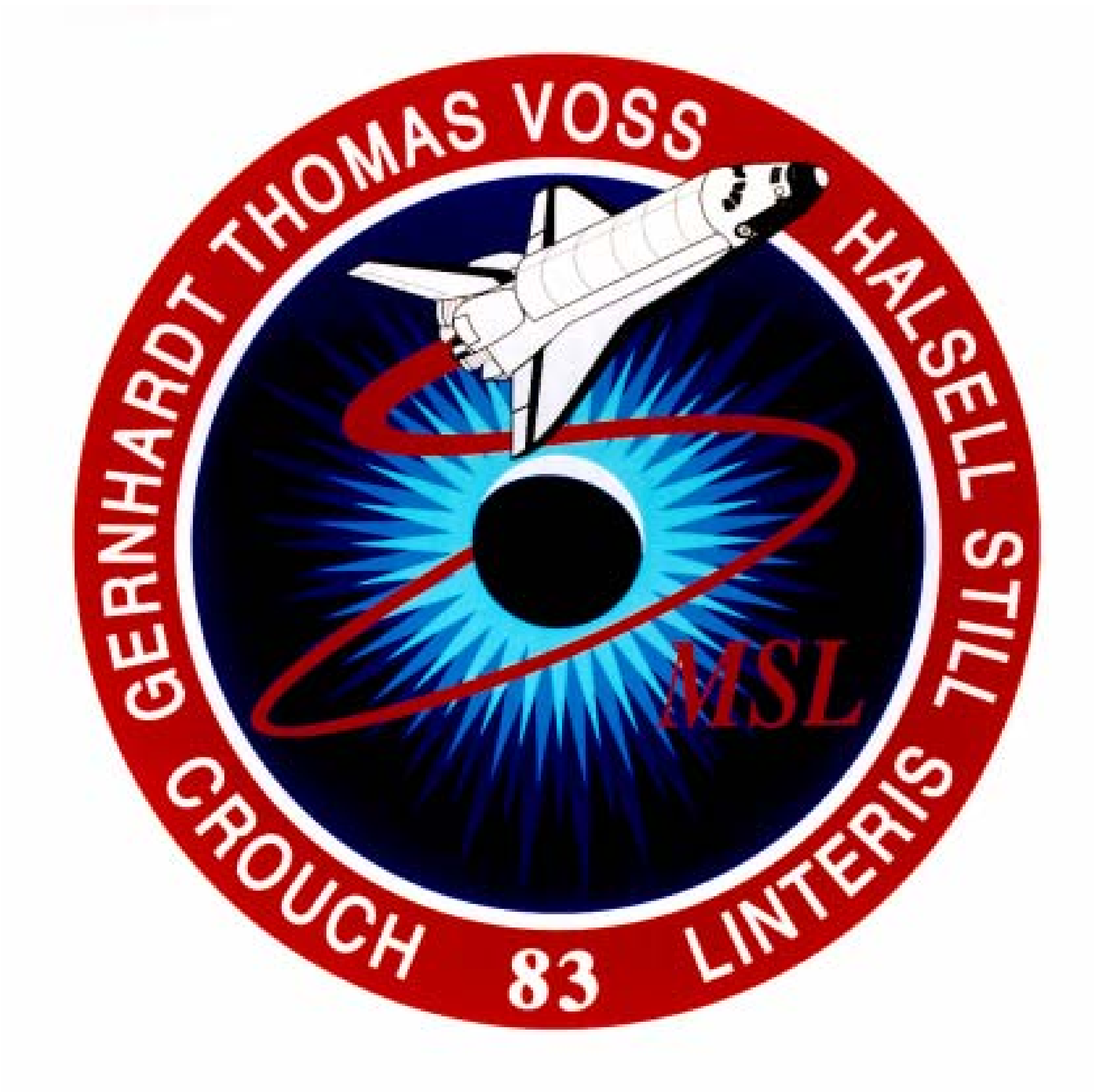
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION
STS-83

PRESS KIT
APRIL 1997



MICROGRAVITY SCIENCE LABORATORY-1 (MSL-1)

STS-83 INSIGNIA

STS083-S-001 – The insignia for NASA's STS-83 mission depicts the space shuttle Columbia launching into space for the first Microgravity Sciences Laboratory (MSL) mission. MSL will investigate materials science, fluid dynamics, biotechnology, and combustion science in the microgravity environment of space, experiments that will be conducted in the Spacelab module in Columbia's cargo bay during the planned 16-day mission. The center circle symbolizes a free liquid under microgravity conditions representing various fluid and materials science experiments. Symbolic of the combustion experiments is the surrounding starburst of a blue flame burning in space. The 3-lobed shape of the outermost starburst ring traces the dot pattern of a transmission Laue photograph typical of biotechnology experiments. The numerical designation for the mission is shown at bottom center. As a forerunner to missions involving International Space Station, STS-83 represents the hope that scientific results and knowledge gained during the flight will be applied to solving problems on Earth for the benefit and advancement of humankind.

