NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION
STS-62

PRESS KIT
MARCH 1994

UNITED STATES MICROGRAVITY PAYLOAD-2

STS-62 INSIGNIA

STS062-S-001 **--** *The STS-62 insignia depicts the world's first reusable spacecraft on its sixteenth flight. Columbia is in its entry-interface attitude as it prepares to return to Earth. The primary mission objectives of STS-62 include the United States Microgravity Payload (USMP-2) and the Office of Aeronautics and Space Technology (OAST-2) payloads. These payloads represent a multifaceted array of space science and engineering experiments. The varied hues of the rainbow on the horizon connote the varied, but complementary, nature of all the payloads united on this mission. The upward-pointing vector shape of the insignia is symbolic of America's reach for excellence in its in its unswerving pursuit to explore the frontiers of space. The brilliant sunrise just beyond Columbia suggests the promise that research in space holds for the hopes and dreams of future generations. The STS-62 insignia was designed by Mark Pestana.*

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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CONTENTS

RELEASE: 94-25

UNITED STATES MICROGRAVITY PAYLOAD MAKES SECOND FLIGHT

In a mission which reflects all the ways space exploration is helping reshape planet Earth, Shuttle Columbia is set to take off on a 2-week mission during which the five member crew will conduct dozens of experiments that run the gamut of space research -- from materials processing, to biotechnology, to advanced technology to environmental monitoring.

Leading the STS-62 crew will be Mission Commander John H. Casper who will be making his third space flight. Pilot for the mission is Andrew M. Allen who will be making his second space flight. Pierre J. Thuot is mission specialist 1 (MS1); Charles D. (Sam) Gemar is mission specialist 2 (MS2) and Marsha S. Ivins is mission specialist 3 (MS3) -- all of whom will be making their third space flights.

Launch of Columbia on the STS-62 mission currently is scheduled for no earlier than March 3, 1994, at 8:54 a.m. EST. The planned mission duration is 13 days, 23 hours and 4 minutes. Launch of Columbia at the opening of the window on March 3 would produce a landing at 7:58 a.m. EST on March 17 at Kennedy Space Center's Shuttle Landing Facility. STS-62 will be the 16th flight of Space Shuttle Columbia and the 61st flight of the Space Shuttle system.

The 14-day mission is the latest in a series of Extended Duration Orbiter (EDO) flights which will provide additional information for on-going medical studies that assess the impact of long-duration spaceflight, 10 or more days, on astronaut health, identify any operational medical concerns and test countermeasures for the adverse effects of weightlessness on human physiology.

The United States Microgravity Payload (USMP) will be making its second flight aboard the Space Shuttle. The USMP flights are regularly scheduled on Shuttle missions to permit scientists access to space for microgravity and fundamental science experiments which cannot be duplicated on Earth and provide the foundation for advanced scientific investigations that will be done on the international space station.

On USMP-2, two of the experiments will focus on studies which could lead to better, faster semiconductors. Another experiment will look at one of the most interesting areas of study in physics -- the critical point where a fluid is simultaneously a gas and a liquid -- to gather information on a fundamental theory which has widespread applications on Earth.

Another experiment will use the space laboratory to examine a phenomena that occurs on Earth -- the formation of dendrites -- which on Earth can determine the strength and durability of steel, aluminum and superalloys used in the production of automobile and aircraft components.

The six OAST-2 experiments will obtain technology data to support future needs for advanced satellites, sensors, microcircuits and the space station. Data gathered by the OAST-2 experiments could lead to satellites and spacecraft that are cheaper, more reliable and able to operate more efficiently.

STS-62 will help scientists calibrate sensitive ozone- detecting instruments with the sixth flight of the Shuttle Solar Backscatter Ultraviolet (SSBUV) Instrument. This highly calibrated tool is used to check data from ozone-measuring instruments on free-flying satellites -- NASA's Total Ozone Mapping Spectrometer (TOMS) and Upper Atmosphere Research Satellite (UARS) and the National Oceanic and Atmospheric Administration NOAA-9 and NOAA-11 satellites.

The Protein Crystal Growth (PCG) experiments and the Commercial Protein Crystal Growth (CPCG) experiments aboard Columbia will help scientists understand the growth of crystals to study the complex molecular structures of important proteins. By knowing the structure of specific proteins, scientists can design new drug treatments for humans and animals and develop new or better food crops.

NASA's efforts in the important field of biotechnology are represented by the fourth flight of the Physiological Systems Experiment which is designed to evaluate pharmaceutical, agricultural or biotechnological products, and the first flight of the Biotechnology Specimen Temperature Controller (BSTC), designed to test the performance of a temperature control device being developed for use with the Bioreactor, a cell- culture growth device. Also flying again on the Shuttle is the Commercial Generic Bioprocessing Apparatus (CGBA) payload which will support more than 15 commercial life science investigations that have application in biomaterials, biotechnology, medicine and agriculture.

The Middeck 0-Gravity Dynamics Experiment (MODE) will make its second flight on STS-62. MODE investigates how the microgravity of space flight influences the behavior of large space structures. The MODE test article can be configured in different shapes typical of space structural forms-- the truss of a space station, for example -- to help engineers develop and verify an analytical modeling capability for predicting the linear and nonlinear modal characteristics of space structures in a microgravity environment. MODE also will gather force measurements of nominal, crew-induced disturbance loads on the Shuttle.

Astronauts will demonstrate a new magnetic end effector and grapple fixture design for the Shuttle's Canadian-built robot arm that engineers believe will increase the arm's dexterity and alignment accuracy, provide operators with a sense of touch and allow the use of more compact "handles" on satellites and other Shuttle payloads.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is now available through a new satellite system, Spacenet-2, Transponder 5, located at 69 Degrees West Longitude with horizontal polarization. Frequency is 3880.0 MHz, audio is 6.8 MHz.

The schedule for television transmissions from the Shuttle orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Dryden Flight Research Center, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. 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 report 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 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 per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-62 QUICK LOOK

Launch Date/Site:	March 3, 1994/Kennedy Space Center - Pad 39B
Launch Time:	8:54 a.m. EST
Orbiter:	Columbia (OV-102) - 16th Flight
Orbit/Inclination:	160 nautical miles/39 degrees
Mission Duration:	13 days, 23 hours, 04 minutes
Landing Time/Date:	7:58 a.m. EST, March 17, 1994
Primary Landing Site:	Kennedy Space Center, FL
Abort Landing Sites:	Return to Launch Site: KSC, FL Trans-Atlantic Abort Landing: Ben Guerir, Morocco Moron, Spain Zaragoza, Spain Moron, Spain Zaragoza, Spain Abort Once Around: Edwards AFB, CA
Crew:	John Casper, Commander (CDR) Andrew Allen, Pilot (PLT) Pierre Thuot, Mission Specialist 1 (MS1) Sam Gemar, Mission Specialist 2 (MS2) Marsha Ivins, Mission Specialist 3 (MS3)
Cargo Bay Payloads:	United States Microgravity Payload-2 (USMP-2) Office of Aeronautics and Space Technology-2 (OAST-2) Dexterous End Effector (DEE) Shuttle Solar Backscatter Ultraviolet/A (SSBUV/A) Limited Duration Space Environment Candidate Materials Exposure (LDCE)
In-Cabin Payloads:	Protein Crystal Growth (PCG) Experiments Physiological System Experiment (PSE) Commercial Protein Crystal Growth (CPCG) Commercial Generic Bioprocessing Apparatus (CGBA) Middeck 0-Gravity Dynamics Experiments (MODE) Bioreactor Demonstration System (BDS): Biotechnology Specimen Temperature Controller (BSTC)
Other:	Air Force Maui Optical Site Calibration Test (AMOS)

Detailed Test Objectives/Detailed Supplementary Objectives:

DTO 301D Ascent Wing Structural Capability
DTO 307D Entry Structural Capability
DTO 312 External Tank Thermal Protection System Performance
DTO 319D: Orbiter/Payload Acceleration and Acoustics Environment Data
DTO 413: On-Orbit Power Reactant Storage and Distribution System Cryogenic Hydrogen Boiloff
DTO 414: Auxiliary Power Unit Shutdown Test
DTO 656: Payload and General Purpose Support Computer Single Event Upset Monitoring
DTO 664: Cabin Temperature Survey
DTO 667: Portable In-Flight Landing Operations Trainer
DTO 670: Passive Cycle Isolation System
DTO 678: Infrared Thermal Survey of Orbiter Crew Compartment, Spacelab and Spacehab Module
DTO 679: Ku-Band Communications Adapter Demonstration
DTO 805: Crosswind Landing Performance
DTO 910: Orbiter Experiments Package-Orbiter Acceleration Research Experiment
DSO 324: Payload On-Orbit Low Frequency Environment
DSO 326: Window Impact Observations
DSO 487: Immunological Assessment of Crewmembers
DSO 492: In-Flight Evaluation of a Portable, Clinical Blood Analyzer
DSO 802: Educational Activities
DSO 901: Documentary Television
DSO 902: Documentary Motion Picture Photography
DSO 903: Documentary Still Photography

Extended Duration Orbiter Medical Project DSOs:

DSO 603: Orthostatic Function During Entry, Landing and Egress
DSO 604: Visual-Vestibular Integration as a Function of Adaptation
DSO 605: Postural Equilibrium Control During Landing/Egress
DSO 608: Effects of Space Flight on Aerobic and Anaerobic Metabolism During Exercise
DSO 610: In-Flight Assessment of Renal Stone Risk
DSO 611: Air Monitoring Instrument Evaluation Atmosphere Characterization
DSO 612: Energy Utilization
DSO 614: The Effect of Prolonged Space Flight on Head and Gaze Stability During Locomotion
DSO 623: In-Flight Lower Body Negative Pressure Unit Test of Countermeasures and End-of-Mission Countermeasure Trial
DSO 626: Cardiovascular and Cerebrovascular Response to Standing Before and After Space Flight

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 Edwards Air Force Base, Calif.

- Trans-Atlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Ben Guerir, Morocco or Zaragoza or Moron, Spain.

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

STS-62 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Ben Guerir, Zaragoza or Moron.

STS-62 SUMMARY TIMELINE

Flight Day 1
Ascent
OMS-2 burn (163 n.m. x 160 n.m.)
USMP-2 activation
OAST-2 operations
Remote Manipulator System checkout
DEE operations
CGBA activation
SSBUV/A activation

Flight Day 2
SSBUV/A instrument activation
USMP-2 operations
OAST-2 operations
CPCG activation
PSE operations
LBNP operations

Flight Day 3
MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 4
LDCE operations
USMP-2 operations
OAST-2 operations
MODE operations
PSE operations
LDCE operations
PLT, MS2 off-duty (half-day)

Flight Day 5
CDR, MS1, MS3 off-duty
LBNP operations
MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 6
MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 7
MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 8
LBNP operations
USMP-2 operations
OAST-2 operations
MODE operations
LDCE operations
PSE operations
CPCG operations

Flight Day 9
MODE operations
LDCE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 10
Entire crew off-duty (half-day)
USMP-2 operations
OAST-2 operations
LDCE operations
PSE operations
CPCG operations

Flight Day 11
Orbital Maneuvering System-3 burn (157 x 140 n.m.)
Orbital Maneuvering System-4 burn (140 x 139 n.m.)
DEE operations
CGBA operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 12
LBNP operations
DEE operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 13
Orbital Maneuvering System-5 burn (138 x 105 n.m.)
DEE operations
CGBA operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day 14
SSBUV/A deactivation
LBNP operations
Flight Control Systems checkout
Reaction Control System hot-fire
Secondary payloads deactivation
Cabin stow

Flight Day 15
USMP-2 deactivation
OAST-2 deactivation
Deorbit preparations
Deorbit
Entry
Landing

STS-62 VEHICLE AND PAYLOAD WEIGHTS

	Pounds
Orbiter (Columbia) empty and 3 SSMEs	181,299
United States Microgravity Package-2	9,606
Office of Aeronautics and Space Technology-2	5,789
Space Shuttle Backscatter Ultraviolet/A	1,073
Dexterous End Effector	693
Limited Duration Candidate Materials Exposure	1,203
Protein Crystal Growth (PCG) Experiments	135
Commercial Protein Crystal Growth	97
Commercial Generic Bioprocessing Apparatus	97
Middeck 0-Gravity Dynamics Experiments	186
Detailed Test/Supplementary Objectives	432
Total Vehicle at SRB Ignition	4,519,319
Orbiter Landing Weight	226,765

STS-62 ORBITAL EVENTS SUMMARY

Event	Start Time (d/h:m:s)	Velocity Change (fps)	Orbit (n.m.)
OMS-2	00/00:45:00	208	163 x 160
OMS-3 (First of two firings lowers Columbia's orbit for certain OAST-2 operations)	09/16:45:00	38	157 x 140
OMS-4 (Completes lowering of Columbia's orbit for OAST-2 operations)	09/17:30:00	32	140 x 139
OMS-5 (Further lowers one side of Columbia's orbit for OAST-2 operations)	11/18:08:00	59	138 x 105
Deorbit	13/22:04:00	209	N/A
Touchdown	13/23:06:00	N/A	N/A

STS-62 CREW RESPONSIBILITIES

Task/Payload	Primary	Backups/Others
USMP-2	Thuot	Gemar
OAST-2	Thuot	Ivins
DEE	Ivins	Thuot, Gemar
SSBUV/A	Thuot	Allen, Casper
LDCE	Thuot	Allen, Casper
Middeck Payloads:		
APCG	Thuot	Gemar
PSE	Gemar	Ivins
CPCG	Thuot	Ivins
CGBA	Ivins	Gemar
MODE	Gemar	Thuot
AMOS	Allen	Casper
BDS	Casper	Allen

Detailed Test Objectives/Detailed Supplementary Objectives

DTO 644	Allen	Casper
DTO 670	Allen	Casper
DTO 413	Allen	Casper
DTO 667	Allen	Casper
DTO 414	Allen	Casper
DTO 656	Ivins	Thuot
DTO 678	Ivins	Thuot
DTO 679	Ivins	Thuot
DTO 910	Gemar	Allen
DSO 603B	Thuot, Gemar, Ivins	
DSO 604	Casper, Allen, Thuot	
DSO 605	Allen, Thuot, Gemar, Ivins	
DSO 610	Casper, Gemar	
DSO 611	Ivins	
DSO 612	Casper, Gemar	
DSO 623	Allen, Gemar	Casper (operator)
DSO 324	Allen	Casper
DSO 326	Allen	Casper
Other:		
Photography/TV	Ivins	Thuot
In-Flight Maintenance	Allen	Gemar
EVA	Thuot (EV1)	Gemar (EV2), Allen (IV)
Earth Observations	Thuot	Allen
Medical	Allen	

UNITED STATES MICROGRAVITY PAYLOAD-2 (USMP-2)

The United States Microgravity Payload-2 (USMP-2) is the second in a series of missions to study the effects of microgravity on materials and fundamental sciences. USMP microgravity experiments are designed to be accomplished in the Space Shuttle payload bay. The Marshall Space Flight Center, Huntsville, Ala., manages USMP for NASA Headquarters Office of Life and Microgravity Sciences and Applications.

