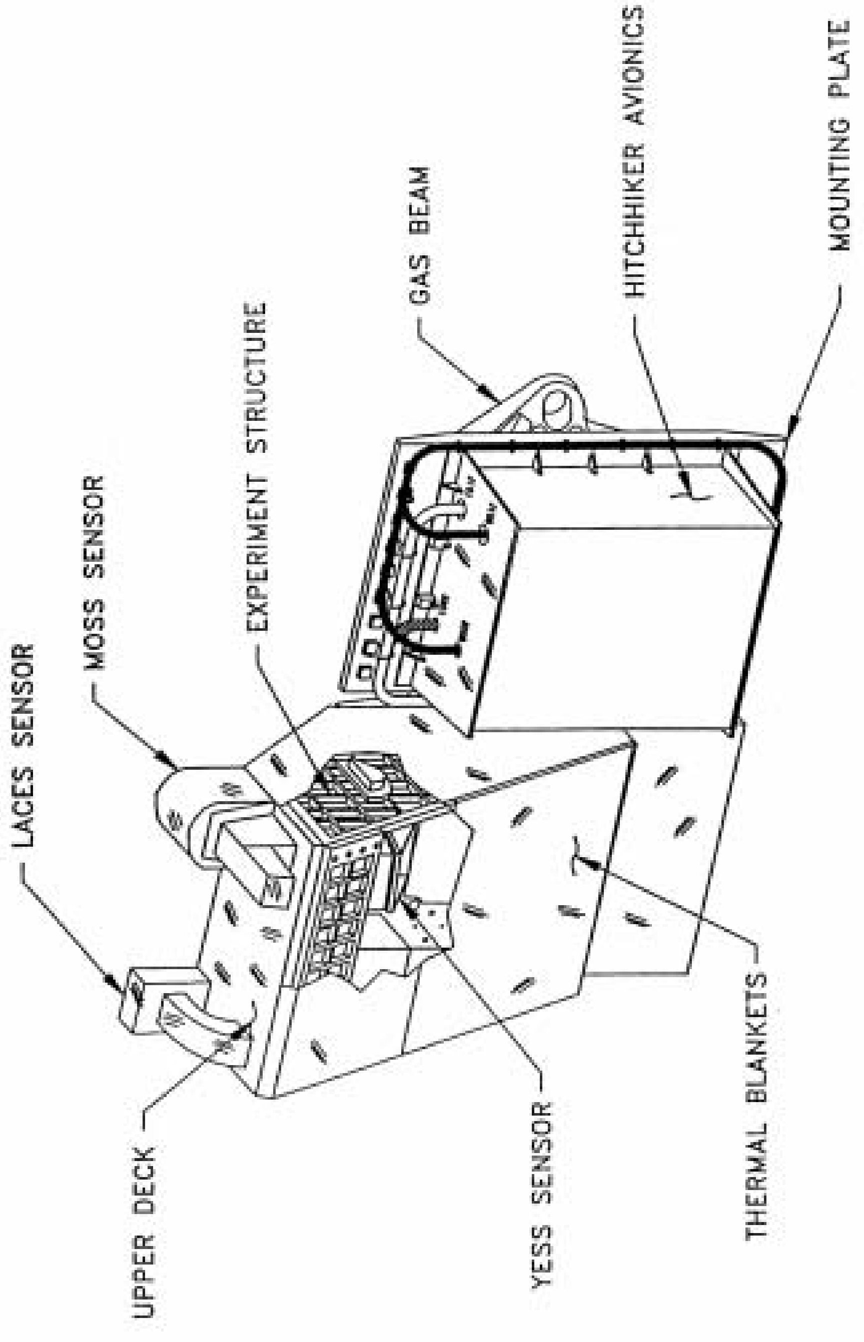
The ASP experiment consists of three unique spacecraft attitude sensors, an on board computer and a support structure. The primary sensor is the Modular Star Sensor (MOSS). The other two sensors are the Yaw Earth Sensor (YESS) and the Low Altitude Conical Earth Sensor (LACES). The ASP sensors and their support structure are assembled on a Hitchhiker small mounting plate. The Hitchhiker avionics, mounted to another small mounting plate, provides power and signal interfaces between the ASP experiment and the Shuttle.

Often the performance of the space instruments cannot be predicted accurately on Earth because of the lack of knowledge of and actual simulation of the space environment. The ASP experiment exposes these attitude sensors to actual space conditions, demonstrating their performance and accuracy. This flight experience will be evaluated by ESA for possible use of these sensors on future ESA programs.

During the mission, the ASP experiment will operate for 16 orbits from the Hitchhiker Payload Operations Control Center (POCC) located at GSFC, Greenbelt, MD. ESA personnel and contractors will operate their ground support equipment in the POCC during the Shuttle flight.

The SSPP is managed by Goddard for NASA's Office of Space Flight. The Hitchhiker Program, managed by the SSPP, performs overall mission management duties for Hitchhiker payloads flying on the NASA Shuttle, including experiment integration on the Shuttle and operations management during the flight.

Theodore C. Goldsmith is SSPP Project Manager. Chris Dunker is Goddard's ASP mission manager. The In-Orbit Technology Demonstration Programme Manager for ESA is Manfred Trischberger, the ESA ASP payload Manager is Roberto Aceti and the ESA Principal Investigator is Peter Underwood. The In-Orbit Technology Demonstration Programme is part of the European Space Technology and Engineering Center, Noordwijk, The Netherlands.



ASP CONFIGURATION

CANADIAN EXPERIMENTS (CANEX)

The Canadian Space Agency

The Canadian Space Agency (CSA) was formed in 1989 with a mandate to promote the peaceful use and development of space, to advance the knowledge of space through science and to ensure that space science and technology provide social and economic benefits for Canadians.

To meet these objectives, CSA coordinates a variety of programs involving space science, space technology, Space Station development, satellite communications, remote sensing and human space flight. An integral part of CSA, the Canadian Astronaut Program, supports space research and development in close cooperation with scientists and engineers in government, universities and the private sector. These investigations focus on space science, space technology and life sciences research carried out on Earth and in space.

Canadian Experiments-2 (CANEX-2)

CANEX-2 is a group of space technology, space science, materials processing and life sciences experiments which will be performed in space by Canadian Payload Specialist Dr. Steve MacLean during the STS-52 mission of Space Shuttle Columbia. Bjarni Tryggvason is a backup crew member and alternate to Dr. MacLean for this mission.