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

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

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MICROGRAVITY RESEARCH HIGHLIGHTS MISSION STS-83

NASA's continuing effort to understand the subtle and complex phenomena associated with the influence of gravity in many aspects of our daily life will be the focus of the upcoming STS-83 Microgravity Science Laboratory (MSL-1) mission. The flight will involve Shuttle Columbia and her seven astronauts spending more than two weeks in orbit as they conduct a variety of experiments to examine how various materials and liquids change and behave in the weightless environment of space.

The STS-83 crew will be commanded by Jim Halsell, who will be making his third Shuttle flight. The pilot is Susan Still, who will be making her first flight and will be the second American woman to serve as a Shuttle pilot. There are three mission specialists on the flight. Janice Voss, making her third flight, is Mission Specialist-1 and is also the Payload Commander for STS-83. Mission Specialist-2 is Mike Gernhardt, making his second flight. Don Thomas is Mission Specialist-3 and is making his third flight. There are also two payload specialists serving on the STS-83 crew. Roger Crouch is Payload Specialist-1 and Greg Linteris is Payload Specialist- 2. Both Crouch and Linteris are making their first space flight.

Columbia is targeted for launch on April 3 from NASA's Kennedy Space Center (KSC) Launch Complex 39-A at 2:01 p.m. EST at the opening of a 2 _ hour available launch window. With an on-time launch on April 3 and a nominal 16-day mission, Columbia will land back at KSC on April 19 at about 7:30 a.m. EDT.

The primary focus for mission STS-83 is to conduct experiments and evaluate facilities associated with the Microgravity Science Laboratory-1 (MSL-1) payload. The MSL mission will serve as a bridge to America's future in space Ð the mission spanning the gap between the relatively short duration work done on today's Shuttle Spacelab flights to the long duration research that will be performed on the International Space Station.

MSL-1 will test some of the hardware, facilities and procedures that will be used on the International Space Station. It will introduce new procedures designed to place scientific payloads into orbit in a shorter amount of time than previously possible. The MSL flight will serve as a test-bed for new ways to conduct experiments in space -- helping to validate and improve that process. New methods of integrating experiments and equipment will be introduced, requiring new procedures at every step.

The STS-83 flight mirrors the future work aboard the Space Station in the international complexion of the flight. MSL-1 is bringing together academic, industrial and governmental partners from around the world. Scientists from four space agencies developed 33 investigations for the MSL-1 mission. Representatives of the European Space Agency, the German Space Agency and the National Space Development Agency of Japan are joining NASA and scientists throughout the United States in this research mission.

The STS-83 mission will introduce some new experiment facilities, designed to give scientists additional tools for finding answers in the microgravity of space. One such new component on MSL-1 is the innovative EXPRESS Rack, standing for EXpedite the PRocessing of Experiments to the Space Station. It is designed for quick and easy installation of experiment and facility hardware on orbit and will provide the same structural and resource connections the rack will have on ISS.

Another advanced operational concept being tested on MSL-1 is the use of expert software systems. Designed to reduce the number of people now required to support ISS operations, the software packages will help human controllers provide rapid response to changes in mission operations.

The work performed on the MSL-1 flight has direct impact to life back on Earth. The protein crystals being grown on the flight may help scientists better understand the structure of various diseases and possible cures. The experiments designed to examine the combustion process which will help improve the design of more efficient, clean-burning combustion engines and shed light, as well, on issues of fire safety. The materials science investigations will help researchers understand how the structure of a material forms and how this structure affects the material's properties with implications from electronic materials, to the strength or resistance to corrosion of some materials, to how flaws in glasses and alloys can make them crack or break more easily.

STS-83 will be the 22nd Flight of Columbia and the 83rd mission flown since the start of the Space Shuttle program in April 1981.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Television Transmission

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

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

Status Reports

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

Briefings

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

Internet Information

Information on STS-83 is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle Web, part of the World Wide Web. This site contains information on the crew and their mission and will be regularly updated with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

http://shuttle.nasa.gov

If that address is busy or unavailable, Shuttle information is available through the Office of Space Flight Home Page:

http://www.osf.hq.nasa.gov/

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

http://www.nasa.gov

or http://www.gsfc.nasa.gov/hqpao/hqpao_home.html

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

http://www.hq.nasa.gov/office/pao/NewsRoom/today.html

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

http://www.hq.nasa.gov/office/pao/ntv.html

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

- Pre-launch status reports (KSC): ftp.hq.nasa.gov/pub/pao/statrpt/ksc
- Mission status reports(JSC): ftp.hq.nasa.gov/pub/pao/statrpt/jsc
- Daily TV schedules: ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked.