The USMP-2 mission consists of five experiments. The Advanced Automated Directional Solidification Furnace (AADSF) will study the directional solidification of semiconductor materials in microgravity. The Critical Fluid Light Scattering Experiment (also called Zeno) will measure the fluctuations of the density of xenon very near its liquid/vapor "critical point." The critical point occurs at a condition of temperature and pressure where a fluid is simultaneously a gas and a liquid with the same density.

The Isothermal Dendritic Growth Experiment (IDGE) is designed to test theories concerning the effect of gravity- driven fluid flows on dendritic solidification of molten materials. Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO) will use several simultaneous measurement techniques in reduced gravity to investigate the precise nature of solidification.

The objective of the Space Acceleration Measurement System (SAMS) is to measure the components of the microgravity environment on the USMP carrier in support of the major experiments and to provide data for orbiter dynamic analysis studies.

In orbit, crew members will activate the USMP-2 experiments. On Earth, investigators at Marshall's Spacelab Mission Operations Control Center will command and monitor instruments and analyze data.

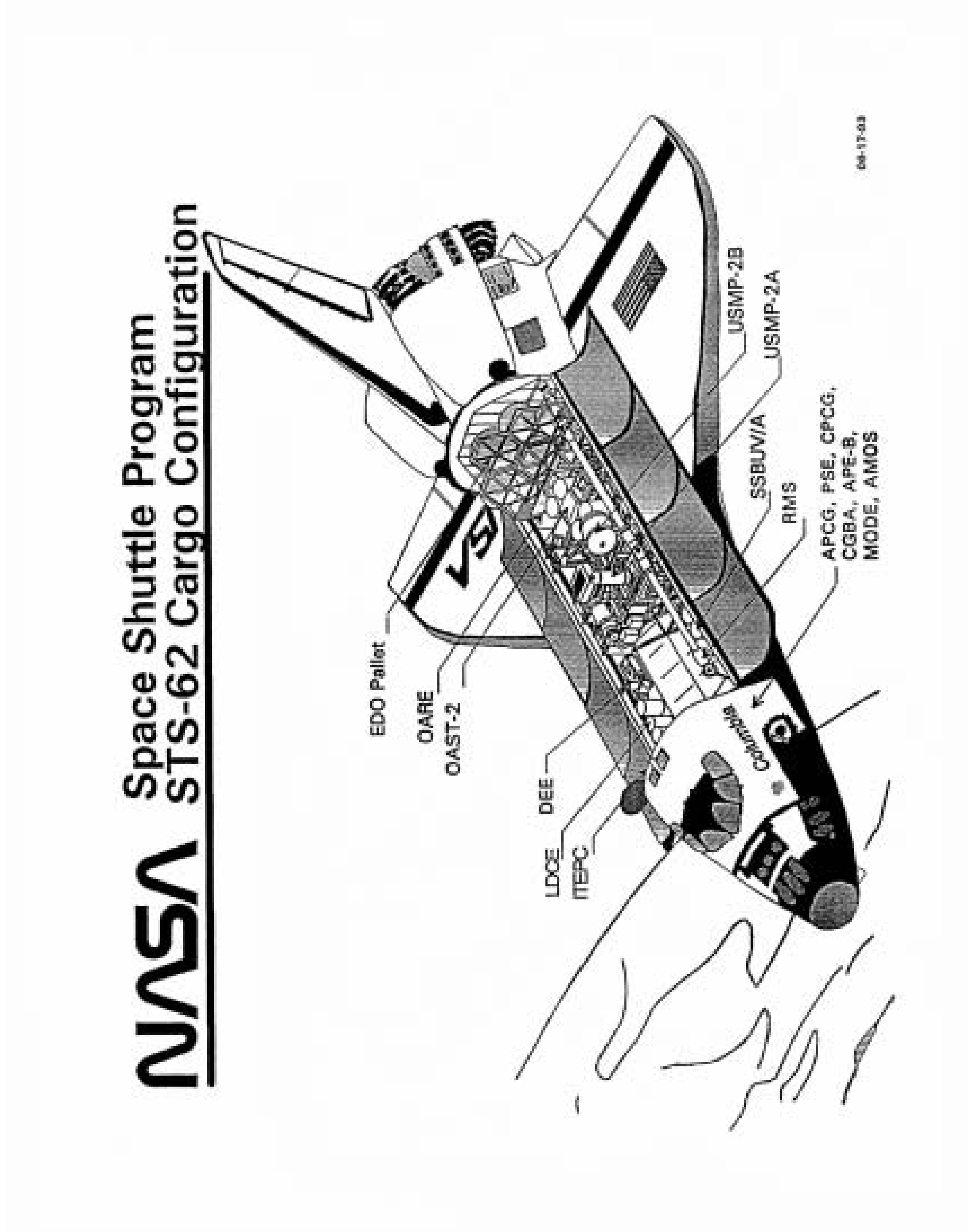
The Marshall-developed USMP carrier consists of two support structures that form a bridge across the payload bay. Experiment hardware is mounted on these support structures. Carrier subsystems mounted on the front structure provide electrical power, communications and data-handling capabilities and thermal control.

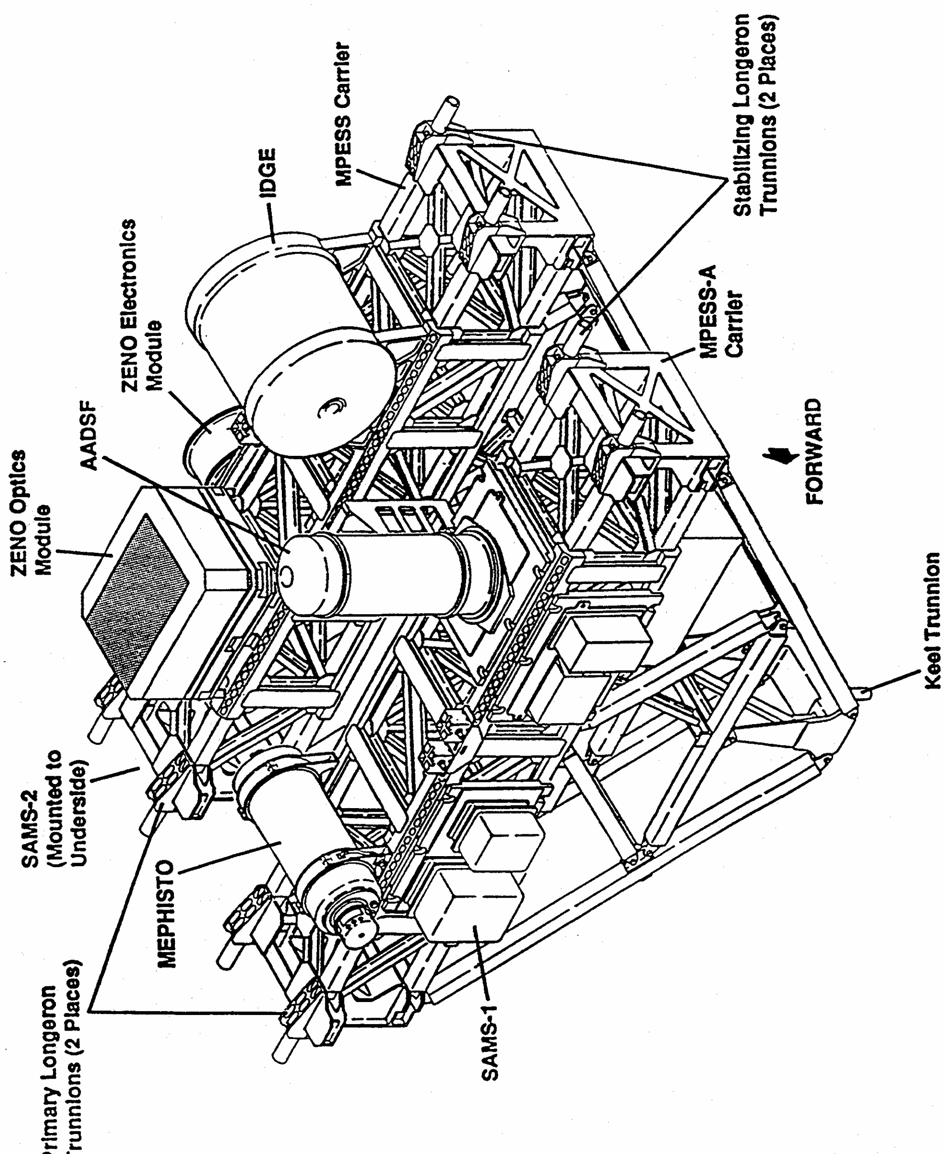
Advanced Automated Directional Solidification Furnace (AADSF)
Principal Investigator: Dr. S. Lehoczky, Marshall Space Flight Center, Huntsville, Ala.

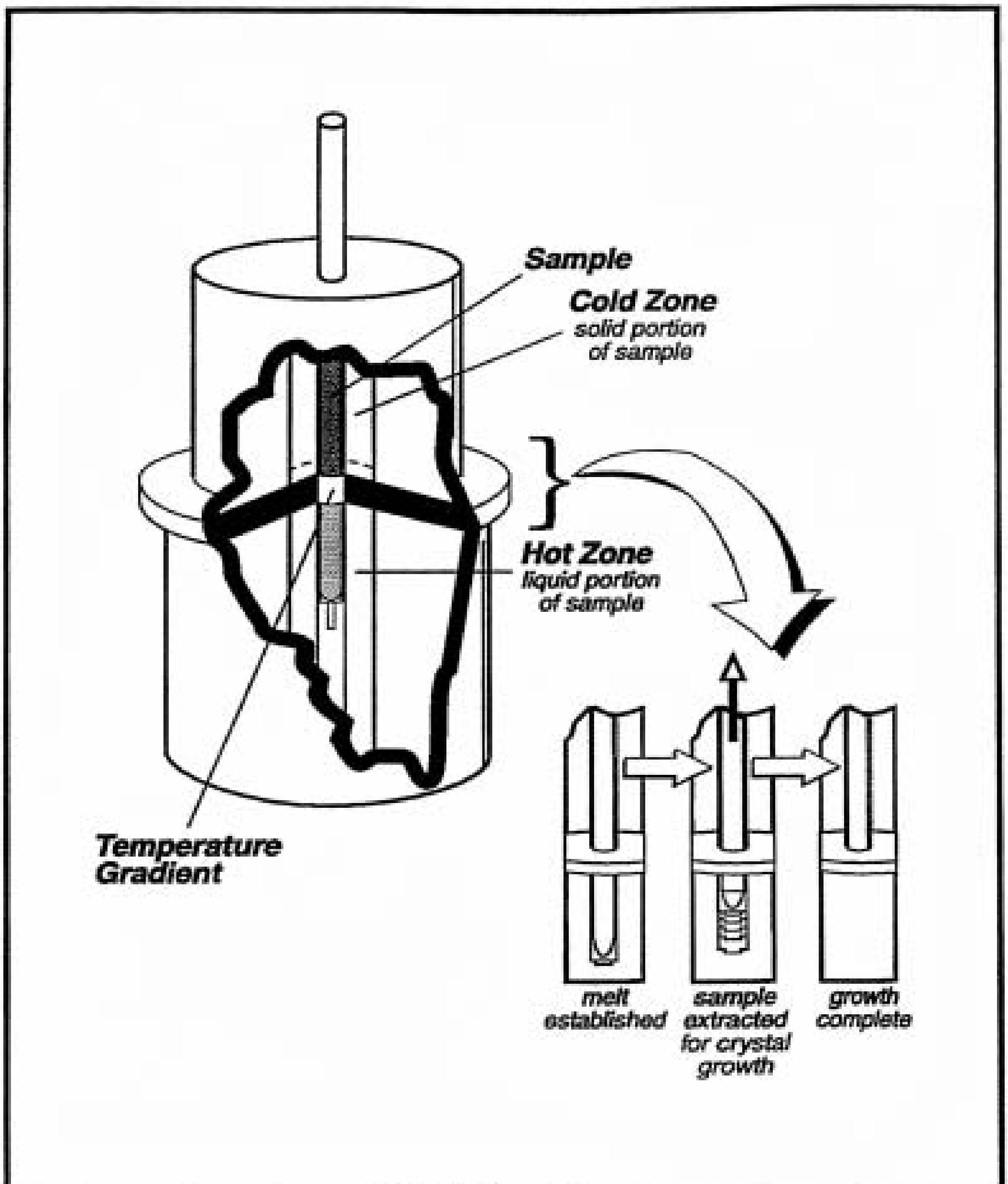
The Advanced Automated Directional Solidification Furnace (AADSF) will be used to study the directional solidification of semiconductor materials in microgravity. Data from these experiments will be used to verify theories about the effect of gravity on the chemical composition of growing semiconductors and also gravity's role in creating defects in semiconductor crystals.

Crystals of semiconductor materials are used in everyday products such as computers, calculators and in high technology applications such as infrared detectors. The properties that make the crystals useful depend on the structural arrangement of the atoms inside and the distribution of the various chemical components which make up the semiconductor material. Suitable properties can be obtained by relatively fast cooling and solidification of most metals, but the electronic properties of semiconductor materials are extremely dependent on slow growth to obtain a high degree of crystal perfection and uniform distribution of the chemical constituents.