The potential applications of CANEX-2 space research include machine vision systems for use with robotic equipment in space and in environments such as mines and nuclear reactors. Other potential applications relate to the manufacturing of goods, the development of new protective coatings for spacecraft materials, improvements in materials processing, a better understanding of the stratosphere which contains the protective ozone layer, and greater knowledge of human adaptation to microgravity.

Many of these experiments are extensions of the work carried out by Dr. Marc Garneau as part of the CANEX group of experiments that helped form his 1984 mission.

Space Vision System Experiment (SVS)
Principal Investigator: Dr. H. F. Lloyd Pinkney, National Research Council of Canada, Ottawa, Ontario.

Space is a difficult visual environment with few reference points and frequent periods of extremely dark or bright lighting conditions. Astronauts working in space find it difficult to gauge the distance and speed of objects such as satellites.

The development of the Space Vision System (SVS), a machine vision system for robotic devices, such as the Canada arm, was undertaken to enhance human vision in the unfavorable viewing conditions of space. The SVS can provide information on the exact location, orientation and motion of a specified object. Dr. MacLean will evaluate an experimental Space Vision System for possible use in the Space Shuttle and in the construction of Space Station Freedom.

The Space Vision System uses a Shuttle TV camera to monitor a pattern of target dots of known spacing arranged on an object to be tracked. As the object moves, the SVS computer measures the changing position of the dots and provides a real-time TV display of the location and orientation of the object. This displayed information will help an operator guide the Canada arm or the Mobile Servicing System (MSS) when berthing or deploying satellites.

For the CANEX-2 experiments, target dots have been placed on the Canadian Target Assembly (CTA), a small satellite carried in the Space Shuttle's cargo bay. During the flight, a mission specialist will use the arm to deploy the CTA and take it through a series of maneuvers using the information displayed by the SVS. Dr. MacLean will evaluate SVS performance and investigate details that need to be considered to design a production model of the system.

Beyond its possible application as a computerized eye for the Space Shuttle, a system derived from the Space Vision System may be used to help construct and maintain the Space Station. In another application, an SVS-based system could guide small, remotely-operated space vehicles for satellite retrieval and servicing. On Earth, advances in machine vision could lead to improvements in the manufacturing of products, in auto plants for example, and to applications involving work in environments such as mines or nuclear reactors.

SPACE TECHNOLOGY AND SCIENCE EXPERIMENTS

Materials Exposure in Low-Earth Orbit (MELEO)
Principal Investigator: Dr. David G. Zimcik, Canadian Space Agency, Ottawa, Ontario.

Plastics and composite materials used on the external surfaces of spacecraft have been found to degrade in the harsh environment of space. Evidence suggests that this degradation is caused by interaction with atomic oxygen which induces damaging chemical and physical reactions. The result is a loss in mass, strength, stiffness and stability of size and shape.

The MELEO experiment is an extension of work performed by the CSA which began with the Advanced Composite Materials Experiment (ACOMEX) flown on Marc Garneau's 1984 mission. Researchers now want to extend the valuable baseline date obtained to further investigate the deterioration process, try new protective coatings and test materials designed for use on specific space hardware such as the Mobile Servicing System (MSS) for the Space Station Freedom and RADARSAT, the Canadian remote sensing satellite scheduled for launch in early 1995.

The MELEO experiment will expose over 350 material specimens mounted on "witness plates" on the Canada arm and analyzed after the mission. Typical spacecraft materials will be tested along with new developments in protective measures against atomic oxygen. The specimens will be exposed in the flight direction for at least 30 hours. Dr. MacLean periodically will photograph the specimens to record the stages of erosion. All materials will be returned to Earth for detailed examination.

The MELEO experiment uses active elements called Quartz Crystal Microbalances (QCMs), attached to the end of the Canada arm, to measure the erosion of material with a very high degree of accuracy. Their electrical functions are regulated by a controller located on the aft flight-deck of the Shuttle orbiter. Data will be recorded using the on- board Payload General Service Computer (PGSC). This will enable the Canadian Payload Specialist to have real-time readouts of the erosion data during the mission.

It is expected that the MELEO experiment will provide data on the performance of new materials exposed to the true space environment and provide information to be used in the development of effective ground-based space simulation facilities capable of testing and screening spacecraft materials in the laboratory.

Orbiter Glow-2 (OGLOW-2)
Principal Investigator: Dr. E. J. (Ted) Llewellyn, University of Saskatchewan, Saskatoon.

Photographs taken by astronauts have revealed a glow emanating from Shuttle surfaces facing the direction of motion. This phenomenon is thought to be caused by the impact of high-velocity atoms and the effect of the orbiter's surface temperature.

In the first OGLOW experiment, Dr. Marc Garneau successfully photographed the glow phenomenon. Computer analysis of these photographs and of corresponding video recordings revealed the bright areas to be concentrated around the Shuttle's tail section instead of around the entire Shuttle, as had been expected.

Additional data, obtained when Dr. Garneau took several photographs while the Shuttle's thrusters were firing, led to the need for an OGLOW-2 experiment. This experiment will explore in greater detail the gaseous reactions caused by the orbiter thrusters through the post-flight analysis of the thruster-induced glow spectrum.

Photographs of the Shuttle's tail, primarily while the thrusters are firing, will be taken. On-board TV cameras will obtain corresponding video recordings. The OGLOW-2 experiment also should determine when theoretical measurements taken from the Shuttle might be adversely affected by the glow.

As part of the experiment, Dr. MacLean will use newly developed equipment to photograph the Canadian Target Assembly with its different material surfaces. The OGLOW-2 experiment also will study the glow from the Earth's upper atmosphere.

Queen's University Experiment in Liquid-Metal Diffusion (QUELD)
Principal Investigator: Prof. Reginald W. Smith, Queen's University, Kingston, Ontario.

Atoms of any substance, whether liquid or solid, are in constant motion. Knowledge of the rate at which atoms move around and in between each other (diffusion) is important for a variety of industrial processes. On Earth, the effects of convection make it difficult to measure the actual degree of diffusion taking place within a substance. In space, where convection is eliminated, it is possible to obtain more accurate information.

The QUELD experiment will allow diffusion coefficient measurements of a number of liquid state metals. The QUELD apparatus contains two small electric furnaces in which over 40 specimens will be heated in tiny graphite crucibles until the test metals are molten. They will be allowed to diffuse for 30 minutes or more and then rapidly cooled to solidify the metals for post-flight analysis.