NASA's Spacelink, a resource for educators, also provides mission information via the Internet. The system fully supports the following Internet services:

- World Wide Web: http://spacelink.msfc.nasa.gov
- Gopher: spacelink.msfc.nasa.gov
- Anonymous FTP: spacelink.msfc.nasa.gov
- Telnet : spacelink.msfc.nasa.gov

Spacelink's dial-up modem line is 205/895-0028.

Access by CompuServe

Users with CompuServe accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

STS-83 QUICK LOOK

Launch Date/Site:	April 3, 1997/KSC Launch Pad 39-A
Launch Time:	2:01 P.M. EST
Launch Window:	2 hours, 30 minutes
Orbiter:	Columbia (OV-102), 22nd flight
Orbit Altitude/Inclination:	160 nautical miles, 28.45 degrees
Mission Duration:	15 days, 16 hours, 36 minutes
Landing Date:	April 19, 1997
Landing Time:	7:37 A.M. EDT
Primary Landing Site:	Kennedy Space Center, Florida
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites Ben Guerir, Morocco; Moron, Spain Abort-Once Around - Edwards AFB, CA
Crew:	Jim Halsell, Commander (CDR), 3rd flight Susan Still, Pilot (PLT), 1st flight Janice Voss, Payload Commander, Mission Specialist-1 (MS-1), 3rd flight Mike Gernhardt, Mission Specialist-2 (MS-2), 2nd flight Don Thomas, Mission Specialist 3 (MS 3), 3rd flight Roger Crouch, Payload Specialist 1 (PS 1), 1st flight Greg Linteris, Payload Specialist 2, (PS 2), 1st flight
Spacelab Teams:	Red Team: Halsell, Still, Thomas, Linteris Blue Team: Voss, Gernhardt, Crouch
EVA Crewmembers) (if needed, contingency)	Mike Gernhardt (EV 1), Don Thomas (EV 2
Cargo Bay Payloads:	MSL-1, CRYOFD, OARE
In-Cabin Payloads:	SAREX, MSX

CREW RESPONSIBILITIES

Payloads	Prime	Backup
MSL-1 Activation/Deact	Voss	Gernhardt
MSL-1 Science	Voss	Others
Secondary Experiments	Gernhardt	Halsell, Still
EVA (if needed)	Gernhardt (EV 1)	Thomas
(EV 2) Intravehicular Crewmember	Still	----
Earth Observations	Still	Gernhardt
SAREX	Halsell	Gernhardt

DEVELOPMENT TEST OBJECTIVES

DTO 255:	Wraparound DAP Flight Test Verification
DTO 312:	External Tank TPS Performance
DTO 416:	Water Spray Boiler Quick Restart Capability
DTO 667:	Portable In-Flight Landing Operations Trainer
DTO 677:	Evaluation of Microbial Capture Device in Microgravity
DTO 684:	Radiation Measurement in Crew Compartment
DTO 805:	Crosswind Landing Performance

DETAILED SUPPLEMENTARY OBJECTIVES

DSO 331:	Integration of the Space Shuttle Launch and Entry Suit
DSO 487:	Immunological Assessment of Crewmembers
DSO 493:	Monitoring Latent Virus Reactivation and Shedding in Astronauts
RME 1309:	In-Suit Doppler Ultrasound for Determining the Risk of Decompression Sickness during Extravehicular Activities

RISK MITIGATION EXPERIMENTS

RME 1330:	Wireless Data Acquisition System

PAYLOAD AND VEHICLE WEIGHTS

	Pounds
Orbiter (Columbia) empty and 3 SSMEs	187,634
Shuttle System at SRB Ignition	4,522,854
Orbiter Weight at Landing with Cargo	259,705
MSL-1 Spacelab Module	22,418
CRYOFD	763
OARE	252

MISSION SUMMARY TIMELINE

Flight Day 1
Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
Spacelab Activation
MSL-1 Science Operations

Flight Day 2-14
MSL-1 Science Operations

Flight Day 15
MSL-1 Science Operations
Crew News Conference

Flight Day 16
MSL-1 Science Operations
Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stow
Spacelab Deactivation

Flight Day 17
Deorbit Preparation
Payload Bay Door Closing
Deorbit Burn
KSC Landing

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes for STS-83 include:

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

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

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

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

MICROGRAVITY SCIENCE LABORATORY-1 (MSL-1)

The first Microgravity Science Laboratory mission (MSL-1) is the bridge to America's future in space -- the mission spanning the gap between today's Spacelab and tomorrow's International Space Station.