During the production of semiconductor crystals, gravity - - through convection (the buoyancy-driven flow of fluid caused by temperature differences) and settling of molten components - - can cause defects in this atomic structure. These gravity- induced imperfections cause problems ranging from physical flaws in the internal structure of the crystal to an uneven distribution of different components that make up the crystal. These defects can degrade properties required for the use of a particular crystal.


NASA
Space Shuttle Program
STS-62 Cargo Configuration
EDO Pallet
OARE
OAST-2
DEE
LDCE
ITEPC
USMP-2B
USMP-2A
SSBUV/A
RMS
APCG, PSE, CPCG,
CGBA, APE-B,
MODE, AMOS
Columbia


ZENO Optics Module
AADSF
ZENO Electronics Module
IDGE
MPESS Carrier
Stabilizing Longeron Trunnions (2 Places)
MPESS-A Carrier
FORWARD
Keel Trunnion
SAMS-1
MEPHISTO
SAMS-2 (Mounted to Underside)
Primary Longeron Trunnions (2 Places)



AADSF Experiment

Using directional solidification, a technique commonly used to process metals and to grow crystals, AADSF will slowly process a cylinder-shaped sample of mercury cadmium telluride, a material used as an infrared radiation detector. The sample will be sealed in a container made of quartz. Inside a tubular furnace which has three temperature zones (each independently controlled), the sample will move from the "hot zone" (about 1600 degrees F) where the material stays molten, up to the "cold zone" (about 650 degrees F) where the material will solidify as it cools. The solidification region grows as the solid/liquid interface moves from one end of the sample to the other at a controlled rate, thus the term directional solidification.

Scientists are particularly interested in the solid/liquid interface. It is here that the flows of molten material influence the final composition and structure of the solid and its properties. After the mission, scientists will analyze the solidified sample to determine the density of defects and the distribution of elements in the crystal.

Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO)
U.S. Principal Investigator: Dr. R. Abbaschian, University of Florida, Gainesville
French Principal Investigator: Dr. J. J. Favier Centre d'Etudes Nucleaires de Grenoble, Grenoble, France

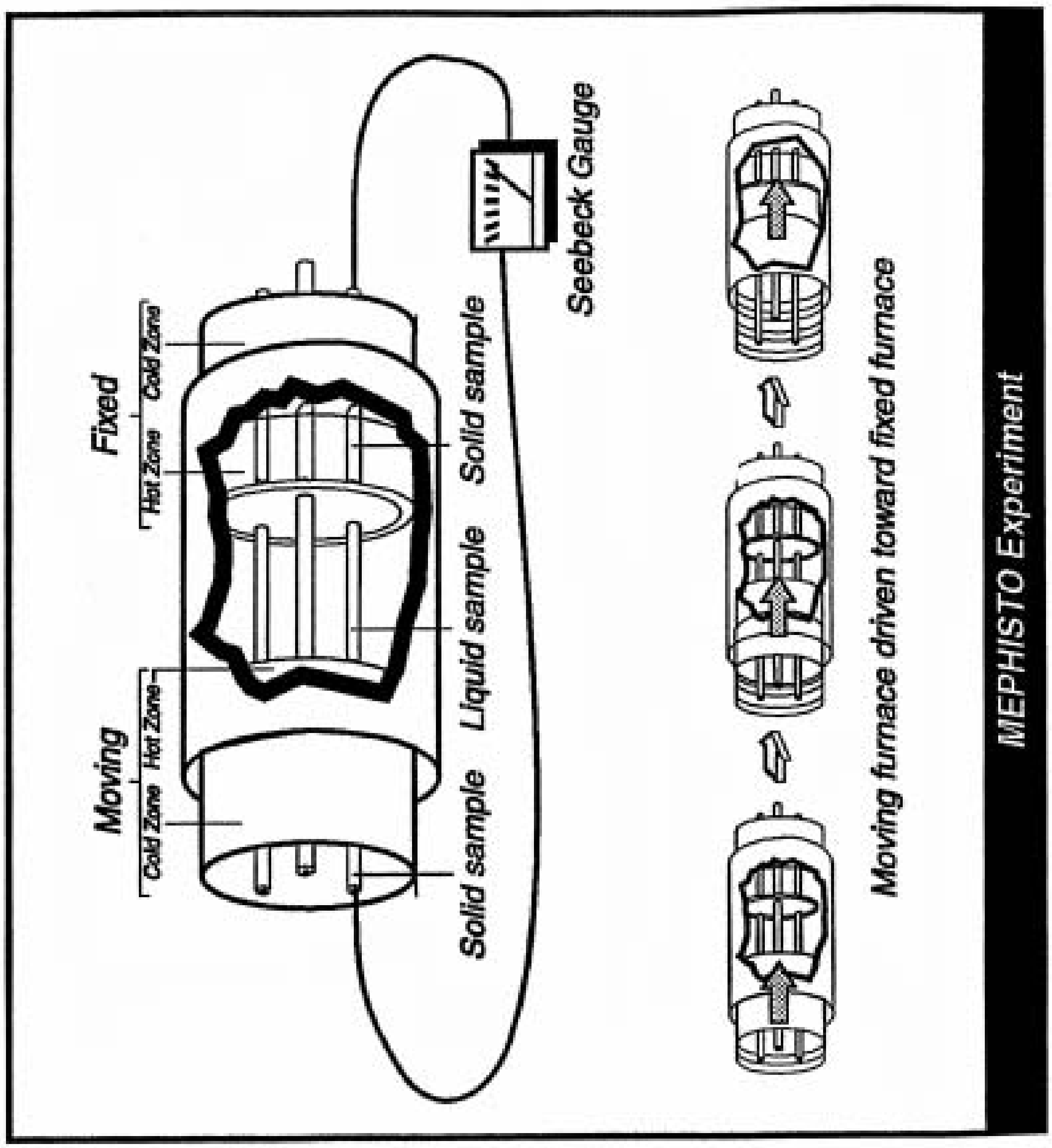
MEPHISTO is flying for the second time on a USMP mission in a series of cooperative investigations between NASA and the French Space Agency (CNES). MEPHISTO studies the behavior of metals and semiconductors as they solidify. Results from MEPHISTO on USMP-2 will be compared with those gathered on USMP-1 which flew in October 1992. Solidification processes become unstable under certain circumstances, such as convection caused by gravity. This instability causes changes to the structural properties of the resulting product. Scientists need to understand these gravity-driven phenomena in the solidification of metals, alloys and electronic materials. This information could result in improvements to production methods and materials on Earth.

To study this solidification phenomenon, scientists measure the temperature, velocity and the shape of the solidification front by melting and solidifying alloy samples. In USMP-1, melting and solidifying runs were conducted using alloy samples consisting of mostly tin with a small amount of bismuth. In USMP-2, the samples will consist mostly of bismuth with a small amount of tin. Although the samples are similar, they differ greatly in the way they solidify.

MEPHISTO will use a fixed furnace and a moving furnace simultaneously to process three identical rod-shaped samples of the bismuth-tin alloy. The fixed furnace provides a reference for the electrical voltages produced in the sample by the moving furnace. The moving furnace will be responsible for the actual melting and solidification of the samples. The second sample will determine the position of the solid/liquid interface, and the third sample will be marked with electrical current pulses that cause a momentary change in the local chemical composition which "outlines" the shape and position of the interface at that moment.

It is important to know the position of the interface and how fast it moves as the crystal is grown. Local conditions at the solidification front largely determine the crystal growth rate, crystal structure and composition. These factors in turn determine the quality of the crystal, its properties and its usefulness in electronic devices.

As a solidification run begins, the mobile furnace moves outward away from the fixed furnace, thus melting the samples. The mobile furnace then moves back towards the fixed furnace and the sample resolidifies. The MEPHISTO apparatus allows many solidification and remelting runs and is particularly well suited for long-duration missions.



MEPHISTO Experiment

During STS-62, MEPHISTO data will be correlated with data from the Space Acceleration Measurement System (SAMS). By comparing the data, scientists can determine how accelerations and vibrations aboard the Shuttle disturb the solid/liquid interface.

On USMP-1, scientists found regular cellular patterns in the structure of the alloy at or near the point where the solidification becomes unstable. This is important because if these patterns can be predicted and controlled, the mechanical and electrical properties of the materials can be better controlled as well.

In addition, USMP-1 afforded researchers the opportunity to see what effect, if any, Shuttle movement and crew activity had on the growing crystals. Using the SAMS instrument, researchers found that buoyancy-driven convection from accelerations such as crew motion did not affect the solidification at the growth rates used for most of the MEPHISTO runs. Scientists also found that larger accelerations did have an effect on the quality of the crystal, and they were able to measure and study their impact.

Isothermal Dendritic Growth Experiment (IDGE)
Principal Investigator: Dr. M. Glicksman, Rensselaer Polytechnic Institute, Troy, N.Y.

Dendrites are crystalline forms that develop as materials solidify under certain conditions. Snowflakes are an example of dendritic solidification, forming beautiful tree-like patterns as they develop.

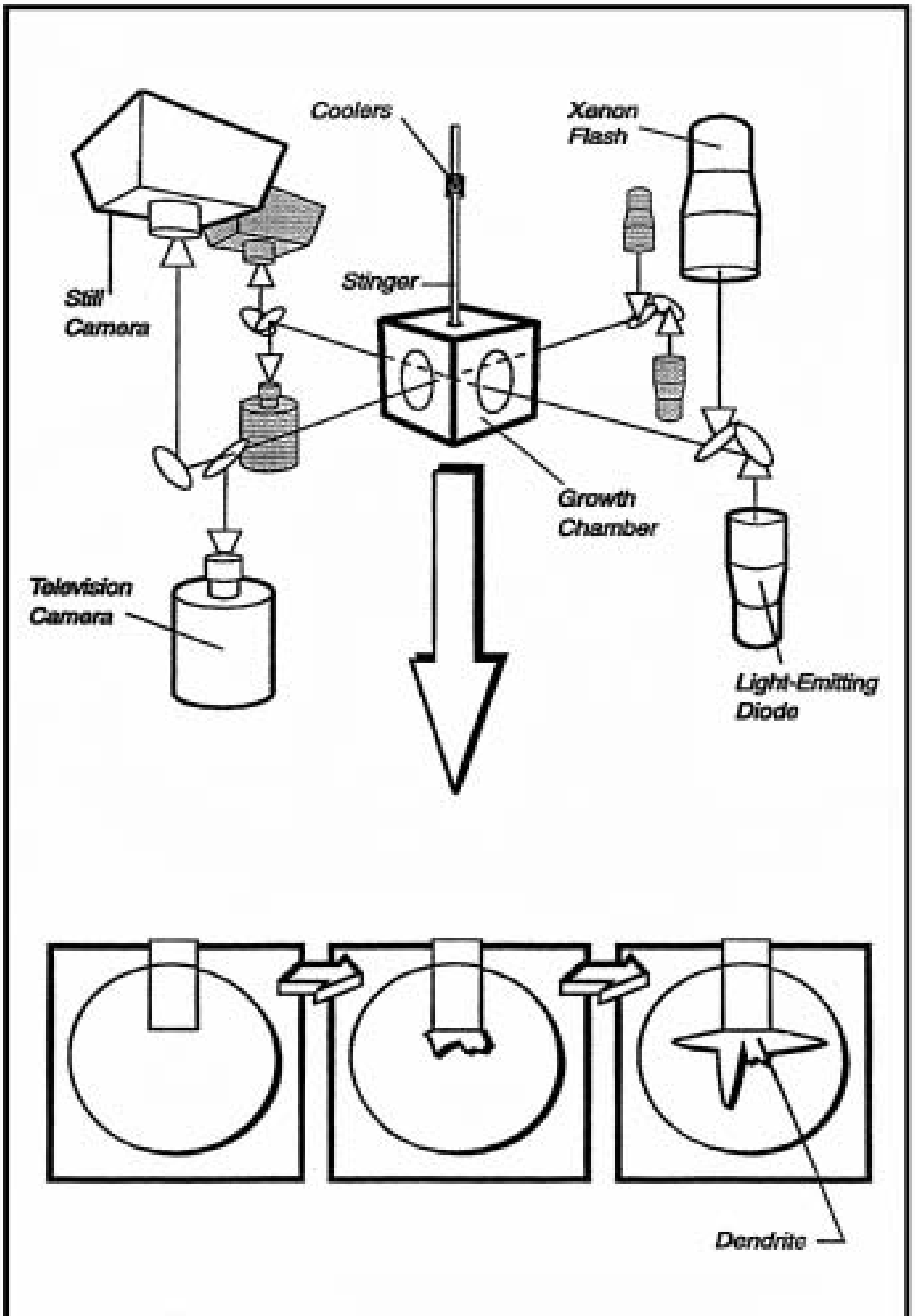
Most metal products that we use in our society are commonly solidified under conditions that form dendrites. When dendrites form, their size, shape and the direction in which they develop can determine the strength and durability of steel, aluminum and superalloys used in the production of cars and airplanes.

On Earth, gravity causes convective fluid flows in molten metals during solidification, thus affecting the characteristics of the final product. Scientists are interested in studying the size and shape of the dendrite branches and how they interact with each other. This can be more easily accomplished without the interference of gravity- driven convection. Because most industrially important alloys solidify from a molten state by dendritic processes, gaining a better understanding of how these processes work may help improve industrial production techniques.

The Isothermal Dendritic Growth Experiment (IDGE) will use the material succinonitrile (SCN) to study dendritic solidification of molten materials in the microgravity environment of space. SCN mimics the behavior of solidifying metal alloys, but is transparent, allowing photography of the dendrites. The IDGE principal investigator will compare photographs of space-grown dendrites with photos of those grown on Earth.

IDGE hardware consists of a thermostat that contains the dendrite growth chamber and a hollow tube connected to coolers on the outside of the chamber. Prior to the flight, the growth chamber is filled with ultra-pure SCN. The tube also will be filled with SCN, and it will be placed in the growth chamber. As the coolers lower the temperature of the SCN in the hollow tube, the material begins to solidify. The solidification front moves down the tube shaft to the tip of the tube where it emerges as an individual dendrite into the growth chamber and the SCN.

Two 35 mm cameras photograph the emerging dendrites during growth. Video downlink from the experiment is also transmitted to the IDGE science team on the ground.