The researchers hope to use the data to help develop a general theory to predict the rate of diffusion for any metal in the liquid state, as well as provide fundamental information about the structure of liquid metals. This is expected to lead to creation of better crystals for use in the fabrication of computer microchips and radiation sensors and to the development of special alloys which cannot be made on Earth.

Sun Photo Spectrometer Earth Atmosphere Measurement (SPEAM-2)
Principal Investigator: Dr. David I. Wardle, Environment Canada, Toronto, Ontario.

The measurement of atmospheric structure and composition using space-based instruments has provided a vast new capability for environmental monitoring. SPEAM-2 will add to an expanding body of information about the stratosphere, the part of the upper atmosphere containing most of Earth's protective ozone layer.

The SPEAM-2 experiment comprises two measuring instruments and a control computer developed by the Atmospheric Environment Service of Environment Canada. The Sun Photo Spectrometer (SPS) will make multi-spectral measurements of ozone and nitrogen compounds which play an important role in controlling ozone balance especially in the presence of chlorine. Atmospheric transmission, or the degree to which light is absorbed in the Earth's atmosphere, also will be measured in the visible and near-infrared parts of the solar spectrum. This hand-held instrument will be aimed at the sun by Dr. MacLean during several sunset and sunrise periods.

The Airglow Imaging Radiometer (AIR) will observe atmospheric air glow from atmospheric molecular oxygen in several regions of the electromagnetic spectrum and possibly from OH radicals, highly reactive molecules composed of oxygen and hydrogen, which affect the ozone concentration in the stratosphere.

These measurements will provide information about the chemical processes which take place in the stratosphere and affect the protective ozone layer. SPEAM-2 data will complement other measurements including those from NASA's Solar Aerosol and Gas Experiment (SAGE) and other ground- based observations.

It is expected that the SPEAM-2 experiment will provide extremely useful information about the upper atmosphere and the capabilities of the new instruments. The engineering data and experience gathered will enable Canadian atmospheric scientists to make more effective use of future space platforms such as research satellites and Space Station Freedom.

Phase Partitioning in Liquids (PARLIQ)
Principal Investigator: Dr. Donald E. Brooks, Department of Pathology and Chemistry, University of British Columbia, Vancouver.

Phase partitioning is being studied as a way of separating, from complex substances, different kinds of cells which differ only subtly in their surface properties.

The process uses two types of polymers (compounds formed by repeated units of similar but not identical molecules) dissolved together in water. They form two solutions, called "phases", which react to one another like oil and vinegar, one floating up to lie on top of the other once they have been mixed and left to stand. When mixtures of small particles such as cells are added to the liquids, some are attracted to one of the phases, some to the other. Consequently, the liquids separate the cell types.

The astronaut will shake a container holding a number of chambers with solutions containing different mixtures of model cells visible through windows. The container then will be observed and photographed at short intervals as partitioning occurs. At the end of the experiment, the separated phases containing their cells will be isolated and returned to Earth. The effects of applying an electric field on the separation process also will be studied.

The ultimate objective is to increase the purity of the separated cells. On Earth, it is difficult to separate substances and achieve maximum purity using this process because of gravity-induced fluid flow. In microgravity, the combined forces acting on the liquids and the cells are entirely different from those on Earth, and the physics of the process can be better understood.

A phase partitioning experiment using the same apparatus was performed by Dr. Roberta Bondar and other crew members during her January 1992 mission. This investigation was itself an extension of an experiment carried out in 1985 on Shuttle mission 51D in which test solutions separated in a way that had not been observed previously. The results of this experiment will be of interest to medical researchers because the results apply to the separation and purification of cells involved in transplants and treatment of disease.

Space Adaptation Tests and Observations (SATO)
Principal Investigator: Dr. Alan Mortimer, CSA, Ottawa, Ontario.

Every flight by a Canadian astronaut includes research into human adaptation to space flight. Dr. MacLean's mission is no exception. The data obtained will supplement the results of similar experiments performed during the missions of Drs. Marc Garneau and Roberta Bondar. What follows are descriptions of the investigations which make up the SATO group of experiments.

Vestibular-Ocular Reflex Check
Investigator: Dr. Doug Watt, McGill University, Montreal, Quebec.

An experiment performed by Marc Garneau in October 1984 investigated the effect of weightlessness on the vestibulo-ocular reflex, an automatic response triggered by the vestibular system that keeps the eyes focused on a given object despite head motion. Although researchers expected at least a slight deterioration in the functioning of this reflex, systematic testing revealed no change.

Since these unexpected results were obtained several hours after launch, time during which considerable adaptation could have occurred, it is now necessary to test the vestibulo-ocular reflex at the time of entry into microgravity.

The payload specialist will use a hand-held target and by rotating the head back and forth, determine the ability of the eyes to track correctly.

Body Water Changes in Microgravity
Investigators: Dr. Howard Parsons, Dr. Jayne Thirsk and Dr. Roy Krouse, University of Calgary.

In the absence of gravity there is a shift of body fluids towards the head which leads to the "puffy face" syndrome observed in astronauts after several days of space flight. There also is a loss of water from the body early in a space flight. Preliminary results from Dr. Roberta Bondar's IML-1 mission indicate that there may be significant dehydration occurring.

This test will determine changes in total body water throughout the space flight. The payload specialist will ingest a sample of heavy water at the beginning and end of the mission, and saliva samples will be collected daily. Upon return, the samples will be analyzed to determine total body water.

The results of this experiment are important in developing nutritional protocols for long duration space flight and will contribute to the development of countermeasures to be used during re-entry.

Assessment of Back Pain in Astronauts
Investigator: Dr. Peter C. Wing, Head, Department of Orthopedic Surgery, University of British Columbia,, University Hospital, Vancouver.

More than two thirds of astronauts have reported experiencing back pain during space flight. The pain seems to be worst during the first few days in space. This may be due to the astronauts' total height increase of up to 7.4 cm as recently documented during Dr. Roberta Bondar's IML-1 mission.

The height increase in the absence of gravity results from spinal column lengthening and the flattening of the normal spinal curves. This probably results from an increase in the water content and thus, the height of the discs between the vertebrae of the spine. This in turn may result in an increase in the distance between the vertebrae and may cause pain from tension on soft tissue such as muscle, nerves and ligaments.
This experiment will continue the investigation of the causes of back pain in space which began during the IML-1 mission. The ultimate goal is to develop techniques to be used either before or during space flight to alleviate its effects. During the mission, Dr. Steve MacLean will measure his height and use a special diagram to record the precise location and intensity of any back pain. It is expected that the results of this experiment will lead to an increased understanding of back pain on Earth.