MSL-1 will connect the foundations of American space exploration and discovery, laid by the Apollo, Skylab and Spacelab programs, to the Space Station.

Using Spacelab as a test-bed, MSL-1 will test some of the hardware, facilities and procedures that will be used on the International Space Station.

MSL-1 incorporates new and existing facilities to expand previous research -- and begin exploration in new directions.

With its primary goal as an orbiting laboratory for long- term research in microgravity, MSL-1 will introduce new procedures designed to place scientific payloads into orbit in a shorter amount of time than previously possible. It will serve as a test-bed for new ways to conduct experiments in space -- helping to validate and improve that process. New methods of integrating experiments and equipment will be introduced, requiring new procedures at every step.

Bringing together international academic, industrial and governmental partners in a venture that will model future operations, MSL-1 builds on past cooperative and scientific foundations. Those include the International Microgravity Laboratory missions, the U.S. Microgravity Laboratory missions, Spacelab J and the German Spacelab missions.

By thoroughly testing these new procedures, hardware, and systems, MSL-1 will help ensure that Space Station research has the best start possible. The information and samples from the mission's scientific investigations also will ensure mature, long-term research in microgravity.

MSL-1 Science

Scientists from four space agencies developed 33 investigations for the MSL-1 mission. Representatives of the European Space Agency, the German Space Agency and the National Space Development Agency of Japan are joining NASA and scientists throughout the United States in this mission of discovery.

The crew will conduct these experiments inside Spacelab, a versatile research laboratory which fits in the Space Shuttle cargo bay. With its extra work area, power supplies, information management capability and versatile equipment racks, scientists in space can work much as they would in their laboratories on Earth.

Many MSL-1 experiments owe their heritage to earlier Skylab, sounding rocket and ground-based experiments. Some experiments have evolved over several Spacelab missions. Some flown on previous flights are being flown again to probe new scientific questions or further explore prior studies.

Experiment Facilities

This mission will introduce some new experiment facilities, designed to give scientists additional tools for finding answers in the microgravity of space.

A new, key component on MSL-1 is the innovative EXPRESS Rack, standing for EXpedite the PRocessing of Experiments to the Space Station. It is designed for quick and easy installation of experiment and facility hardware on orbit.

On MSL-1, the EXPRESS Rack will replace a Spacelab double rack, and special hardware will provide the same structural and resource connections the rack will have on Space Station. Two payloads -- the Physics of Hard Spheres experiment and the Astro/Plant Generic Bioprocessing Apparatus experiment -- will be flown to check the design, development and adaptation of the EXPRESS Rack hardware.

Another advanced operational concept being tested on MSL-1 is the use of expert software systems. Designed to reduce the number of people now required to support Space Station operations, the software packages will help human controllers provide rapid response to changes in mission operations. If there is an unscheduled event during a mission, the system will provide immediate information about its impact on the operation of each experiment.

Conducting Science in Microgravity

The microgravity environment of the orbiting Space Shuttle provides unique opportunities to researchers.

Subtle and complex phenomena, normally hidden by the stronger force of gravity, can be revealed for detailed study. Mixtures that separate on Earth because of the different densities of their components can be mixed evenly and processed in microgravity. This allows scientists to study the processing of such materials and possibly to create advanced materials for study and comparison.

The growth of near-perfect protein crystals will enhance our understanding of protein molecular structures and may speed the development of improved drugs.

Also, scientists can use the microgravity environment of space to learn how the presence or absence of gravity affects living organisms. This will aid long-term space efforts and provide a better understanding of life on Earth by allowing scientists to study biological processes and phenomena impossible to study in gravity.

Protein Crystallography

Science has gained a better understanding of various diseases through research known as protein crystallography. Proteins are essential components of all living cells and serve many different functions. By studying a protein that is part of a virus, researchers can learn how that virus attacks plants or animals.

To determine the exact structure of a selected protein, scientists must grow near-perfect crystals of that protein. While some proteins can be crystallized easily on Earth, gravity works against the formation of perfect crystals of any substance. By growing protein crystals in microgravity, investigators can get significantly closer to the ideal of perfection.

Three protein crystal growth experiments are scheduled for MSL-1. The Protein Crystal Growth Using the Protein Crystallization Apparatus for Microgravity experiment will grow large quantities of various proteins. The Protein Crystal Growth Using the Second Generation Vapor Diffusion Apparatus experiment will grow high-quality crystals of various proteins using the alternate method known as vapor diffusion. The Protein Crystal Growth Using the Hand-Held Diffusion Test Cells experiment will grow crystals to investigate differences in the processes in microgravity from those on Earth and to refine the cell design for the Observable Protein Crystal Growth Apparatus.