IDGE Experiment

Critical Fluid Light Scattering Experiment-Zeno (CFLSE-Zeno)
Principal Investigator: Dr. R. Gammon, University of Maryland, College Park

Onboard USMP-2 the Critical Fluid Light Scattering Experiment-Zeno is designed to study the behavior of xenon at its “critical point.” The critical point occurs at a condition of temperature and pressure where a fluid is simultaneously a gas and a liquid with the same density. Zeno will measure properties of xenon much closer to its critical point than is possible on Earth. This will be accomplished by minimizing the density driven separation due to gravity on Earth.

An example of a phase transition is water changing to steam when its temperature is increased beyond 212 degrees Fahrenheit (100 degrees Celsius). During this transition, the water goes through a density change as well. The steam is much less dense than the water. If the water’s pressure is increased beyond sea-level pressure it will boil at a higher temperature and be more dense when it changes to vapor. At the “critical point,” there is no difference between the liquid and vapor states. An example of the commercial use of critical point phenomenon is the removal of caffeine from coffee using water at its critical point. By using water in this critical stage instead of methylene chloride, a potential cancer risk has been removed from the decaffeinated coffee and a hazardous waste product eliminated.

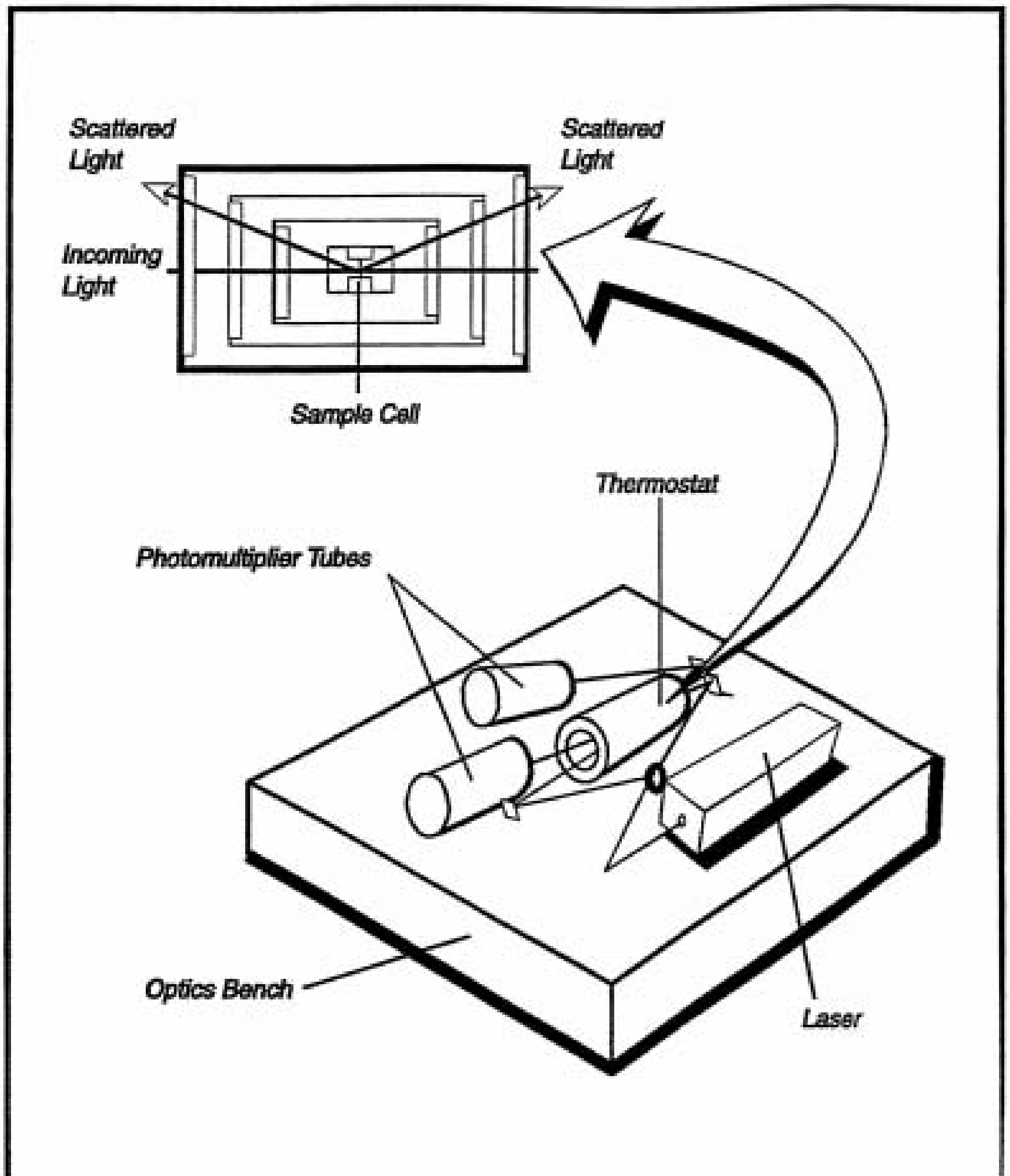
The critical point is difficult to study on Earth because gravity distorts the density of the samples, and the weight of the column of fluid compresses the lower part of the sample until its density is greater than the critical density. The sample literally collapses under its own weight. When this occurs, it leaves only a very small area for scientists to study, giving them an unclear picture of the transition. In reduced gravity, the critical zone will be “widened” thus giving scientists a much “crisper” picture of the critical point phenomenon.

Because many different materials we use on Earth share this phenomenon, scientists are particularly interested in the critical point. Materials at the critical point will exhibit behavior that does not occur under any other circumstances. Some systems that are different physically will act similarly when they are near their critical points. Scientists hope understanding the physics near the critical point will help provide insight into a variety of physics problems in solids, liquids and gases.

In the USMP-2 experiment, a tiny sample of ultra-pure xenon will be housed inside a high-precision thermostat, where it will be kept near its critical density. The Zeno instrument then will “search” for the critical temperature of the sample.

As the xenon approaches its critical point, patches of the normally clear gas will become cloudy (much like water from a faucet with an aerator on it, caused by the intermingling of minute gas droplets within a liquid) as microscopic portions of the sample pass through the critical point and back again. Closer to the critical point, these areas will become larger and exist for longer periods.

When a laser light is passed through the sample at temperatures successively closer to the critical temperature, the light is scattered by these cloudy areas. Two detectors measure these fluctuations, and scientists will use the data gathered to determine how large the areas are and how long they exist in relation to temperature changes near the critical point.



Zeno Experiment

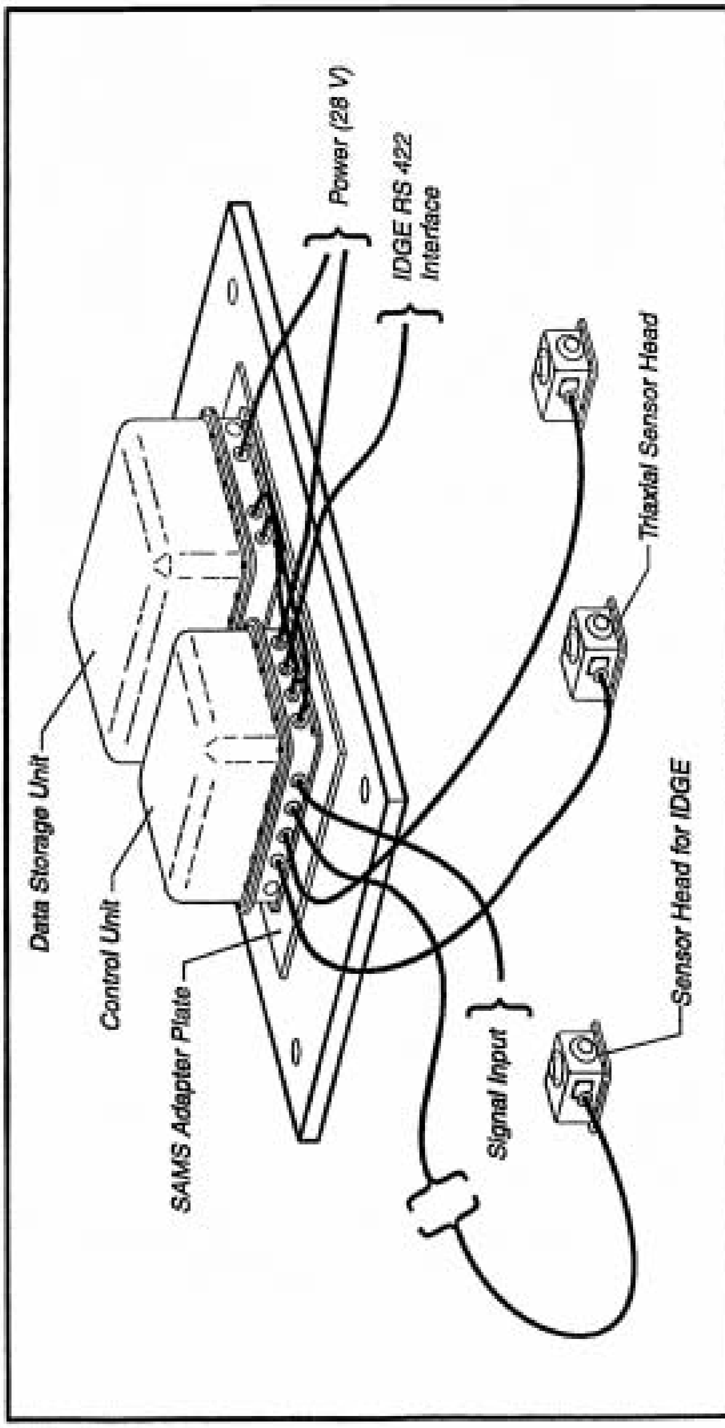
Space Acceleration Measurement System (SAMS)
Project Manager: C. Siegert, NASA Lewis Research Center, Cleveland

The Space Acceleration Measurement System (SAMS) instrument monitors and records onboard accelerations and vibrations experienced on orbit during a Shuttle flight. The effects of Earth's gravity are greatly reduced, but not eliminated. Such influences as crew activity, Shuttle maneuvers and the slight atmospheric drag on the Shuttle can create disturbances that mimic gravity. Although these are slight, they can affect the highly gravity-sensitive science experiments onboard.

Using sensors called accelerometers, SAMS takes measurements of these disturbances and transmits them to scientists on the ground where they can make adjustments to improve their results if the disturbances are significant. Data also are recorded for post-mission analysis. Based on data analysis, scientists can learn what kinds of disturbances affected their experiments, and they can make new designs for future missions which take these into account.

SAMS also will support orbiter studies. SAMS acceleration data recorded during orbiter maneuvers will be used to verify existing Shuttle structural dynamic models.

SAMS consists of electronics packages and remote sensor heads. Four of the sensor heads are placed on the USMP carrier (two on the front structure and two on the back structure). A fifth sensor is mounted within the Isothermal Dendritic Growth Experiment instrument. Data from this head are pre-processed by the SAMS unit and returned to the experiment computer to support IDGE scientific analysis. Each SAMS sensor consists of three single-axis acceleration sensors connected to the SAMS electronics package with cables. Each sensor produces signals in response to accelerations. Electronics amplify and filter the signals, then convert them into digital data.



SAMS-2 Apparatus

OAST-2

The overall objective of this payload is to obtain technology data to support future needs for advanced satellites, sensors, microcircuits and the international space station.

There are six In-Space Technology Program (INSTEP) experiments mounted on a Hitchhiker carrier. The six experiments and their overall mission objectives are:

Solar Array Module Plasma Interaction Experiment (SAMPIE) - Determine the arcing and current collection behavior of different types, sizes and shapes of solar cells, solar modules and spacecraft materials.

Thermal Energy Storage (TES) - Determine the microgravity behavior of two different thermal energy storage salts that undergo repeated melting and freezing.

Experimental Investigation of Spacecraft Glow (EISG) and Spacecraft Kinetic Infrared Test (SKIRT) - Develop an understanding of the physical processes leading to the spacecraft glow phenomena by studying infrared, visible and far-ultraviolet light emissions as a function of surface temperature and orbital altitude.

Emulsion Chamber Technology (ECT) - Measure background cosmic ray radiation as a function of shielding and radiation energy photographic films.

Cryogenic Two Phase (CRYOTP) - Determine the performance of microgravity nitrogen space heat pipe and cryogenically-cooled, vibration-free, phase-change-material thermal storage unit thermal energy control technologies.

The Hitchhiker carrier used to support the OAST-2 experiments is commonly referred to as a Mission Peculiar Equipment Support Structure (MPESS). The carrier sits across the orbiter’s payload bay. It also includes an onboard avionics control box which provides electrical, telemetry and command and control interface between the orbiter and the experiment packages.

The SAMPIE, EISG, SKIRT and CRYOTP payloads will be operated by teams of principal investigators through the Goddard payload operations control center. The only experiment mounted on the Hitchhiker which is not controlled through the avionics box located on Hitchhiker is the Thermal Energy Storage experiment. It is operated from a laptop computer setup by the crew in the aft flight deck. Because of its completely passive nature, the ECT experiment has no commanding functions and does not downlink data to the GSFC POC.

Four of the experiments on the OAST-2 Hitchhiker will investigate the interaction between orbiting spacecraft and the space environment. These four are the SAMPIE, EISG, SKIRT and ECT. The other two (TES and CRYOTP) will investigate spacecraft thermal control and storage technologies.

The Office of Advanced Concepts and Technology is the program office responsible for the OAST-2 payload. Payload integration was performed by the Goddard Space Flight Center, which is also responsible for project management. The GSFC Project Manager is Neal Barthelme. The OACT Program Manager is Mark Nall. Overall payload development and operations costs, including the Hitchhiker carrier and integration, total $30 million including $500,000 of U.S. Air Force development funds for the CRYOTP experiment.

Solar Array Module Plasma Interaction Experiment

The Solar Array Module Plasma Interaction Experiment (SAMPIE) will investigate the plasma interactions of high voltage space power systems with the space plasma in low Earth orbit (LEO).

Modern satellites and spacecraft have become larger, heavier and more sophisticated to the point that they now require higher operating voltages. Although LEO does not have an atmosphere in the classic sense, it still contains widely spaced atoms of oxygen and nitrogen which have become ionized and are contained in a plasma layer in the region in the first few hundred miles above the Earth's ionosphere. Spacecraft voltage can potentially interact with these atoms in space causing arcing problems between spacecraft components. This experiment will investigate and quantify the interaction of high voltage surfaces with the surrounding space environment.