Illusions During Movement
Investigator: Dr. Doug Watt, McGill University, Montreal, Quebec.

Astronauts have experienced the disconcerting illusion that the floor is moving up and down while performing deep knee bends in space and after return to Earth.

The objective of this test is to determine when these illusions occur and to investigate how visual and tactile inputs may affect such illusions. For example, the payload specialist may hold onto a fixed object such as a seat while doing knee bends to see if that alters the illusion of the floor moving.

TANK PRESSURE CONTROL EXPERIMENT/THERMAL PHENOMENA

An important issue in microgravity fluid management is controlling pressure in on-orbit storage tanks for cryogenic propellants and life support fluids, particularly liquid hydrogen, oxygen and nitrogen. The purpose of the Tank Pressure Control Experiment/Thermal Phenomena (TPCE/TP) is to provide some of the data required to develop the technology for pressure control of cryogenic tankage.

TPCE/TP represents an extension of the data acquired in the Tank Pressure Control Experiment (TPCE) which flew on STS-43 in 1991. The flight of TPCE significantly increased the knowledge base for using jet-induced mixing to reduce the pressure in thermally stratified subcritical tanks. Mixing represents a positive means of limiting pressure build-up due to thermal stratification and may allow non-vented storage of cryogenics for some of the shorter duration missions.

Longer missions, however, will require venting and will likely use thermodynamic vent systems for pressure control. The efficient design of either active or passive pressure control systems will depend on knowledge of the thermodynamic processes and phenomena controlling the pressure build-up in a low-gravity environment.

The purpose of the reflight, TPCE/TP, is to focus on the thermal phenomena involved in the self-pressurization of subcritical tanks in a low-g environment.

New technology for managing fluids in low gravity will be required for future space systems, such as the Space Transfer Vehicle, Space Station Freedom, space exploration initiatives, serviceable satellites, hypervelocity aerospace vehicles and space defense systems.

Both TPCE and TPCE/TP are part of NASA's In-Space Technology Experiments Program (IN-STEP), managed by NASA's Office of Aeronautics and Space Technology. The TPCE/TP Project Manager is Richard Knoll, NASA Lewis Research Center, Cleveland. Lewis investigators proposed and are managing the reflight. M. M. Hasan from Lewis is the Principal Investigator. Boeing Aerospace Co., Seattle, Washington, developed the original flight hardware.

PHYSIOLOGICAL SYSTEMS EXPERIMENT

The Physiological Systems Experiment-02 (PSE-02) is a middeck payload resulting from a collaboration by Merck & Co., Inc., and the Center for Cell Research (CCR), a NASA Center for the Commercial Development of Space located at Pennsylvania State University.

Physiological systems experiments use microgravity-induced biological effects, such as bone loss, muscle atrophy, depressed hormone secretion, decreased immune response, cardiac deconditioning, neurovestibular disturbances or other changes to test pharmaceutical products or to discover new therapeutic agents.

PSE-02 will evaluate a compound being developed to treat osteoporosis. The experiment will test the ability of the compound to slow or stop bone loss induced by microgravity. Merck scientists will examine whether the lower gravity experienced on a space flight accelerates the rate at which bone mass is lost, compared to losses observed when a limb is immobilized on Earth.

The compound to be tested in PSE-02 is currently in large scale human clinical studies as a treatment for osteoporosis associated with menopause. In post-menopausal women, this loss is a consequence of estrogen depletion.

Today, 25 million Americans, primarily women, have the bone-thinning disease known as osteoporosis. Osteoporosis often progresses without symptoms or pain until a fracture occurs, typically in the hips, spine or wrist. Each year, it leads to more than 1.3 million fractures that can cause permanent disability, loss of independence or death.

PSE-02 could help determine if the compound will be useful in treating the bone loss caused by prolonged immobilization of weight-bearing limbs in bedridden or paralyzed patients. The experiment also may have direct application in space, as a preventative for bone loss that might effect astronauts on extended flights.

In this experiment, six healthy, adolescent, male, albino rats will be treated with the Merck developmental anti-osteoporotic compound prior to flight. An equivalent number of flight rats will remain untreated to serve as controls. The two groups will be housed in completely self- contained units called Animal Enclosure Modules (AEMs) during the flight. The AEMs will contain enough food and water for the duration of the mission. No interaction with the crew is required on orbit. A clear plastic cover on the AEM will permit the crew to visually inspect the condition of the rats.

The experiment protocol has been reviewed and approved by the Animal Care and Use Committees of both NASA and Merck. Veterinarians oversee selection, care and handling of the rats.

After the flight, tissues from the rats will be evaluated in a series of studies by teams of scientists from both Merck and the CCR. These studies are expected to last several months to a year.

Dr. W. C. Hymer is Director of the Center for Cell Research at Penn State and co-investigator for PSE. Dr. William W. Wilfinger is the CCR Director of Physiological Testing. Dr. Gideon Rodan of Merck & Co., Inc., is Principal Investigator.

HEAT PIPE PERFORMANCE EXPERIMENT (HPP)

The Heat Pipe Performance experiment is the latest in a series of tests to develop technology that will make it easier for a space vehicle to reject excess heat generated by its equipment and crew.

Current heat control technology - as found on the Shuttle orbiter, for example - uses a complex system of pumps, valves and radiators to dump waste heat into space. A fluid, Freon 21, circulates through a loop where heat is collected and then pumped between two flat plates that radiate the heat to space. But radiators can be damaged by orbital debris and mechanical pumping systems may not be reliable for longer missions.

A heat pipe system provides a simple, highly reliable way to reject heat. It is a closed vessel containing a fluid and does not have moving mechanical parts. Instead, it relies on the natural phenomenon of liquids absorbing heat to evaporate and releasing that heat when condensing. The waste heat generated by a spacecraft evaporates the liquid at one end of the heat pipe, and the vapor condenses and releases heat to space at the other end. Capillary action moves the fluid back to the evaporator end.

The Heat Pipe Performance experiment on STS-52 will evaluate the sensitivity of state-of-the-art heat pipes to large and small accelerations. It also will gather data on the force needed to 'deprime' (dry out) heat pipes and how long it takes them to recover.

Columbia's crew will test two designs for fluid return by capillary action: eight heat pipes with axial grooves and six with a fibrous wick. Some of the heat pipes consist of a copper vessel with water as the working fluid and the others of aluminum with Freon 113.