Combustion Science

Combustion -- the more scientific term for burning -- plays a key role in processes involved in ground transportation, spacecraft and aircraft propulsion, and hazardous waste disposal. Yet, despite years of study, there is only a limited understanding of many fundamental combustion processes because Earth's gravity limits studies -- again, by masking many subtle phenomena.

The microgravity environment of space, however, allows scientists to expand the scale and duration of experiments and to study details hidden on Earth.

The MSL-1 mission will support three combustion investigations. The Laminar Soot Processes experiment will explore the properties and processes of soot and flames. The Structure of Flame Balls at Low Lewis-number experiment will try to determine if stable flame balls can exist. The Droplet Combustion Experiment will study the processes and phenomena associated with combustion in spherical fuel droplets.

Results from these experiments will improve understanding of how fundamental combustion phenomena are affected by gravity; advance combustion science and technology on Earth -- including the improved design of more efficient, clean-burning combustion engines; and shed light, as well, on issues of fire safety in space.

Materials Science

The key to materials science research is understanding how the structure of a material forms and how this structure affects the material's properties.

On Earth, sedimentation and buoyancy cause uneven mixing of a material's ingredients and can deform the structure as it solidifies. These gravity-induced imperfections limit the usefulness of many electronic materials. Imperfections in the structures of metals and alloys can affect mechanical strength or resistance to corrosion, while similar flaws in glasses and alloys can make them crack or break more easily. Gravity also affects the internal structure of polymers, long chains of organic molecules that form the basis of a range of products from nylon to plastic.

In microgravity, sedimentation and buoyancy are reduced or eliminated, allowing scientists to study the process of material formation in ways never before possible. Minute forces and phenomena that are overwhelmed by gravity on Earth can be observed and studied. Physical and chemical conditions present during processing can be controlled and changed, enabling investigators to learn how these factors affect the final structure of the material.

MSL-1 will feature 19 materials science investigations in three major facilities. These facilities are the Large Isothermal Furnace, the EXPRESS Rack and the Electromagnetic Containerless Processing Facility.

Additional technology demonstrations and experiments will be performed in the Middeck Glovebox facility.

The knowledge gained from these studies will benefit future microgravity research and material processing efforts and also will be used to improve materials processing on Earth.

Mission Operations

The Marshall Space Flight Center in Huntsville, Ala., manages MSL-1 as NASA's lead center for microgravity research.

Experiment operations for the 16-day flight will be directed from the Spacelab Mission Operations Control center at Marshall.

During the mission, scientists and engineers representing many MSL-1 experiments will work in Marshall's Science Operations Area. There, they will monitor experiments by video and voice links with the Shuttle, send remote commands to their instruments, discuss operations with the MSL-1 crew, and coordinate mission activities with members of other experiment teams.

The teams will be backed by colleagues working at remote sites for science operations and support.

Remote operations have been an important part of previous Spacelab missions. But MSL-1 will refine their operation, while making use of previous hardware and facilities. MSL-1 will have new remote operations in Tsukuba, Japan, as well as sites at Lewis Research Center in Cleveland, Ohio; and the University of Colorado at Denver. Also, a remote site -- distinct from the Spacelab Mission Operations Control facility -- will be operational at Marshall for the Glovebox experiments. Additional science teams will be located at the Johnson Space Center in Houston, Texas, and the Kennedy Space Center in Florida.

Primary responsibility for operating the experiments in orbit belongs to the Spacelab science crew. Payload Commander Janice E. Voss, Mission Specialists Donald A. Thomas and Michael L. Gernhardt, and Payload Specialists Roger K. Crouch and Gregory Linteris will work in two 12-hour shifts. Operating Spacelab 24 hours a day enables scientists to obtain the most from valuable time in orbit. The crew will work from a pre-planned master timeline, with adjustments allowed for unexpected opportunities.

After landing, many experiment samples -- some with limited lifetimes -- will be returned to the scientists for evaluation.

Later, experiment hardware will be returned to the space agency that developed it. And computer tapes, voice recordings, video tapes and other information collected in the experiments will be organized and forwarded to investigators. Analysis of the results will start even before the Shuttle returns to Earth, and may continue for several years.

The investigators will be rewarded with new insights into the intrinsic properties of materials and increased knowledge of how gravity affects living systems on Earth. And MSL-1 will certainly provide new questions for scientists and engineers seeking additional answers in the unique laboratory of space.

COMBUSTION MODULE-1

Combustion Module-1 was developed by NASA to test hardware and experiment approaches on Spacelab. The module can accommodate a variety of combustion experiments through the use of experiment-unique chamber inserts called Experiment Mounting Structures.

It requires two Spacelab racks--one double and one single-- with a combined weight of 1,600 pounds.

Housed in the double rack is the Experiment Package. The package contains a 24 gallon combustion chamber, a gas chromatograph, seven cameras, the experiments' computers and support equipment.