Numerous ground and flight experiments already have shown there are two basic interactions with the surrounding plasma when spacecraft surfaces are at a high voltage relative to that of the plasma. One type of interaction occurs when conducting surfaces, whose electrical voltage is highly negative compared to the plasma, undergo arcing which damages the material and disrupts normal spacecraft electrical operations. This is similar to the lightning which occurs in cloud-to-cloud strikes. The other type of interaction occurs when a surface voltage is highly positive with respect to the surrounding plasma. In that case, the spacecraft surface collects vast quantities of electrons resulting in a loss of power.

The overall objectives of the SAMPIE experiment are to investigate the arcing and current collection behavior of different materials and shapes. Traditional ground-based plasma tests have provided useful data but have never satisfactorily duplicated the in-orbit space plasma environment. SAMPIE will allow ground-based test data to be verified and validated as well as providing complete sets of data on arcing and current flow.

The SAMPIE test setup creates an environment suitable for arcing to occur. The instruments will detect occurrences of arcing and will measure the arc rate. The experiment hardware consists of a metal box with an experiment plate affixed to the top surface. The container houses the electronics subsystems which consist of a power supply to bias the solar cell samples to 600 volts (as measured from the plasma ground), an electorate to measure current collection, the arc measurement system, the plasma diagnostic and measurement system and a data interface unit. The data from the experiment will be both stored onboard and transmitted to the Payload Operations Control Center at the Goddard Space Flight Center.

The experiment plate provides the mounting surface for all the experiment samples. The test samples consist of four types of solar cells and two additional sample materials for special purpose arcing experiments. The solar cells represent a variety of existing and in-development materials, representing several technologies. Each of the samples will be biased to high voltages to characterize both negative potential arcing and positive potential current collection.

The solar cell types to be tested are:

- Space Station Cells -- a 4-cell sample of space station cells, having copper interconnects in the back, will test this technology. Arcing is expected to occur from the cell edges. There is considerable interest in both the arcing characteristics and the current collection of these cells.

- Advanced Photovoltaic Solar Array -- a sample blanket of this material will test the behavior of this relatively new, very thin cell technology. The array uses germanium-coated Kapton for protection against oxidation from the atomic oxygen.

- Standard Silicon -- this type of solar cell has been used exclusively in the U.S. space program and will provide a baseline for comparison with the other test materials.

- Modified Space Station -- three samples of this material are designed to test a known set of factors about these cells which significantly affect their behavior in plasma interactions.

In addition to the four samples of solar cells cited above, there are two specific tests which will investigate multiple breakdown and single breakdown arcing events. For the multiple breakdown test, five metallic samples will be tested in an identical configuration with only the metal being changed. The test metals are gold, silver, copper, aluminum and tungsten.

The single breakdown test will use anodized aluminum samples to determine if the material undergoes a breakdown when subjected to high voltage arcing conditions.

Approximately 24 hours of experiment time are planned with the payload bay pointed in the direction of orbital travel (ram-side) and another 12 hours with the payload bay pointed away from the line of flight (wake-side). The mounting scheme for the plasma current and plasma potential (volts) probes places the probes out of the plasma sheath which forms during experiment operation and provides for an accurate plasma data measurement and an accurate measure of the Shuttle's plasma potential (voltage potential between the orbiter and an object in the payload bay).

The specific objectives for this experiment are:

- Determine the plasma current collection and arcing characteristics on an array of solar photovoltaic cells made from traditional silicon materials, from an array of solar cells using an advanced material and from a set of cells representing those which will fly aboard the space station.

- Determine collection current characteristics on a sample of anodized aluminum coating with Z93 paint used to support the space station program.

- Collect arcing data on solar modules specifically to preclude arcing in low Earth orbit.

- Determine collection current characteristics on simple metal/insulator geometries and arcing characteristics on various metal samples of controlled design.

- Measure a basic set of plasma parameters during the flight period.

- Using test results obtained in the observations cited above, validate the existing NASA space plasma and spacecraft charging computer models.

The minimum success criteria for this experiment will be the successful collection of current (amperage) data in the bay-to-ram operation mode, successful collection of data on the space station solar cell and standard solar cell samples and successful collection of data on the anodized aluminum sample. A fully successful experiment will be the result of data collection through the entire set of planned sequences.

The experiment hardware and testing procedures were developed by NASA Lewis Research Center, Cleveland. Sverdrup Technology, Inc., is providing engineering support. Lawrence Wald, LeRC In-Space Technology Branch, Space Experiments Division, is the experiment manager.

Thermal Energy Storage

The Thermal Energy Storage (TES) experiments are designed to provide data about the microgravity behavior of thermal energy storage salts which undergo repeated freezing and melting. This type of data has never been obtained before and has a direct impact on the development of on-orbit energy storage systems.

These power systems to be tested will store collected solar thermal energy in a salt which is contained in vacuum- sealed containers. As the salt absorbs the thermal energy, it melts. When the thermal salt is melted, it expands by about 30 percent. When it is cooled, the salt solidifies and shrinks, creating voids or pockets in the salt. This void formation within the salt affects the heat absorption rate of the salt and the design of the heat receiver containers holding the salt. These tests will assist in the development of future solar dynamic power receivers being considered for space station.

The two experiment components (TES-1 and TES-2) are self- contained autonomous payloads which will be placed inside Get Away Special (GAS) containers. The GAS containers are mounted along with the other experiments on the Hitchhiker MPESS carrier.

Each TES component occupies 5-cubic feet of the container and weighs 245 pounds. The payloads placed inside each container consist of identical sets of subsystems -- the top section of each container holds the experiment subsystem, the middle section contains the data acquisition and command and control subsystem along with experiment temperature control electronics and the bottom section contains a battery box containing 23 silver-zinc cells and a power conditioning unit.

The experiment sequence for each of the two payloads calls for four thermal cycles. The contained salts are melted and refrozen for each thermal cycle. Minimum success criteria call for one melt/freeze cycle for each of the two systems. The experiment protocol calls for a 5-hour heat up period, 10 hours for completing the four thermal cycles and a cooldown period. The thermal storage material for TES-1 is lithium fluoride, which melts at 1121 Kelvin. The material used in TES-2 is lithium fluoride/calcium difluoride eutectic, which melts at 1042 Kelvin. The experiments are deactivated at a time when the experiment section has cooled down to about 750 Kelvin.

The specific experiment objectives are:

- Determine the long duration low-gravity behavior of void shape and location in lithium fluoride based thermal energy storage materials that have application to solar dynamic power systems on spacecraft.

- Provide flight data that will be correlated with analytical computer code predictions for the behavior of lithium fluoride based salts in a 1-g and low-g microgravity environment.

The flight experiment hardware and testing procedures were developed by an in-house dedicated project team consisting of NASA Lewis Research Center and Sverdrup Technology, Inc. engineers and technicians. Project management and scientific oversight was performed by Andrew J. Szaniszlo in the In-Step Payload Development Branch of the Space Experiments Division at LeRC.

Investigation of Spacecraft Glow and Kinetic Infrared Test

The Experimental Investigation of Spacecraft Glow (EISG) and Spacecraft Kinetic Infrared Test (SKIRT) experiments will investigate the phenomenon known as spacecraft glow. This is an aura of light created around the leading or front-facing surfaces of all spacecraft as they orbit Earth. Oxygen and nitrogen form molecules in excited states when the spacecraft rams into them at high velocity.

These molecules give off light as they decay to their lower energy levels, thus causing the glow. This glow can interfere with data collected by optical and other instruments that record specific wavelengths of photon energy.

These two experiments will measure gas-phase and surface glow emissions as a function of different orbital altitudes, attitudes and temperature of the surface of the test object. These glows will be studied under various thermal, orbital attitude (ram versus wake) and atmospheric conditions. Of particular interest is the study of the interaction of natural atmospheric constituents with the fast moving spacecraft.

Pressurized nitrogen gas containers are mounted beneath the sample plate on the EISG instrument and will be used during the observations as a source of ionizing atoms for the tests.

The EISG includes 530 pounds of hardware including the sample plate and electronics packages. There is an optical diagnostic instrument set which views the 1-x-1 meter sample plate. Samples include common white and black paints (Z306 and Z276 Chemglaze) used as thermal and baffle paint coatings. The coatings are applied to 10-mil metal substrates which are insulated from attachment structures so they can be radiatively cooled.

A steering mirror directs the instruments to different sections of the sample plate. The mirror is used to direct optical observations to the Visible Imaging Spectrometer (VIS) and the Far Ultraviolet Spectrometer (FUV). These instruments cover the range from 4200-8200 angstroms (VIS) to 1400-3600 angstroms (FUV) and will gather spectral data of the samples at varying oblique incident angles looking directly at the plate to looking above the plate.

A different set of sensors will gather data directly over the sample plate. These sensors will gather data in the infrared in two regions (1-3 microns and 3-5.4 microns) and are cooled detectors. Nitrogen gas tanks will supply the source material for a series of experiments using ionization of nitrogen as the plasma. Orbital operations on the Shuttle are planned which include 7 dedicated highly elliptical orbits and 4 orbits at 140 nautical miles circular so studies of the plasma interaction can occur at varying altitudes down to 105 nautical miles.

Most of the data produced by the two spectrometers and infrared sensors will be recorded onboard the EISG tape recorders. Some of the data will be downlinked during the mission for analysis by scientists at Goddard's POCC.

This experiment aims to develop an understanding of the physical processes which lead to spacecraft glow phenomena with an emphasis on surface temperature of test samples as related to the effects of spacecraft altitude. Optical diagnostic packages are used which cover the far-ultraviolet, the visible and the infrared regions of the spectrum. The instruments have been optimized for observations in the spectral regions associated with the glow phenomena.

Orbital experiment protocol for the EISG requires a 3-hour period for initial experiment and functional system checks. Flight tests will be conducted on seven dedicated orbits which have attitudes optimized for investigations into the thermal, altitude and release effects while the experiment's optical diagnostic sensors are taking readings above both material samples alternately. Shuttle glow data will be taken on shadow portions of the orbits for periods of about 30 minutes for a total of 3 and one-half hours of shadow glow data.

In addition to the planned sequences, the EISG instruments also will be operated during periods of orbiter and crew opportunity to study spacecraft glow and luminosities from thruster effluents and Earth atmospheric airglows.

SKIRT is a circular variable filter infrared spectrometer contained in a GAS can and cooled by solid nitrogen to a temperature of 57 degrees Kelvin. As the spectrometer is rotated, the instrument obtains a spectral reading every 5 seconds covering the 0.6 to 5.3 micron infrared range. There also is an aperture on the instrument which allows a reading to be taken of the space directly overhead the payload bay.

The SKIRT sensors will obtain infrared data during all observations using the visible and ultraviolet sensors on the EISG. In addition, SKIRT will have six dedicated maneuvers for observations, four involving orbiter nose-down rolls and two involving lunar calibrations. The SKIRT also will be used whenever possible during other mission operations.

The SKIRT experiment can take data during both day and night orbit cycles, during thruster firings and during lunar illumination. The instrument will avoid taking readings during orbiter water dumps, orbital maneuvering system firings, direct sunlight and direct ram exposure.

The specific experiment objectives are:

- Characterize the glow intensity with ram (in the direction of flight) atmosphere and to study the variation of cold and warm samples.

- Characterize the glow as a function of altitude by studying the altitude effects of the glow specimens through stepped circular and elliptical orbits of the Shuttle.

- Characterize the glow intensity and spectra as it is modified by the active chemical release of gaseous nitrogen into the ram atmosphere.

- Characterize the glow for the two specific samples, i.e., Z306 and A276 coatings.

- Study the entire glow process by observing ultraviolet, visible and infrared glow simultaneously.

Data will be sent to the Goddard POCC and will be reduced at Goddard in real-time during the mission.

The experiment hardware and procedures were developed as a joint program by NASA Johnson Space Center, Lockheed Palo Alto Research Laboratory, Lockheed Engineering and Sciences Co. and the Department of Defense (U.S. Air Force Phillips Laboratory). G. Swenson of Lockheed is the Principal Investigator for the experiment. M. Ahmadjion is the Phillips Lab Project Manager.

Emulsion Chamber Technology

The Emulsion Chamber Technology (ECT) experiment will test the sensitivity of photographic materials, used as detectors for cosmic ray analysis, to deterioration effects from heat, mechanical vibration and unwanted background radiation.

This test will evaluate detectors and methods of using calorimetric photographic stacks as orbital high energy cosmic ray detectors during the later stages of this decade. This technology has the potential for achieving many of the astrophysics high energy cosmic ray objectives at a fraction of the cost of large electronic calorimeters. This experiment will gather data which will help assess the ability of the new detectors to withstand longer exposures without losing the capacity to extract data from the detectors after the flight.

New space radiation dosimetry data also will be obtained on high shielding depths, allowing precise tests of the radiation transport model and the dose calculation model presently used by NASA scientists.

The hardware consists of a stack of photographic films of unique design encased in a hermetically sealed aluminum box at normal atmospheric pressure. The film stack consists of X-Ray film, lead plates and dosimetry detectors stacked together. Internal temperatures and pressures of the stack are monitored and recorded. Because the cosmic ray detectors are entirely passive, this experiment tracks incidences of cosmic ray abundance throughout the entire mission.

The mission objectives of this experiment are:

- Assess the ability of emulsion calorimetry methods to be used for long periods in space to achieve NASA objectives in cosmic ray astrophysics and high energy nuclear particle physics.

- Determine the retrieval efficiency of cosmic ray spectra above 1 TerraVolt per nucleon and compare this with prior balloon flight results.

- Measure all components of the space radiation background and secondary or induced radiation. These measurements will be compared with calculations to develop models which can predict the conditions which would occur on longer exposure flights.

- Obtain comprehensive dosimetry data for a well-defined massive body in space radiation fields.

- Verify the detailed thermal design of the entire stack assembly.

The ECT hardware is a space-qualified version of hardware developed by the University of Alabama-Huntsville, the Marshall Space Flight Center, Huntsville, and other collaborators over a 15-year period of balloon-flight testing. The space version weighs 550 pounds and is 30 inches on each side and 12 inches high. Jimmie Johnson, Marshall Payload Project Office, is the ECT Experiment Manager and J. Gregory is the Marshall Principal Investigator.