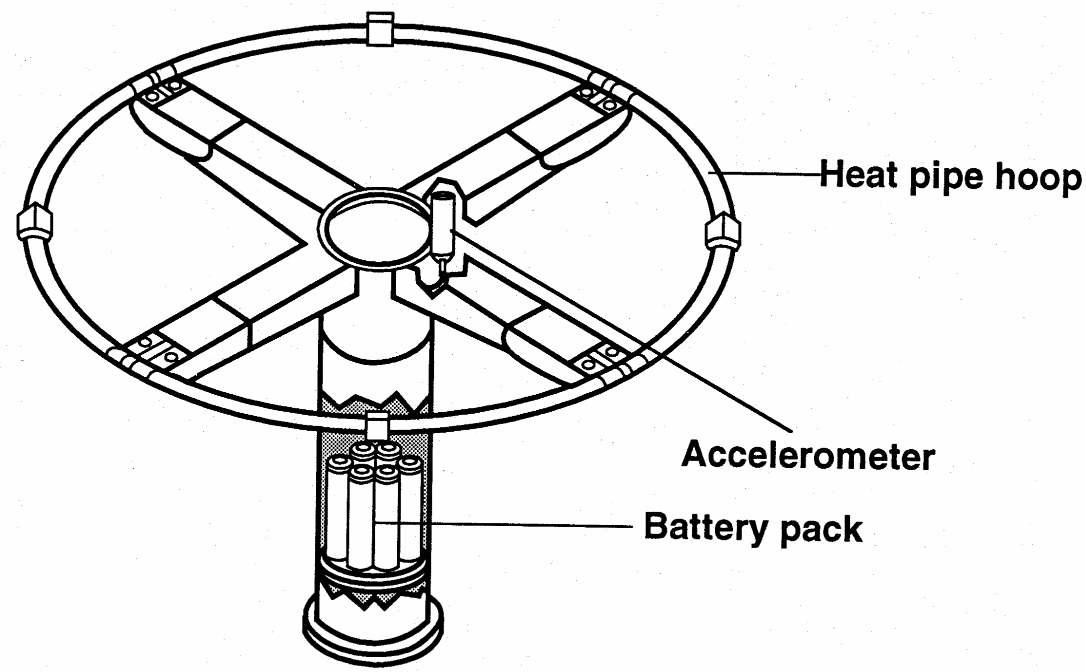
During the mission, one or two astronauts will assemble HPP in the orbiter's middeck area and conduct the tests. Four heat pipes will be evaluated in each experiment run by rotating them on a cross-shaped frame. A motor on an instrument unit mounted to the middeck floor will drive the assembly. A battery-powered data logger will record the data.

The HPP device will spin at various rates to simulate different levels of spacecraft acceleration and body forces. Crew members also will do 're-wicking' tests to measure the time needed for the heat pipes to reprime and operate after excessive spin forces make them deprime. Mission plans call for 18.3 hours of HPP flight tests with another 4.5 hours needed for setup and stowage.

Researchers will carefully check the results of the tests with existing computer models and static ground tests to see how well they can predict heat pipe performance in microgravity.

Heat Pipe Performance is part of NASA's In-Space Technology Experiments Program (IN-STEP) that brings NASA, the aerospace community and universities together to research potentially valuable space technologies using small, relatively inexpensive experiments.

NASA's Office of Aeronautics and Space Technology selects the experiments and manages the program. Hughes Aircraft Co. designed and built the HPP hardware. The experiment is managed at NASA's Goddard Space Flight Center, Greenbelt, MD.



HEAT PIPE PERFORMANCE EXPERIMENT

SHUTTLE PLUME IMPINGEMENT EXPERIMENT

The Shuttle Plume Impingement Experiment (SPIE) will record measurements of atomic oxygen and contamination from Shuttle thruster firings during STS-52.

With sensors located at the end of Columbia's mechanical arm, SPIE will support the CANEX-2 MELEO experiment as it exposes materials to the atomic oxygen in the vicinity of Columbia. During these operations, the mechanical arm will be positioned to place the SPIE sensor package in the direction of travel of Columbia, and the atomic oxygen levels will be recorded on a portable computer in the Shuttle cabin.

To measure contamination from Columbia's steering jets, the SPIE package at the end of the arm will be positioned above the nose of the Shuttle and a large or primary reaction control system (RCS) jet will be fired in its vicinity. Quartz Crystal Microbalances are the sensors used to measure the contaminants. In addition, any particles ejected by the thrusters will be collected via a sticky piece of Kapton material that is part of the sensor package.

Measurements from the quartz sensors will be recorded on the Payload and General Support Computer (PGSC), a portable lap-top computer in the crew cabin of Columbia, for later analysis on the ground. Measurements of the amount and kinds of contamination produced by thruster firings from the Shuttle will assist designers in assessing the materials planned for use in constructing Space Station Freedom.

Contamination will be a part of space station operations because the Shuttle will fire its thrusters as it docks and departs from the station on each visit. Designers want to know what and how much contamination should be planned for in building Freedom. The SPIE principal investigator is Steve Koontz of the Non-Metallic Materials Section in the Structures and Mechanics Division at the Johnson Space Center, Houston.

COMMERCIAL MDA ITA EXPERIMENTS

NASA's Office of Commercial Programs is sponsoring the Commercial MDA ITA Experiments (CMIX) payload, with program management provided by the Consortium for Materials Development in Space (CMDS). CMDS is one of NASA's 17 Centers for the Commercial Development of Space (CCDS). CMDS is based at the University of Alabama in Huntsville (UAH).

Flight hardware for the payload, including four Materials Dispersion Apparatus (MDA) Minilabs, is provided by Instrumentation Technology Associates, Inc. (ITA), Exton, Penn., an industry partner of the UAH CMDS.

ITA has a commercial agreement with the UAH CMDS to provide its MDA hardware for five Shuttle missions. The arrangement is a "value exchange" by which the MDA will be flown in exchange for a designated amount of MDA capacity provided to NASA's CCDS researchers. The agreement is for a 5-year period or until the five flight activities are complete, whichever comes first.

The MDA was developed by ITA as a commercial space infrastructure element and as such, is in support of the Administration's and NASA's Commercial Development of Space initiatives. Financed with support from private sector resources over the past 5 years, the MDA hardware provides generic turnkey space experiments equipment for users who want to conduct suitable science in the microgravity environment of space. The company performs the integration and documentation, thus freeing the user to concentrate on the experiment.

The objective of the CMIX payload is to provide industry and CCDS users with low-cost space experimentation opportunities, thereby supporting one of the objectives of the NASA CCDS program to provide commercial materials development projects that benefit from the unique attributes of space.