The combustion chamber has slide rails and can be quickly disconnected, allowing the crew to insert and connect the Experiment Mounting Structures.

The single rack contains the Fluid Supply Package and the Video Cassette Recorder Package. The Fluid Package consists of 20 bottled gases and supplies gas for combustion, combustion chamber purges, soot sampling, chemical diagnostics, on-orbit leak tests and pure air in the combustion chamber for science and crew access.

Combustion Module-1 will support two investigations during the mission.

Experiment: Laminar Soot Processes
Facility: Combustion Module 1
PI: Dr. Gerard Faeth, University of Michigan in Ann Arbor.

Laminar jet diffusion flames involve the combustion of a hydrocarbon fuel in still air. They are similar to candle flames except that the fuel is supplied by a gas jet rather than by evaporation from a wick. The shape of a laminar jet diffusion flame approximates combustion processes in many practical devices, such as diesel engines, aircraft jet engines and furnaces. Information will be collected on flame shape, the type and amount of soot produced under various conditions and the temperature of soot components. This experiment could lead to ways to contain unwanted fires, and also limit the number of fatalities from carbon monoxide emissions. Scientists also hope to use information learned from the experiment to improve theoretical models of combustion.

Experiment: Structure of Flame Balls at Low Lewis-number (SOFBALL)
Facility: Combustion Module-1
PI: Dr. Paul Ronney, University of Southern California in Los Angeles

The purpose of the investigation is to determine if stable balls of flame can exist. If proven they can, additional studies may determine if radiative loss is the stabilizing mechanism and how mixture properties affect flame balls. Information gained from this experiment could lead to improvements in lean-burn internal combustion engines, to increase efficiency and reduce emissions. Other benefits may include improved fire safety for mine shafts, chemical plants and spacecraft.

DROPLET COMBUSTION APPARATUS

The Droplet Combustion Apparatus is an enclosed chamber in which one investigation, the Droplet Combustion Experiment, will process during MSL-1.

Experiment: Droplet Combustion Experiment
Facility: Droplet Combustion Apparatus
PI: Dr. Forman Williams, University of California at San Diego

The purpose of the experiment is to collect information on burning rates of flames, flame structures and conditions when extinguishing a flame. Combustion of fuel droplets is an important element in heating furnaces for materials processing, heating homes and businesses, producing power by gas turbines, as well as combustion of gasoline in vehicle engines. With improved understanding of droplet combustion, the results of this experiment could lead to cleaner and safer ways to burn fossil fuels, and more efficient methods of generating heat and power on Earth.

Experiment: Fiber-Supported Droplet Combustion
Facility: Middeck Glove Box
PI: Dr. Forman Williams, University of California at San Diego

The purpose of the experiment is to study how fuels burn and test a new technique of droplet deployment and ignition using thin fibers for positioning. The fiber-supported droplet combustion technique will allow researchers to study fundamental combustion processes, such as how pollutants are formed. The mechanisms that cause the production of soot in flames are among the most

important unresolved problems of combustion science because soot affects life on Earth in many ways. Knowledge gained from this experiment could be applied to increased efficiency in the utilization of fossil fuels and to further the understanding of combustion byproducts such as soot and smog.

PROTEIN CRYSTAL GROWTH

Each cell in a living organism contains thousands of different proteins the substances which play essential roles in the maintenance of life. Protein crystals are used in basic biological research, pharmacology and drug development. However, the structures of many important proteins remain a mystery simply because researchers are unable to obtain crystals of sufficient quality or size. Earth's gravity affects the purity and structural integrity of crystals. The low gravity environment in space allows for the growth of larger, purer crystals of greater structural integrity. In some cases, the analysis of protein crystals grown in space has revealed more about a protein's molecular structure than has been possible even after years of effort with crystals grown on Earth. Three protein crystal growth studies will be conducted on MSL-1.

Experiment: Protein Crystallization Apparatus for Microgravity
PI: Dr. Dan Carter of New Century Pharmaceuticals in Huntsville, Ala.

Facility: The Protein Crystallization Apparatus for Microgravity consists of small plastic trays with seven sample wells surrounded by donut-shaped reservoirs. The complete crystallization apparatus comprises nine trays (63 specimens) carried in a cylinder with a crank mechanism.

MSL-1 will carry six cylinders in a Single-locker Thermal Enclosure System and another six in cabin-temperature locker, for a total of 756 specimens.

Experiment: Second-Generation Vapor Diffusion Apparatus
PI: Dr. Larry DeLucas of the Center for Macromolecular Crystallography at the University of Alabama in Birmingham.