Cryogenic Two Phase

The Cryogenic Two Phase (CRYOTP) experiment is investigating the use of very cold liquids - cryogens - for the purpose of heat dissipation. Heat pipes are being tested as possible solutions to thermal control problems. The heat pipe is a very efficient heat transfer device commonly used for cooling electronic components and sensors. A heat pipe is essentially a closed, evacuated tube that contains a porous structure, called a wick, and a small quantity of liquid, called the working fluid.

Heat is absorbed at one end of the heat pipe, evaporating liquid contained in the wick structure and forming vapor. This vapor is transported to the other end of the heat pipe, where the heat is released as the vapor condenses. The condensate is transported back to the heated end of the heat pipe by capillary forces formed in the wick, and the cycle is then repeated.

Phase change material storage units also are being investigated as solutions to thermal control of instruments. A phase change material storage unit consists of a container housing a substance that can be frozen using a cryogenic system. Once frozen, the phase change material acts like an ice cube, drawing heat away from instruments or electronics. Once the material has been frozen, the cryo-cooling device can be shut off, thereby eliminating any possible vibration from the cooling unit.

The Brilliant Eyes Thermal Storage Unit (BETSU) is the CRYOTP experiment that will study this type of cryogenic heat dissipation. The BETSU is attached to a heater assembly on one side and to two cryo-coolers on the other side. The BETSU phase change material will absorb thermal energy from the heater in cycles without the internal fluid circulation required by heat pipes.

Very little is known about how heat pipes and the phase change material thermal storage units will perform in orbiting microgravity conditions and which of the possible configurations are better than others.

The CRYOTP experiment is the second flight of a cryogenic test bed developed for the Cryogenic Heat Pipe experiment, which was flown on the STS-53 mission in December 1992. The new test bed configuration replaces a Hughes Aircraft oxygen heat pipe with the BETSU unit on the 2-cooler side of the test bed. The nitrogen Space Heat Pipe is located on the 3-cooler side of the test bed, replacing a TRW oxygen heat pipe.

The BETSU uses approximately 35 grams of 2-methyl-pentate with three percent acetone to provide 2500 joules of stored energy at a melt temperature of 120 degrees Kelvin. The methyl-pentane phase-change material is contained within an aluminum canister. The remainder of the hardware is identical to that flown on the STS-53 mission.

BETSU experiment protocol calls for turning on its two coolers and cooling the phase-change material down to below 120 degrees Kelvin. Once it is determined that the phase-change material is frozen, an electrical heater is activated to melt the material. The BETSU tests consist of melting and freezing the phase-change material at different heating and cooling rates and measuring the temperature stability afforded by melting the material. Melt and freeze cycles are repeated on the BETSU to obtain both demonstrated repeatability and multiple data points for good correlation of existing analytical models.

The Space Heat Pipe uses three coolers and a fibrous wick nitrogen heat pipe fabricated out of titanium alloy. The SHP experiment protocol calls for cycling the coolers for about 6 hours until the temperature is down to 80 degrees Kelvin and stabilizing the temperature with the use of a cooler-mounted heater to compensate for excess cooler capacity.

A heater located on the cooler’s evaporator is then activated in one-half watt increments until the heat pipe “dries out,” as evidenced through temperature data sent to the ground. The test of the heat pipe transport mechanism is repeated at different temperatures between 70 and 115 degrees Kelvin to obtain multiple data points for corroboration of existing analytical models.

The mission experiment sequence calls for three complete cycles of the two cooler systems for a total of 96 hours of combined experiment time. Flight test results of the CRYOTP experiment will be compared to ground test data and analytical models.

The specific mission objectives for this experiment are:

- Determine the freeze/thaw and temperature control characteristics of the BETSU in a microgravity environment.
- Verify the analytical model for the BETSU’s freeze/thaw behavior.
- Provide correlation of flight and ground data for a cryogenic phase-change material.
- Develop confidence, through a space demonstration, for a phase-change material thermal storage unit based on the Brilliant Eyes Ballistic Missile Defense Organization (BMDO) program.
- Determine the transport capability of the Space Heat Pipe (SHP) nitrogen heat pipe in microgravity.
- Verify the analytical model for the SHP performance and establish the correlation between 1-g and microgravity thermal performance.
- Demonstrate SHP start-up from a super-critical condition.
- Establish the cost-effectiveness of a reusable test bed for cryogenic thermal control devices.

Minimum mission success consists of obtaining one complete thermal cycle from each of the two different systems.
The experiment is a joint program of NASA-Goddard and the U.S. Air Force Phillips Laboratory. Ted Swanson, Goddard Engineering Directorate, Thermal Engineering Branch, is the CRYOTP Experiment Manager. Marco Stoyanof, Phillips Laboratory, and Mel Bello, Aerospace Corp., are co-investigators for the BETSU components. Matt Buchko, also Goddard Thermal Engineering Branch, is the Principal Investigator for the SHP.

SHUTTLE SOLAR BACKSCATTER ULTRAVIOLET (SSBUV) INSTRUMENT

Principal Investigator: Ernest Hilsenrath, NASA Goddard Space Flight Center, Greenbelt, Md.

STS-62 is the sixth Space Shuttle flight of the Shuttle Solar Backscatter Ultraviolet (SSBUV) Instrument, a highly calibrated instrument that can be used to check data from ozone-measuring instruments on free-flying satellites. Data from SSBUV, developed at NASA's Goddard Space Flight Center, Greenbelt, Md., are compared to observations from instruments on NASA's Total Ozone Mapping Spectrometer (TOMS) and Upper Atmosphere Research Satellite (UARS), and the National Oceanic and Atmospheric Administration NOAA-9 and NOAA-11 satellites. Calibration of these data sets ensures the most accurate readings possible for the detection of atmospheric ozone trends.

SSBUV and the NOAA SBUV instruments estimate the amount and height distribution of ozone in the upper atmosphere by measuring incoming solar ultraviolet radiation and ultraviolet radiation reflected or scattered back from the Earth's atmosphere. Because ozone absorbs ultraviolet energy, the difference in these measurements can be used to derive ozone levels in the atmosphere.

The SSBUV uses the Space Shuttle's orbital flight path to assess performance by directly comparing data from identical instruments aboard the NOAA spacecraft as the Shuttle and the satellites pass over the same Earth location within an hour. These orbital coincidences can occur 17 times a day.

SSBUV's value lies in its ability to provide precisely calibrated or verified ozone measurements. The instrument is verified to a laboratory standard before flight, then is recalibrated during and after flight to ensure its accuracy. These laboratory standards are routinely calibrated at the National Institute of Standards and Technology, Gaithersburg, Md. This rigorous calibration provides a highly reliable standard to which data from the SSBUV instruments can be compared.

Results from Previous Flights

The five 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 and STS-56/ATLAS-2 in April 1993. NASA's goal is to fly SSBUV periodically throughout the 1990s as a vital part of NASA's Mission to Planet Earth, a long-term effort to study Earth as a global environmental system.

Using data from the first three flights, SSBUV has achieved one of its primary objectives: updating the calibration of the NOAA-11 Solar Backscatter Ultraviolet (SBUV/2) ozone sounder, which has been in orbit since late 1988. NOAA data from 1989 to 1993 have been reprocessed, based on SSBUV and the SBUV/2 inflight calibration data provided by NASA.

The reprocessed data have been checked against ground- based ozone observations, and these comparisons show very good agreement. Also, there now is excellent consistency between the refined NOAA-11 data and the Nimbus-7 SBUV/TOMS data set, which goes back to 1978. The combined 15-year data set is a primary resource for ozone, climate and trend studies.

Work is underway to explore how SSBUV data can provide improved ozone observations from the TOMS instrument flying on the Russian Meteor satellite and the upcoming TOMS/Earth Probe scheduled for launch in May 1994.

The fourth and fifth SSBUV flights continued to provide calibration data for the NOAA SBUV/2 and the NASA TOMS instruments and also measured ozone changes from 1992 to 1993. The SSBUV data confirmed TOMS data showing approximately 10 percent ozone depletion in the Northern hemisphere mid- latitudes. Scientists believe that this significant depletion resulted from the combined effects of residual aerosols -- liquid particles -- in the upper atmosphere after the eruption of Mount Pinatubo and cold stratospheric temperatures during the winter of 1992-1993.

Simultaneous measurements by SSBUV with the UARS instruments provide a unique opportunity to tie in the detailed observations of the physics and chemistry of the stratosphere being made by UARS with the regular ongoing NOAA ozone observations. These data sets then can be used as a baseline for detecting long-term changes in the stratosphere.

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. The instrument canister holds the SSBUV instrument, its aspect sensors and inflight calibration system.

Once in orbit, a motorized door assembly opens the canister allowing the SSBUV to view the sun and Earth. The canister closes to protect SSBUV from contamination while it performs inflight 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.

SSBUV is managed by Goddard for NASA's Office of Mission to Planet Earth, Washington, D.C. Mission to Planet Earth is studying how Earth's global environment is changing.

Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale environmental processes, focusing on climate change. MTPE satellite data, complemented by aircraft and ground data, are allowing scientists to better understand environmental changes and to distinguish human-induced changes from other natural changes. MTPE data, which NASA is distributing to researchers worldwide, are essential to humans making informed decisions about protecting their environment.

DEXTEROUS END EFFECTOR

Powerful electromagnets, generating an attraction force of 3,200 pounds, will be used to grapple objects with the robot arm in Columbia's payload bay during a flight demonstration of the Dexterous End Effector (DEE).

The new end effector and grapple fixture design will increase the arm's dexterity and alignment accuracy, provide operators with a sense of touch and allow the use of more compact "handles" on satellites and payloads.

During the test, three STS-62 crew members will take turns operating and observing the remote manipulator system (RMS) in a series of 1-hour sessions, each involving approximately eight tasks, for a total of about 24 hours. The tasks will involve aligning the arm with targets, grappling a test probe, inserting the test probe into receptacles of progressively smaller clearances and applying force and torque to the probe with the arm.

Extensive testing on the ground has verified the concepts used by DEE, but only in space can the tests reflect the lack of gravity, atmosphere and the extreme temperature shifts to which telerobotic machinery are exposed.

DEE incorporates a magnetic end effector (MEE), a targeting and reflective alignment concept (TRAC) camera system and a carrier latch assembly (CLA), all developed at NASA's Johnson Space Center, and a force torque sensor (FTS) developed by NASA's Jet Propulsion Laboratory. The standard arm configuration is virtually unchanged for this flight.

Magnetic End Effector

MEE uses two U-shaped electromagnets to grab and release payloads fitted with a flat, ferrous grapple fixture or "handle." MEE provides a reliable method of maintaining a good grip on the payload and a safer, more reliable method for releasing it in the event of an RMS or orbiter failure.

If a failure occurs when the arm is mechanically attached to a payload, the ability of the crew to close the payload bay doors and return to Earth could be threatened. MEE eliminates that risk because the electromagnetic grapple always can be terminated by cutting power or allowing the backup batteries to run down. MEE also is smaller, lighter and has fewer moving parts than the standard end effector.

The flat grapple fixture is lighter and more compact than the standard 10-inch-long grapple fixture post. Many proposed space operations for the Shuttle's arm or a space station arm involve stacking and unstacking objects for construction purposes, and grapple posts would reduce the number of components that could be carried in the cargo bay.

Targeting and Reflective Alignment Concept

TRAC provides a simpler, faster, more intuitive grapple alignment targeting system and can be used manually or automatically. It allows for the precise alignment of two objects using a video system and a mirrored target. In essence, the operator looks through a camera that points outward from the center of DEE at the target until the camera can see its own reflection, then finishes the process by lining up a set of cross hairs.

TRAC utilizes one of three additional television cameras at a time. The first is set on the arm's centerline, the second looks out at a right angle from the centerline and the third is mounted separately in the payload bay. Both the camera inside DEE and a monitor on the Shuttle's aft flight deck have alignment marks that are matched to the cross hairs on the reflective target. Once alignment is achieved, the operator drives the arm forward until magnetic forces mate the end effector to the target.

An AUTO-TRAC system designed to enhance the standard TRAC alignment system will use the third camera, a set of flashing light-emitting diodes and a specially equipped payload general support computer to process the television image and provide digital read-outs of the alignment errors for the arm operator.

By comparison, the standard arm configuration includes a camera mounted on top of the end effector and therefore, off- center. The operator must align the arm with a target mounted above the grapple fixture, then engage the end effector's snare-like wires around the grapple fixture. The visual cues of the standard target are black and white markings on a three- dimensional protruding post.

Force Torque Sensor.

The FTS provides the robot arm operator with feedback on the forces being applied by the arm and minimizes the loads placed on the RMS. The feedback information is displayed graphically for easy interpretation by the arm operator. The FTS is comprised of a data collection assembly (DCA) that includes a strain gauge and temperature sensors and a display electronics assembly (DEA) that gives the operator insight into how much force and torque are being applied.

Magnetic Attachment Tool

A special adapter will connect the arm's special purpose end effector to an electrical flight grapple fixture on the back of the DEE end effector assembly, which is called the magnetic attachment tool (MAT). Once grappled by the arm operator, MAT becomes the operational end effector for the DEE demonstration test.

Carrier Latch Assembly

Two small payload carriers, called Carrier Latch Assemblies (CLA), will be used during the demonstration. Both use a combination of electromagnetic and mechanical latches. One holds the MAT like a vice during launch and entry, and the other holds the test probe. The Class are part of the experiment stowage and activities plate (ESAP) installed on a longeron-mounted getaway special (GAS) beam mounted to the starboard sill of the cargo bay.

Project Management

DEE is managed by the Automation and Robotics Division of NASA's John- son Space Center, Houston. Project engineers are Leo G. Monford, JSC, and Edward L. Carter, Lockheed Engineering and Sciences Co., Houston. DEE is sponsored by the Office of Space Systems Development, NASA Headquarters, Washington, D.C.