The MDA was initially developed to grow protein crystals in space. However, since flying on two Shuttle missions and several suborbital rocket flights, use of the MDA has been expanded to include other research areas, including thin-film membrane formation, zeolite crystal growth, bioprocessing and live test cells. During the STS-52 mission, 31 different types of experiments will be conducted in these research areas.

The goal of the protein crystal growth experiments is to produce larger, more pure crystals than can be produced on Earth. The pharmaceutical industry will use such crystals to help decipher the structure of a protein using X-Ray crystallographic analysis. The principal commercial application of such data is in the development of new drugs or treatments.

Data collected from experiments in thin-film membrane formation will be used in gaining an understanding of membrane structures applicable to producing membranes made on the ground. The microgravity environment may be used to develop a more uniform membrane structure, specifically one with few irregularities and with uniform thickness and internal structure. Potential commercial applications of membranes produced in microgravity exist in areas such as gas separation, biotechnology, pollution control and waste stream recovery.

Results from zeolite crystal growth experiments are applicable in improving the manufacturing of zeolites on Earth because those found in nature and made by man are small and do not feature uniform molecular structures. Zeolites are a class of minerals whose crystal structure is porous rather than solid. Because of this, zeolites are full of molecular size holes that can be used as sieves. Synthetic zeolites are used by the petrochemical industry for catalytic cracking of large hydrocarbon molecules to increase the yield of gasoline and other products. Zeolites also are used to clean up low-level nuclear wastes and other hazardous wastes.

Bioprocessing experiments will provide knowledge on benefits from space processing and on how to improve bioprocessing efforts on Earth. One example is the use of microgravity for self-assembly of macromolecules. This type of research has potential in the development of new implant materials for heart valves, replacement joints, blood vessels and replacement lenses for the human eye. Another commercial application exists with the assembly of complex liposomes and virus particles to target specific drugs to treat cancer.

Recently modified to accommodate live test cells, the MDAs also will carry several human and mouse cell types. Information from live test cells will be used in identifying low-response cells for potential development of pharmaceuticals targeted at improving the undesirable effects of space travel.

In addition to the 31 CCDS- and industry-sponsored experiments, ITA is donating five percent of the four MDA Minilabs to high school students, for a total of seven experiments. Among these student-designed experiments are investigations of seed germination, brine shrimp growth and crystal formation in the low-gravity of space. ITA sponsors these experiments as part of its space educational program.

The MDA Minilab is a brick-sized materials processing device that has the capability to bring into contact and/or mix as many as 100 different samples of multiple fluids and/or solids at precisely timed intervals. The MDA operates on the principles of liquid-to-liquid diffusion and vapor diffusion (osmotic dewatering).

Throughout STS-52, the four MDA Minilabs, each consisting of an upper and lower block, will remain in the thermally-controlled environment of a Commercial Refrigerator/Incubator Module (CRIM). The upper and lower blocks, misaligned at launch, will contain an equal number of reservoirs filled with different substances. When the experiment is activated, blocks will be moved in relation to each other, and the self-aligning reservoirs will align to allow dispersion (or mixing) of the different substances.

To complete microgravity operations, the blocks again will be moved to bring a third set of reservoirs to mix additional fluids or to fix the process for selected reservoirs. A prism window in each MDA allows the crew member to determine alignment of the blocks.

To activate the four MDAs, the crew will open the CRIM door to access the MDAs and the MDA Controller and Power Supply. Activation will occur simultaneously and is required as early as possible in the mission, followed by minimum microgravity disturbances for a period of at least 8 hours. The crew will operate switches to activate each MDA and once all the MDAs are activated, the CRIM door will be closed.

Deactivation of each MDA will occur at different intervals. For example, one MDA will automatically deactivate within minutes of being activated. Whereas one will not deactivate at all. Deactivation of the other two MDAs will occur later in the mission. Once the Shuttle lands, the MDA Minilabs will be deintegrated, and the samples will be returned to the researchers for post-flight analyses.

Principal Investigator for the CMIX payload is Dr. Marian Lewis of the UAH CMDS. Dr. Charles Lundquist is Director of the UAH CMDS. John Cassanto, President, Instrumentation Technology Associates, Inc., is co- investigator.

CRYSTAL VAPOR TRANSPORT EXPERIMENT

NASA's Office of Commercial Programs is sponsoring the Crystal Vapor Transport Experiment (CVTE) payload, developed by Boeing Defense & Space Group, Missiles & Space Division, Kent, Wash.

The Boeing-designed crystal growth experiment will enable scientists to learn more about growing larger and more uniform industrial crystals for use in producing faster and more capable semiconductors. The CVTE equipment designed to produce these crystals is a precursor to the kinds of scientific work planned to take place aboard Space Station Freedom later this decade.

This experiment is important to the semiconductor industry because the ability of semiconductors to process and store information is dependent on the quality of the crystals used. Thus, large, uniform crystals grown in space may lead to greater speed and capability of computers, sensors and other electronic devices.

Although materials scientists have succeeded in producing very high-quality silicon found in today's computer chips, certain effects caused by Earth's gravitational pull - - known as thermal convection, buoyancy and sedimentation -- have limited scientists' ability to produce more advanced materials on Earth.

Thermal convection is turbulence induced by variations in densities caused by the temperature differences that occur in a material when it's heated. Buoyancy and sedimentation is a similar phenomenon, created by Earth's gravitational pull, that makes less dense materials rise (buoyancy) and denser materials sink (sedimentation). Because of these gravity-induced phenomena, crystals grown on Earth are smaller and less ordered, containing imperfections that limit the capability of transistors, sensors and other types of electronic devices.

In the microgravity environment of space, the Boeing CVTE system will attempt to grow purer and more uniform crystals using a cadmium telluride compound and a process called vapor transport.

The cadmium telluride compound is a solid, sealed inside a glass tube placed inside the CVTE furnace and heated to 850 degrees Celsius. When heated, the compound evaporates and forms two gaseous materials: cadmium and tellurium. This process is reversed during crystallization. Both evaporation and crystallization processes occur in the CVTE glass tube.

Cadmium telluride vaporizes at one end of the glass tube and crystallizes at the other. By carefully controlling the temperatures and temperature profile inside the glass tube, large single crystals can be produced. The high temperature used in this experiment is expected to produce samples as large in diameter as a dime -- whereas previous crystal- growth facilities only have been able to grow samples about the size of a pencil eraser.