Facility: This facility will use vapor diffusion techniques to process eleven different proteins in 80 crystallization chambers. These experiments in protein crystallization research include efforts to obtain detailed structural data on two proteins that relate to Chagas' disease, a debilitating and deadly disease that effects more than 20 million people in Latin America and parts of the United States. This work is in collaboration with an Investigators' Working Group currently comprised of Argentina, Brazil, Chile, Costa Rica, Mexico, Uruguay and the United States as part of a larger effort to help control communicable diseases.

Experiment: Handheld Diffusion Test Cells
PI: Dr. Alexander McPherson of the University of California, Riverside.

Facility: A single unit of the Hand-Held Diffusion Test Cells experiment consists of eight cells mounted on a rail and contained in a protective enclosure. Each test cell has three chambers containing a protein solution, a buffer solution and a precipitant solution chamber. Using the liquid-liquid diffusion method the different fluids are brought into contact but not mixed. Over time, the fluids will diffuse into each other through the random motion of molecules. The gradual increase in concentration of the precipitant within the protein solution causes the proteins to crystallize. A total of 32 specimens will be flown on MSL-1, and results will be used to refine the design of an Observable Protein Crystal Growth Apparatus being designed for later missions

EXPRESS RACK

The EXPRESS Rack is designed to simplify and speed the process of housing, transporting, installing and operating Space Station experiments. Officially called Expedite the Processing of Experiments to the International Space Station, the EXPRESS rack complies with established standards of Space Station hardware.

Developed by NASA's Life Sciences division, the rack contains 10 compartments for housing experiments -- eight smaller compartments called lockers and two larger, standardized compartments called drawers.

During the Microgravity Science Laboratory mission, two experiments will be conducted in the EXPRESS Rack to test and demonstrate the hardware.

The Physics of Hard Spheres Experiment will be transported into orbit in the EXPRESS Rack. It will be housed in four lockers and one drawer of the facility, demonstrating the rack's capability to accommodate smaller, standardized experiments.

The Astro/Plant Generic Bioprocessing Apparatus will be carried into orbit in the Shuttle's middeck and transferred to the EXPRESS Rack once in orbit. The apparatus will be returned to the middeck following the experiment run. This will demonstrate the ease and speed of installing and removing an EXPRESS Rack experiment, a process which will be used to transfer experiments to and from the International Space Station.

Physics of Hard Spheres Experiment
Dr. Paul Chaikin, Princeton University, Princeton, N.J.

Objective: The experiment will examine the changes which occur during the transition of a substances from liquids to solids and solids to liquids. These transitions are fundamental to materials processing. A better understanding of liquid-to- solid and solid-to-liquid transitional phases may result in the improved design of metallic alloys and processing techniques.

The investigation will examine seven, three-component samples of varying concentrations. The samples, contained in glass spheres, will be colloidal systems -- a colloid dispersed in a gas, liquid or solid. A colloidal substance consists of very small particles which will remain suspended in a medium, do not dissolve in it, and will diffract light. Using a Light Scattering Instrument, measurements of diffracted light from the small particles of the colloids will be obtained as varying degrees of force -- produced by a laser in the Light Scattering Instrument -- are applied to the samples.

Astro/Plant Generic Bioprocessing Apparatus (AstroPGBA)
Dr. Louis Stodieck, University of Colorado, Boulder, Colo.

Objective: This experiment will study the effect of space on certain species of plants. Specifically, it will investigate the production of lignin Ð essential for the formation and joining of woody cell walls in plants; the production of secondary metabolites -- essential to generating energy needed to sustain vital life processes; and changes which occur in the sugars and starches of vegetable plants. From this investigation, researchers hope to determine if these processes are interrelated and how they may be manipulated to improve plant growth and production on Earth. Researchers also hope the study will verify evidence that plants grown in microgravity require less metabolic energy to produce lignin, permitting greater production of secondary metabolites, a source of many medicinal drugs. Secondary metabolites may also serve to attract, repel or poison insects.

Plants to be studied include Artemisia annua, a species of sage native to Southeast Asia and a source of the antimalarial drug artemisinin; Catharanthus roseus, which produces vinca alkaloids, used in chemotherapy treatment of cancer; Pinus taeda (loblolly pine), used widely in the paper and lumber industries; and Spinacia oleracea, a variety of spinach.

LARGE ISOTHERMAL FURNACE

The Large Isothermal Furnace is a facility capable of uniformly heating large samples of metal alloys to 2912 degrees Fahrenheit (1,600 degrees Celsius) and rapidly cooling samples using a flow of helium. A vacuum-heating facility, the furnace consists of a sample container and heating element surrounded by a vacuum chamber.

The furnace will be used to study the diffusion of liquid metals -- the process by which liquid metals mix when heated. This process cannot adequately be studied on Earth because of convection.