LIMITED DURATION SPACE ENVIRONMENT CANDIDATE MATERIAL EXPOSURE (LDCE)

The Limited Duration Space Candidate Materials Exposure (LDCE) flight series uses small cargo bay payload accommodations to evaluate materials being considered for use in space structures. The LDCE flights are sponsored by the Center on Materials for Space Structures (CMSS), the NASA Center for the Commercial Development of Space at Case Western University, Cleveland. The objective of the CMSS is to provide engineering and scientific services to those involved in developing space systems and structures, with a focus on applying new scientific insights to ground-based applications.

The STS-62 LDCE activities will expose three identical sets of materials to the space environment. Each set is comprised of 264 samples mounted in its own container, the lid of which opens mechanically to expose the samples. The containers are positioned such that when open, the samples face directly up and out of the payload bay. One container will be opened soon after reaching orbit and will be left open until preparations for orbiter reentry.

A second container will be handled the same way except that its lid will be returned to the closed position during mission segments when the cargo bay is facing the direction of orbital motion (the “ram” direction). The third container will be opened only during those times that the cargo bay is facing the ram direction.

Previous LDCE flights had samples mounted only in a “flat” position on a plate perpendicular to the direction of the opening of the container. On STS-62, some samples will be similarly mounted, but others will be centrally mounted in a three dimensional “crown” arrangement to seek exposure to environmental factors coming from all directions above the plane of the sample mounting plate.

PROTEIN CRYSTAL GROWTH (PCG) EXPERIMENTS

Proteins are vital to all life, playing roles from providing nourishment to fighting disease. Since 1985, Protein Crystal Growth (PCG) experiments aboard the Space Shuttle have been helping scientists determine the complex molecular structures of important proteins. The PCG experiment hardware for STS-62 incorporates several improvements based on experience from past Shuttle flights.

By knowing the structure of specific proteins, scientists can design new drug treatments for humans and animals and develop new or better food crops. For example, most pharmaceuticals are formulated by trial and error. But if scientists can identify the precise structure of a disease- related protein, they can use it to design a drug to fit the protein like a key fits a lock.

Researchers use a method called X-Ray crystallography to determine the three-dimensional structure of proteins, but analysis requires large, single protein crystals about the size of a grain of table salt. Earth-grown crystals large enough to study often have numerous flaws caused by Earth's gravity. Crystals grown in space tend to have more uniform internal structures, allowing much better X-Ray studies.

In addition to producing single, well-ordered protein crystals to be analyzed post-flight, the STS-62 experiment will provide insights into the dynamics involved in the growth of protein crystals in microgravity. By studying crystals grown under different conditions, scientists can improve methods for producing higher quality crystals and large crystals of hard- to-grow proteins on future flights.

Two different experiments on STS-62 will use the vapor diffusion technique to grow protein crystals in space. One of the two techniques is the improved version of the vapor diffusion apparatus used on previous flights. The other is a flight test of off-the-shelf crystallization chambers commonly used in Earth-based labs.

Vapor diffusion is begun by mixing a protein solution with a solution containing a precipitating agent, such as a salt, to initiate the process. The mixture forms a small droplet, and water from the droplet then transfers to a surrounding reservoir, which is an absorbent material containing a solution with a salt concentration higher than that of the droplet. The water transfer is caused by the difference between vapor pressures of the droplet and reservoir solutions.

Vapor Diffusion Apparatus (VDA) Experiment

A new thermal enclosure system (TES) used in the place of two mid-deck lockers, will house four vapor diffusion apparatus trays. The enclosure can act either as a refrigerator or an incubator. The temperature can be maintained to an accuracy of one-tenth degree Celsius, and it can be programmed to change over time. For the STS-62 flight, the temperature will be maintained at about 72 degrees Fahrenheit (22 degrees Celsius). Internal temperatures are recorded by a data logger in the thermal enclosure system.

Each of the four vapor diffusion apparatus trays in the TES has 20 protein crystal growth chambers. In each chamber, protein solutions are contained in one barrel and precipitating agent solutions in the other barrel of a small, double-barreled syringe.

About 5 hours after launch, a crew member will use a torque device for each tray to simultaneously retract plugs sealing the 20 syringe tips. He then will use the torque device to mix the solutions in each chamber by moving them in and out of the syringes. After mixing, the droplets will be moved out onto the syringe tips so vapor diffusion can begin. Shortly before the Shuttle returns to Earth, a crew member will deactivate the experiment by drawing the droplets, which by then will contain crystals, back into the syringes.

Some of the vapor diffusion apparatus syringes have been modified for this mission. Instead of being parallel, the barrels are bent toward one another at the syringe tips to ensure thorough mixing. On past flights, some solutions did not mix properly.

For instance, scientists had been unable to grow malic enzyme crystals in space until the 1992 United States Microgravity Laboratory-1 mission, when VDA experiment Principal Investigator Dr. Lawrence DeLucas served as a payload specialist. He was able to produce high-quality malic enzyme crystals by manually mixing the protein and precipitating agent solutions in the glovebox.

Protein Crystallization Apparatus for Microgravity (PCAM) Experiment

STS-62 will be the first flight of commercially purchased protein crystal growth plates, which will be housed in the hand-held PCAM. Four PCAMs, each containing a 6-inch by 4-inch plastic plate with 24 sample chambers, will be stowed in a middeck locker. Protein and precipitant solutions will be pre- mixed and loaded into small receptacles on the tips of pedestals in the centers of the circular chambers. A camcorder will be used to document the condition of solutions inside the PCAMs.

About 5 hours into Flight Day 2, a crew member will withdraw seals over the pedestal receptacles. This will expose the sample solutions to the open chambers, where donut-shaped absorbent reservoirs, containing more concentrated precipitating agent solutions, surround the pedestals. Crystal growth will continue throughout the mission. Solutions containing crystals will remain on the pedestal receptacles after they are resealed to deactivate the experiment shortly before landing.

If the PCAM equipment performs as expected, multiple units will be flown on future missions, allowing many more samples to be loaded in the same volume now used for vapor diffusion apparatus trays.

Individual plates flown for various co-investigators can be taken directly to their labs after landing. Currently, crystals go to a central lab for removal from the more complex vapor diffusion apparatus trays and for preliminary analysis before they are distributed to sponsoring scientists. Decreased handling and turnaround time would enhance X-Ray studies of the fragile crystals.

More than a dozen co-investigators from universities, research institutes and pharmaceutical companies around the world have proposed crystals for flight aboard STS-62. Candidate proteins were selected two to three months before the launch date, but the loaded configuration of flight samples in the VDAs and PCAMs will not be finalized until 2 days prior to liftoff.

These protein crystal growth experiments are sponsored by the Office of Life and Microgravity Sciences and Applications, NASA Headquarters, Washington, D.C., and the experiments and hardware are managed by the Marshall Space Flight Center, Huntsville, Ala. Dr. Dan Carter of Marshall is Principal Investigator for the hand-held PCAM experiments, and Dr. Lawrence DeLucas of the University of Alabama, Birmingham, is Principal Investigator for the Vapor Diffusion Apparatus experiments on STS-62.

COMMERCIAL DEVELOPMENT PROTEIN CRYSTAL GROWTH

The Commercial Protein Crystal Growth (CPCG) payload will be located in the Shuttle middeck and will use the space required for up to two standard middeck lockers. Protein crystal growth activities, sponsored by the Center for Macromolecular Crystallography (CMC), based at the University of Alabama-Birmingham, have focused on understanding and improving techniques for growth of protein crystals in space.

It has been shown that the weightlessness of spaceflight provides an excellent environment for improving the quality of protein crystals, which can be used in medical and scientific research. It is expected that the techniques developed by CMC will become the basis for commercially viable endeavors with significant benefit to the U.S. economy, along with providing dramatic advances in medicine and other scientific activities.

MIDDECK 0-GRAVITY DYNAMICS EXPERIMENT

The Middeck 0-Gravity Dynamics Experiment (MODE) is a reusable Space Shuttle middeck facility designed to study the nonlinear, gravity-dependent behavior of two types of space hardware -- contained fluids and large space structures -- planned for future spacecraft.

MODE is classified as a complex secondary payload and occupies 4 middeck lockers. The experiment requires less than 115 watts to operate.

MODE was first flown on STS-48 (Discovery, September 1991) where two separate fluids and structures experiments were combined into a single mission to take advantage of the commonality in the required electronics. In 18 hours of on- orbit operation, the MODE hardware performed flawlessly and returned more than 600 megabytes of high quality data on the nonlinear behavior of fluids and truss structures in the microgravity environment of the Shuttle middeck.

During the STS-62 mission approximately 40 hours of tests will be conducted on the MODE Structural Test Article (STA). MODE operations are scheduled for Flight Days 3 through 9.

The MODE mission objectives on Shuttle flight STS-62 are:

- Measure structural vibration modes not recorded during STS-48 due to unpredicted behavior of the test article.
- Expand structural test matrix through use of improved fidelity alpha-joint.
- Complete the MODE in-space test matrix.
- Complete and verify an analytical modeling capability for a reliable prediction of the linear and nonlinear modal characteristics of space structures in a microgravity environment.
- Obtain data on space structures to investigate on-orbit modal identification schemes.
- Obtain force measurements of nominal crew-induced disturbance loads on the Shuttle (MODE/STS-62 auxiliary experiment objective)

MODE/STS-62 will perform an extensive array of tests on various configurations of the MODE Structural Test Article (STA) to expand on the structural dynamics results of the STS- 48 mission.

The STA is composed of erectable and deployable modules which are arranged to produce configurations. Each module was fashioned after a typical space structural form.

The simplest arrangement of the modules, the “baseline- configuration”, is formed from two four-bay deployable modules connected in the center with erectable hardware components to form a straight truss. The objectives of the tests of this configuration are to determine the impact of gravity and suspension influences on a straight truss primarily composed of deployable hardware and to examine the influence of preload in the diagonal bracing wires of the deployable hardware on the measured ground and orbital modal parameters.

A slightly more complicated arrangement of modules, the “alpha-configuration”, is formed by replacing the erectable hardware of the center bay in the baseline-configuration with a rotary joint modeled after the alpha joint of the international space station. Although this configuration still forms a straight truss, the additional mass and internal dynamics of the articulating joint substantially changes the behavior of the system. The purpose of testing this configuration is to evaluate the influence of 1-g test methods on a truss with a rotary joint.

A more complex configuration includes deployable modules, erectable hardware and the rotary joint to form a planar truss designated as the “L-configuration”. Due to its shape and mass distribution, the L-configuration is the most difficult to test in a 1-g field and provides the greatest challenge to the testing of a planar structure.

Two sets of test protocols will be conducted on both the alpha- and L-configurations with two different rotary joints. One rotary joint, previously flown on STS-48, is constructed around two aluminum disks whose rotation relative to each other on stainless steel ball bearings can be constrained by a variable frictional load.

STA Configurations

The second rotary joint duplicates the structural load transfer path of the proposed international space station alpha joint and uses a set of torsional rods to more accurately simulate the gear/motor drive train of the space station joint.

Once on-orbit, astronauts will activate the MODE Experiment Support Module (ESM) -- basically, a miniature dynamics laboratory compressed to fit within a middeck locker - - deploy the Structural Test Article (STA) and attach the STA to the ESM via a flexible umbilical cable. The ESM computer then will be commanded to perform one of a series of preprogrammed test protocols.

An astronaut will monitor the experiment and record its operation on videotape. In case of any anomalies, the astronaut can halt the experiment and modify the preprogrammed protocols using a panel-mounted numeric keypad.

MODE Auxiliary Experiment - Crew Motion Force Measurements

This activity is directed to the measurement of crew push- off loads on board the Shuttle and to use these measurements to project the impact of crew motion on the microgravity environment of a space station. The MODE Experiment Support Module will be used to measure the output from a set of three dynamic load sensor assemblies. The three assemblies are configured as:

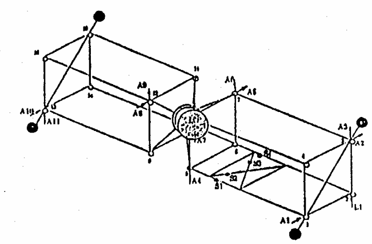
- Hand-hold (Handle, Spacelab Configuration) -- 6 degrees of freedom measuring forces and moments in three axes

- Foot Restraint (SSP temporary/mission specific configuration) -- 6 degrees of freedom measuring forces and moments in three axes

- Touch pad -- 3 degrees of freedom measuring forces in three axes

Approximately 25 hours of crew motion measurements will be made on Flight Days 7 through 13.

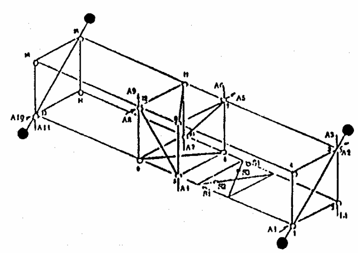
Alpha-Configuration



Utilizes:

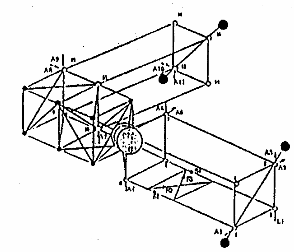
- Adjustable Deployable Unit (No. 1)
- Non-Adjustable Deployable Unit (No. 2)
- Alpha Joint
- 2 Sets of End Masses

Baseline-Configuration



Utilizes:

- Adjustable Deployable Unit (No. 1)
- Non-Adjustable Deployable Unit (No. 2)
- 4 Longerons
- 4 Diagonals
- 2 Sets of End Masses



Utilizes:

- Adjustable Deployable Unit (No. 1)
- Non-Adjustable Deployable Unit (No. 2)
- Alpha Joint
- Alpha Joint Interface Bay
- 10 Longerons
- 9 Diagonals
- 2 Sets of End Masses

\- L-Configuration

\- STA Test Configurations

EXTENDED DURATION ORBITER (EDO) MEDICAL PROJECT

A series of detailed supplementary objectives (DSOs) during the STS-62 mission will provide additional information for ongoing medical studies supporting the Extended Duration Orbiter (EDO) Medical Project.

The EDO Medical Project is designed to assess the impact of long-duration spaceflight, 10 or more days, on astronaut health; identify any operational medical concerns and test countermeasures for the adverse effects of weightlessness on human physiology.

For the STS-62 mission, the Medical Sciences Division of the Johnson Space Center, Houston, is sponsoring 11 DSOs that support the project. All of the studies have been flown on previous Shuttle missions.