Unlike previous, fully automated crystal-growth experiments conducted in space, the Boeing experiment will be tended by the orbiter crew. The CVTE system has a transparent window allowing the crew to observe the growing crystal and adjust its position and furnace temperature to achieve optimum growth.

STS-52 astronauts Bill Shepherd and Mike Baker trained with Boeing scientists to learn to work the CVTE equipment. By having the astronauts monitor and observe the on-orbit crystal growth, it is hoped that they might be able to better interpret the resulting data and ultimately help industry produce superior crystals.

In addition to the astronauts monitoring the experiment, NASA still cameras will document, every several minutes, the rate of crystal growth. Scientists later will use these photos to further analyze the crystal's growth.

The CVTE system is accommodated in a structure about the size of a telephone booth, which will be installed in the galley area of the Shuttle orbiter mid-deck.

Principal investigators for CVTE are Dr. R. T. Ruggeri and Dr. Ching-Hua Su, both of Boeing. The CVTE Program Manager is Barbara Heizer and the Chief Engineer is David Garman, both of Boeing.

COMMERCIAL PROTEIN CRYSTAL GROWTH

The Commercial Protein Crystal Growth (CPCG) payload is sponsored by NASA's Office of Commercial Programs. Program management and development of the CPCG experiments is provided by the Center for Macromolecular Crystallography (CMC), a NASA Center for the Commercial Development of Space (CCDS) based at the University of Alabama at Birmingham. The CMC's goal is to develop the technology and applications needed for successful space-based protein crystal growth (PCG).

Metabolic processes involving proteins play an essential role in the living of our lives from providing nourishment to fighting disease. Protein crystal growth investigations are conducted in space because space-grown crystals tend to be larger, purer and more highly structured than their ground- based counterparts. Having high-quality protein crystals to study is important because they greatly facilitate studies of protein structures. Scientists want to learn about a protein's three-dimensional structure to understand how it works, how to reproduce it or how to change it. Such information is a key to developing new and more effective pharmaceuticals.

The technique most-widely used to determine a protein's three-dimensional structure is X-Ray crystallography, which needs large, well-ordered crystals for analysis. While crystals produced on Earth often are large enough to analyze, usually they have numerous gravity-induced flaws. By comparison, space-grown crystals tend to be purer and have more highly-ordered structures, significantly enhancing X-Ray crystallography studies. Besides the increased size and quality, space-grown crystals are important because they may be the first crystals large enough to reveal their structure through X-Ray analysis.
With the tremendous role that proteins play in everyday life, research in this area is quickly becoming a viable commercial industry. In fact, the profit potential for commercial applications has attracted firms in the pharmaceutical, biotechnological and chemical industries. In response to industry interest, the CMC has formed affiliations with a variety of companies that are investing substantial amounts of time, research and funding in developing protein samples for use in evaluating the benefits of microgravity.

For the past 10 years, exponential growth in protein pharmaceuticals has resulted in the successful use of proteins such as insulin, interferons, human growth hormone and tissue plasminogen activator. Pure, well-ordered protein crystals of uniform size are in demand by the pharmaceutical industry as tools for drug discovery and drug delivery.

Structural information gained from CPCG activities can provide, among other information, a better understanding of the body's immune system, and ultimately aid in the design of safe and effective treatment for disease and infections. For these reasons, CPCG crystal structure studies have been conducted on 7 Shuttle missions starting in 1988.

During 1991 and 1992, other CPCG experiments were conducted on three Shuttle missions, and successful results were obtained using a CMC-developed hardware configuration know as the Protein Crystallization Facility (PCF). These efforts focused on the production of relatively large quantities of crystals that were pure and uniform in size. The space-grown crystals were much larger than their Earth- grown counterparts.

On STS-52, the CPCG flight hardware will consist of the PCF and the third flight of a newly-designed, "state-of-the- art" Commercial Refrigerator/Incubator Module (CRIM). Its thermal profile is programmed prior to launch, and it monitors and records CRIM temperatures during flight.

The objectives for producing protein crystals using the PCF hardware are to grow them in large batches and to use temperature as the means to initiate and control crystal growth. Using temperature as an activator in the microgravity environment of space is advantageous because essentially no temperature-induced convection currents are generated to interfere with protein crystal growth.

The PCF, as used in two past missions, comprises four plastic cylinders. Each PCF cylinder is encapsulated within individual aluminum containment tubes supported by an aluminum structure. Prior to launch, the cylinders will be filled with protein solution and mounted into a CRIM. Each cylinder lid will pass through the left wall of the aluminum structure and come into contact with a temperature-controlled plate inside the CRIM. As configured for the STS-52 mission, the PCF will comprise 50-milliliter cylinders.

Shortly after achieving orbit, the crew will activate the experiment by initiating the pre-programmed temperature profile. The CRIM temperature will be changed gradually over several days to cause the protein solution to form protein crystals. The change in CRIM temperature will be transferred from the temperature-controlled plate through the cylinder lids to the protein solution.

Changing the solution temperature will allow crystals to form and based on previous experience, these crystals will be well-ordered due to a reduction in the damaging effects of the Earth's gravity. Once activated, the payload will not require any further crew interaction except for periodic monitoring, nor will it require any modifications for landing.

Due to the protein's short lifetime and the crystals' resulting instability, the payload will be retrieved from the Shuttle within 3 hours of landing and returned to the CMC for post-flight analyses. The crystals will be analyzed by morphometry to determine size distribution and absolute/relative crystal size. They also will be analyzed with X-Ray crystallography and biochemical assays of purity to determine internal molecular order and protein homogeneity.

The CPCG activities associated with the STS-52 mission are sponsored by NASA's Office of Commercial Programs. Lead investigators for the experiment include CMC Director Dr. Charles Bugg, CMC Deputy Director Dr. Lawrence DeLucas and CMC Associate Director Dr. Marianna Long.

Principal Investigators for CVTE are Dr. R. T. Ruggeri and Dr. Ching-Hua Su, both of Boeing. The CVTE Program Manager is Barbara Heizer and the Chief Engineer is David Garman, both work for Boeing.

STS-52 CREWMEMBERS

STS052-S-001 -- These five NASA astronauts and a Canadian payload specialist are assigned to the STS-52 flight aboard Columbia, Orbiter Vehicle (OV) 102, scheduled for later this year. Pictured on the back row are (left to right) pilot Michael A. Baker, mission commander James D. Wetherbee, and payload specialist Steven G. MacLean. In the front row are (left to right) mission specialists Charles Lacy Veach, Tamara E. Jernigan and William M. Shepherd. Crewmembers are wearing launch and entry suites (LESs) with the flags of the United States (U.S.) and Canada displayed behind them. MacLean represents the Canadian Space Agency (CSA). Portrait made by NASA JSC contract photographer Scott A. Wickes.

BIOGRAPHICAL DATA

JAMES (JIM) D. WETHERBEE, 39, U.S. Navy Commander, is Commander of Columbia's 13th space mission. Selected to be an astronaut in 1984, Wetherbee, from Flushing, NY, is making his second Shuttle flight.

Wetherbee served as Pilot on Columbia's STS-32 mission in January 1990 to rendezvous with and retrieve the Long Duration Exposure Facility and to deploy a Navy communications satellite.

A graduate of Holy Family Diocesan High School in South Huntington, NY, in 1970, Wetherbee received a bachelor of science degree in Aerospace Engineering from the University of Notre Dame in 1974.

He was commissioned in the U.S. Navy in 1975 and was designated a Naval Aviator in 1976. He has logged more than 3,500 hours flying time in 20 different types of aircraft. His first Shuttle mission lasted 261 hours.

MICHAEL (MIKE) A. BAKER, 38, U.S. Navy Captain, is Pilot of STS-52. From Lemoore, Calif., he was selected as an astronaut candidate in 1985 and flew his first Shuttle mission aboard Atlantis' STS-43 mission in August 1991.

As a crewmember on that flight, Baker helped in conducting 32 experiments as well as the primary mission to deploy a Tracking and Data Relay Satellite.

Baker graduated from Lemoore Union High School in 1971 and received a bachelor of science degree in Aerospace Engineering from the University of Texas in 1975.

He completed flight training in 1977 and has logged more than 3,600 hours flying time in almost 50 types of aircraft. Baker logged more than 213 hours in space on his first Shuttle mission.

CHARLES L. (LACY) VEACH, 48, is Mission Specialist 1. Prior to being selected as an astronaut in 1984, he served as an instructor pilot in the Shuttle Training Aircraft used to train pilot astronauts to land the Space Shuttle. Veach from Honolulu, Haw., previously was a mission specialist on STS-39 in April 1991.

Veach was responsible for operating a group of instruments in support of the unclassified Department of Defense mission aboard Discovery to better understand rocket plume signatures in space as part of the Strategic Defense Initiative.

A graduate of Punahou School in Honolulu, Veach received a bachelor of science degree in Engineering Management from the U.S. Air Force Academy in 1966.

He was commissioned in the Air Force after graduation and received his pilot wings at Moody AFB, GA, in 1967. Veach has logged more than 5,000 hours in various aircraft. His first Shuttle mission lasted more than 199 hours.

BIOGRAPHICAL DATA

WILLIAM M. SHEPHERD, 43, Navy Captain, is Mission Specialist 2. He was selected as an astronaut in 1984 and is from Babylon, NY. STS-52 is Shepherd's third Space Shuttle flight.

He served as a mission specialist on Atlantis' STS-27 mission, a Department of Defense flight in December 1988. His second flight also was as a mission specialist on STS-41, a Discovery flight in October 1990 to deploy the Ulysses spacecraft designed to explore the polar regions of the Sun.

Shepherd graduated from Arcadia High School, Scottsdale, AZ, in 1967 and received a bachelor of science degree in Aerospace Engineering from the Naval Academy in 1971. In 1978 he received the degrees of Ocean Engineer and master of science in Mechanical Engineering from the Massachusetts Institute of Technology.

Prior to joining NASA, Shepherd served with the Navy's Underwater Demolition Team, Seal Team and Special Boat Unit. He has logged more than 203 hours in space.

TAMARA (TAMMY) E. JERNIGAN, 33, is Mission Specialist 3. Born in Chattanooga, TN, she was selected to be an astronaut in 1985. She first flew on Columbia's STS-40 Spacelab Life Sciences-1 mission.

As a mission specialist, Jernigan participated in experiments to better understand how the human body adapts to the space environment and then readapts to Earth's gravity. The Spacelab mission was the first dedicated to life sciences aboard the Shuttle.

She graduated from Santa Fe High School in Santa Fe Springs, Calif., in 1977. She received a bachelor of science degree in Physics and a master of science degree in Engineering Science from Stanford University in 1981 and 1983. Jernigan also received a master of science degree in Astronomy from the University of California-Berkeley in 1985 and a doctorate in Space Physics and Astronomy from Rice University in 1988.

Prior to becoming an astronaut, Jernigan worked in the Theoretical Studies Branch at NASA's Ames Research Center. With her first Shuttle mission, Jernigan has logged more than 218 hours in space.

STEVEN (STEVE) GLENWOOD MACLEAN, 37, is Payload Specialist 1. Born in Ottawa, Ontario, he will be making his first Shuttle flight.

MacLean attended primary and secondary school in Ottawa and received a bachelor of science degree in Honours Physics and doctorate in Physics from York University in 1977 and 1983, respectively.

He was one of six Canadian astronauts selected in December 1983. He was designated as the payload specialist to fly with the CANEX-2 set of Canadian experiments manifested on the STS-52 flight.

MacLean is currently actively involved in the development of space technology, space science, materials processing and life sciences experiments that he will perform in space on the mission. He is astronaut advisor to the Strategic Technologies in the Automation and Robotics Program and Program Manager of the Advanced Space Vision System being flown on the mission.

MISSION MANAGEMENT FOR STS-52

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Cary H. Rutland	Manager, Solid Rocket Booster Project
Parker Counts	Manager, External Tank Project
R. E. Valentine	Mission Manager, USMP-1
Sherwood Anderson	Asst. Mission Manager
Dr. S. L. Lehoczky	Mission Scientist, USMP-1
Dr. M. Volz	Asst. Mission Scientist
Lyne Luna	Payload Operations Lead
Rose Cramer	Payload Operations Lead

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Giovanni Rum	Program Manager, IRIS, Italian Space Agency
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Bjarni V. Tryggvason	Alternate Payload Specialist And Payload Operations Director

SHUTTLE FLIGHTS AS OF OCTOBER 1992

50 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 25 SINCE RETURN TO FLIGHT

OV-102 Columbia (12 flights)	OV-099 Challenger (10 flights)	OV-103 Discovery (14 flights)	OV-104 Atlantis (12 flights)	OV-105 Endeavour (2 flights)
		STS-42 01/22/92 - 01/30/92		
		STS-48 09/12/91 - 09/18/91		
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-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-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-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-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-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-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-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