Four of these tests will take place inflight -- DSO 603B “Orthostatic Function During Entry, Landing and Egress”; DSO 611 “Air Monitoring Instrument Evaluation and Atmosphere Characterization”; DSO 612 “Energy Utilization”; and DSO 623 “Lower Body Negative Pressure (LBNP) Countermeasures”. The other DSOs will occur before and/or after the mission.

DSO 603B documents the relationship between mission duration and changes in orthostatic function of crew members during the actual stresses of landing and egress from the seat and crew cabin. The protocol requires crew members to instrument themselves with Holter monitors prior to donning their launch and entry suits. Data from the monitors and blood pressure monitors will be recorded as will comments from the crew members during the operations.

The LBNP activity employs a bag in which a partial vacuum can be created around the lower torso. The bag encases the lower body and seals at the waist. By lowering the pressure within the bag, the subject’s body fluids are drawn to his lower extremities, imitating the natural fluid distribution that occurs on Earth due to gravity.

This conditions the cardiovascular system for the fluid shift that occurs upon re-entry and improves orthostatic tolerances. Two types of sessions will be performed with the LBNP during the mission -- 45-minute long “ramp” sessions that imitate the sudden return to gravity and 4-hour long “soak” protocols that attempt to better prepare the subject for the return to gravity.

DSO 611 is designed to evaluate and verify equipment for sampling the microbial contaminant level of the orbiter air. This is done several times during the mission using a device that resembles a large flashlight.

DSO 612 will assist researchers in determining the actual caloric requirements for spaceflight. Crew members will collect urine and saliva samples as well as keep a log of all fluid and food intake. Measurements also will be taken on astronauts’ blood glucose levels.

The DSOs performed before and after flight only include: DSO 604 “Visual-Vestibular Integration as a Function of Adaptation”; DSO 605 “Postural Equilibrium Control During Landing/Egress”; DSO 614 “The Effect of Prolonged Space Flight on Head and Gaze Stability During Locomotion” and DSO 626 “Cardiovascular and Cerebrovascular Response to Standing Before and After Space Flight.”

DSO 604 studies the changes in the sense of balance and the function of vision as a crew member readapts to gravity by having the subject make specific head movements while looking at a visual target on a locker in front of his seat and recording his sensations on a tape recorder.

DSO 605 is a series of movement coordination tests and sensory organization tests which the subject will perform just after landing. For the test, sensors are placed on one leg to record information on the subject’s muscle activity and its readaptation to gravity.

DSO 614 studies the changes in the sense of balance as the subject readapts to gravity and motion in gravity. For the tests, the subject will walk at different speeds on a treadmill after landing and step off of a small step as he looks at various visual targets. Sensors on the legs will record muscle activity during the tests.

DSO 626 measures the subject’s integrated cardiovascular responses as they stand up after landing. This test includes the measurement of blood volume.

Other DSOs will be performed largely before and/or after flight, but have a small amount of activity for the subject during flight. These include DSO 608 “Effects of Space Flight on Aerobic and Anaerobic Metabolism During Exercise.”

DSO 608 studies the changes in body composition caused by adapting to weightlessness, such as the shift of fluids headward and a general reduction in the total amount of body fluids, and their effect upon a subject’s readaptation to gravity. The only activity required in flight is for the crew member to record their daily fluid intake. After the flight, oxygen intake and body hydration are measured during a series of treadmill sessions, and total lean body mass is determined.

DSO 610 “In-Flight Assessment of Renal Stone Risk” is a study to determine whether prolonged exposure to weightlessness increases the risk of developing renal stones, commonly called kidney stones. For the assessment, subjects maintain a log of their food intake, fluid intake and exercise during the flight and take urine samples at periodic times.

BIOREACTOR DEMONSTRATION SYSTEM:
BIOTECHNOLOGY SPECIMEN TEMPERATURE CONTROLLER

The Biotechnology Specimen Temperature Controller (BSTC) experiment on STS-62 is the first phase of a series of four development tests that will fly on upcoming Shuttle missions to assist in development of the Bioreactor, a cell-culture growth device under development at the Johnson Space Center. The BSTC will test the performance of a temperature control device being developed for use with the Bioreactor. Proper control of temperature is a critical element of cell culture growth. The BSTC experiment does not include a prototype Bioreactor onboard. It is a test of a heating device that may be used with the Bioreactor and the experiment takes one middeck locker onboard Columbia. Colon carcinoma cells completely sealed in cell-culture chambers will be loaded into the unit prior to launch. The only crew interaction required is to turn the temperature controller on the outside of the experiment to 35 degrees Centigrade after reaching orbit. Following landing, the cell cultures will be removed by ground personnel and the specimens studied to evaluate the operation of the temperature controller.

A ground-control group of the same type cells and the same equipment will be run concurrently with the onboard device.

PHYSIOLOGICAL SYSTEM EXPERIMENT (PSE)

The Center for Cell Research, a NASA Center for the Commercial Development of Space at Pennsylvania State University, is sponsoring its fourth Physiological Systems Experiment payload on this flight. This class of experiments includes those which are designed to evaluate pharmaceutical, agricultural or biotechnological products.
The primary objective of PSE-04 is to study the complex interrelationship between the immune and skeletal systems during exposure to microgravity. Previous NASA and Center for Cell Research flight experiments have demonstrated that microgravity exposure rapidly impairs musculo-skeletal and immune system functions simultaneously.

The simultaneous impairment of these two systems also occurs in some disease states on Earth and indicates that the physiological controls of the two systems may be linked. To test the linkage hypothesis, a pharmaceutic that has the capacity to modulate both bone and immune cell function will be administered to 12 adult female rats prior to spaceflight.

COMMERCIAL GENERIC BIOPROCESSING APPARATUS

This payload is sponsored by the NASA Center for the Commercial Development of Space at the University of Colorado- Boulder, BioServe Space Technologies. The payload supports more than 15 commercial life science investigations that have application in biomaterials, biotechnology, medicine and agriculture. Investigations have been selected on the basis of commercial potential and ability to take advantage of the extended orbit time on this flight.

Each experiment sample is contained in a custom designed test tube called the Fluids Processing Apparatus (FPA). Each FPA typically contains three separate fluids that can be mixed sequentially on orbit by depressing a plunger mechanism. Generally the first two fluids are mixed early in the mission.

After a predefined processing interval, the third fluid is added to preserve the sample materials for return to Earth for detailed analysis. A wide variety of commercial life sciences investigations can be performed using this simple, generic approach.

AIR FORCE MAUI OPTICAL SYSTEM

The Air Force Maui Optical System (AMOS) is an electrical- optical facility on the Hawaiian island of Maui. No hardware is required aboard Columbia to support the experimental observations. The AMOS facility tracks the orbiter as it flies over the area and records signatures from thruster firings, water dumps or the phenomena of “Shuttle glow,” a well- documented fluorescent effect created as the Shuttle interacts with atomic oxygen in Earth orbit. The information obtained by AMOS is used to calibrate the infrared and optical sensors at the facility.

STS-62 CREWMEMBERS

STS062-S-002 -- These five NASA astronauts are in training for the ST-62 mission aboard Columbia scheduled for March of this year. John H. Casper, seated right, is mission commander, with Andrew M. Allen, seated left, assigned as Columbia's pilot. Standing, left to right are Charles D. (Sam) Gemar, Marsha S. Ivins and Pierre J. Thuot, all mission specialists.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

BIOGRAPHICAL DATA

JOHN H. CASPER, 50, Col., USAF, will be Commander (CDR) of STS-62. Casper considers Gainesville, Ga., his hometown. He will be making his third space flight.

Casper graduated from Chamblee High School, Chamblee, Ga., in 1961; received a bachelor's in engineering science from the Air Force Academy in 1966; received a master's in astronautics from Purdue University in 1967; and graduated from the Air Force War College in 1986.

Casper was a fighter pilot in the F-100 and F-4 aircraft and flew 229 combat missions in Vietnam. As a test pilot at the Air Force Flight Test Center, Casper was Chief, F-4E Test Team, and later commanded the 6513th Test Squadron. Assigned to Air Force Headquarters, he served as Deputy Chief of Special Projects for the Deputy Chief of Staff, Plans and Operations.

Casper became an astronaut in 1984. He was lead astronaut for improving the Shuttle orbiter nosewheel steering, brakes, tires and development of the landing drag chute. He also was an ascent/entry capsule communicator (Capcom) in the Mission Control Center. In 1990, Casper was Pilot for STS-36, a dedicated Department of Defense mission. In 1993, he commanded STS-54, which deployed a Tracking and Data Relay Satellite.

Casper has flown nearly 7,000 hours in 50 different aircraft and has logged 250 hours in space.

ANDREW M. ALLEN, 38, Major, USMC, will be Pilot (PLT) of STS-62. Selected as an astronaut in 1987, Allen was born in Philadelphia, Pa., and will be making his second space flight.

Allen graduated from Archbishop Wood High School, Warminster, Pa., in 1973 and received a bachelor's in mechanical engineering from Villanova University in 1977.

Allen was commissioned in the Marine Corps in 1977 and following flight school, flew F-4 Phantoms from 1980-83 at the Marine Corps Air Station, Beaufort, S.C. He was later selected for fleet introduction of the F/A-18 Hornet and flew that aircraft at the Marine Corps Air Station in El Toro, Calif., from 1983-86. During his assignment in El Toro, Allen graduated from the Marine Weapons and Tactics Instructor Course and the Naval Fighter Weapons School (Top Gun). In 1987, he graduated from the Navy Test Pilot School and was a test pilot under instruction when selected by NASA.

Allen's first Shuttle flight was as Pilot of STS-46, a mission that carried the Tethered Satellite System aboard Atlantis in August 1992. Allen has logged more than 191 hours in space and 4,000 flying hours in 30 different type of aircraft.

PIERRE J. THUOT, 38, Cmdr., USN, will be Mission Specialist 1 (MS1). Selected as an astronaut in 1985, Thuot considers Fairfax, Va., and New Bedford, Mass., to be his hometowns. He will be making his third space flight.

Thuot graduated from Fairfax High School, Fairfax, Va., in 1973; received a bachelor's in physics from the U.S. Naval Academy in 1977; and received a master's in systems management from the University of Southern California in 1985.

Thuot received his wings with the Navy in 1978 and trained as a radar intercept officer in the F-14 Tomcat. He later made overseas deployments aboard the USS John F. Kennedy and the USS Independence to the Mediterranean and Caribbean and attended the Navy Fighter Weapons School (Top Gun). He graduated from the Naval Test Pilot School in 1983 and was an instructor at that school at the time of his selection by NASA.

Thuot's first Shuttle flight was as a mission specialist on STS-36, a Department of Defense mission aboard Atlantis in February 1990. He next flew as a mission specialist on the first flight of Endeavour on STS-49 in May 1992, a mission that repaired the stranded Intelsat VI F3 communications satellite. During that mission, Thuot performed three spacewalks to capture and repair the satellite.

Thuot has logged more than 319 hours in space, including almost 18 hours spacewalking, and more than 3,000 flying hours in more than 40 different aircraft.

BIOGRAPHICAL DATA

CHARLES D. (SAM) GEMAR, 38, Lt. Col., USA, will be Mission Specialist 2 (MS2). Selected as an astronaut in 1985, Gemar considers Scotland, S.D., his hometown. He will be making his third space flight.

Gemar graduated from Scotland Public High School in 1973 and received a bachelor's in engineering from the U.S. Military Academy in 1979.

Gemar enlisted in the Army in 1973 and after graduating from West Point, attended the Infantry Officers Training Course, Initial Entry Rotary Wing Aviation Course and the Fixed Multi-Wing Aviator's Course at Ft. Rucker, Ala. In 1980, he began assignment at Stewart/Hunter Army Airfield as an assistant flight operations officer and flight platoon leader. He also completed the Army Parachutist Course, Ranger School and the Aviation Officers Advanced Course.

Gemar's first Shuttle flight was as a mission specialist on STS-38, a Department of Defense mission aboard Atlantis in November 1990. He next flew as a mission specialist on STS-48 aboard Discovery that deployed the Upper Atmosphere Research Satellite in September 1991. Gemar has logged more than 245 hours in space.

MARSHA S. IVINS, 42, will be Mission Specialist 3 (MS3). She was selected as an astronaut in 1984. Ivins considers Wallingford, Pa., to be her hometown. She will be making her third space flight.

Ivins graduated from Nether Providence High School in Wallingford in 1969 and received a bachelor's in aerospace engineering from the University of Colorado in 1973.

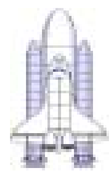
Ivins joined NASA in 1974 as an engineer in the Crew Station Design Branch at the Johnson Space Center, working on orbiter displays and controls and man-machine engineering. Among her major tasks was participating in development of the orbiter's heads-up display. In 1980, she was assigned as a flight simulation engineer on the Shuttle Training Aircraft.

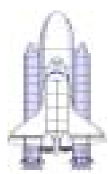
Ivins holds a multi-engine Airline Transport Pilot License, single-engine, airplane, land, sea and glider commercial licenses, and airplane, instrument and glider flight instructor ratings.

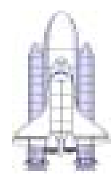
Her first Shuttle flight was as a mission specialist on STS-32 aboard Columbia that retrieved the Long Duration Exposure Facility in January 1990. She next flew as a mission specialist on STS-46 which carried the Tethered Satellite System aboard Atlantis in August 1992. Ivins has logged more than 452 hours in space and more than 5,000 flying hours in civilian and NASA aircraft.

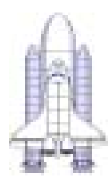
SHUTTLE FLIGHTS AS OF MARCH 1994

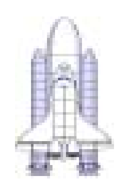
60 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 35 SINCE RETURN TO FLIGHT











OV-102 **Columbia** **(15 flights))**	**OV-099** **Challenger** **(10 flights)**	**OV-103** **Discovery** **(18 flights)**	**OV-104** **Atlantis** **(12 flights)**	**OV-105** **Endeavour** **(5 flights)**
		STS-60 02/03/94 - -2/11/94		
		STS-51 09/12/93 - 09/22/93		
		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-55 04/26/93 - 05/06/93		STS-42 01/22/92 - 01/30/92		
STS-52 10/22/92 - 11/01/92		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-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