The first, convection, is the transfer of heat caused by the movement of fluid particles which results from a variation in concentration and gravity. On Earth, liquids will gradually mix as a result of heat and stirring generated by convection. To study the effect of an outside source of heat and stirring on the mixing process, it is necessary to reduce or eliminate convection.

In the near-zero gravity aboard the orbiting Space Shuttle, researchers are able to study the diffusion process unaffected by convection. The experiments may provide a better understanding of how liquid metals mix, a process vital to the production of high quality metal alloys and products.

Measurement of Diffusion Coefficient by Shear Cell Method
Dr. Shinichi Yoda, National Space Development Agency of Japan (NASDA), Tsukuba, Japan

Objective: This experiment will test the shear cell cartridge, or container, to be used in two investigations conducted in the Large Isothermal Furnace. The cartridge is specifically designed for these two studies which will use the shear cell method to determine the diffusion coefficient -- or an accurate measurement for the fundamental variables which regulate diffusion.

This method involves two column samples of different concentrations. The columns are melted, then rotated into contact with each other for a specific period of time. The resulting single column is sheared into segments and cooled before measurements are taken.

Using the shear cell method, this study may also reveal the rate of diffusion of tin and lead-tin-telluride. Findings may lead to a better understanding of the diffusion process and improved metal alloys and products.

Diffusion of Liquid Metals
Dr. Toshio Itami, Hokkaido University, Sapporo, Japan

Objective: The study is designed to establish an accurate measurement for the fundamental variables which regulate diffusion of liquid tin relative to temperature. On Earth, diffusion experiments conducted at high temperatures have been unsuccessful due to convection, or fluid movement caused by gravity. This experiment may help researchers more clearly define the diffusion process and could lead to improved designs of metallic alloys and processing techniques on Earth.

Diffusion in Liquid Lead-Tin-Telluride
Ms. Misako Uchida, Ishikawajima-Harima Heavy Industries, Tokyo, Japan

Objective: Researchers hope to establish an accurate measurement for the diffusion coefficient of liquid lead-tin-telluride in relative to temperature. On Earth, it is difficult to achieve an equal distribution of particles in this metal mixture as the mixture solidifies. As with other liquid metals, the diffusion process is masked by gravity's influence on the movement of liquid particles. It also appears that diffusion's dependence on temperature is different in microgravity, or near-zero gravity. Lead-tin-telluride holds potential as a material for use in infrared detectors and lasers.

Impurity Diffusion in Ionic Metals
Dr. Tsutomu Yamamura, Tohoku University, Sendai, Japan

Objective: The objective of the study is to determine an accurate measurement for the diffusion coefficient of a tracer, or impurity, in molten salts. Conducting the study in the microgravity environment of the Space Shuttle will eliminate convection, or fluid movement caused by gravity. On Earth, convection disturbs the diffusion process, resulting in inconsistent measurements.

In addition, the study is designed to reveal ideal conditions for electrolysis of molten salts. Electrolysis is the use of an electrical current to break down a dissolved substance into its constituent components.

The experiment may provide needed information to improve the diffusion process. An accurate measurement for the diffusion coefficient in molten salts would also be useful in basic science and engineering work.

Liquid Phase Sintering II
Dr. Randall German, Pennsylvania State University, University Park, Penn.

Objective: The investigation will test theories of liquid- phase sintering -- to heat and liquefy materials to form a mixture without reaching the melting point of the solid phase material. Specifically, the study will examine the coalescence, or mixing together, of materials during liquid-phase sintering. The investigation will also look at changes that occur in the materials' pores which allow the mixing of fluids during liquid-phase sintering. Information gathered will be compared with theoretical predictions in hopes of improving theoretical models and developing a better understanding of sintering in microgravity.

Diffusion Processes in Molten Semiconductors
Dr. David N. Matthiesen, Case Western Reserve University, Cleveland, Ohio

Objective: The experiment is designed to determine an the diffusion coefficient relative to temperature, impurities and diameter of the sample. Specifically, researchers hope to establish an accurate measurement for the fundamental variables which regulate the diffusion of tracers, or impurities, of gallium, silicon and antimony in melted germanium.

On Earth, the movement of tracers during the processing of semiconductors or other materials results from a combination of diffusion and gravity-generated convection, or fluid movement caused by gravity. Since diffusion and convection cannot be separated on Earth, scientists have not been able to accurately measure the diffusion coefficient. This research is aimed at developing better models of diffusion.

MEASURING MICROGRAVITY

Space Acceleration Measurement System (SAMS)

Project Scientist: Dr. Peter Tschen, NASA Lewis Research Center, Cleveland, Ohio

Objective: The effects of Earth's gravity on the Space Shuttle and its cargo are markedly reduced when in orbit. But so strong are the forces of gravity, the effects are never completely eliminated. Disturbances occur when crew members move about the Shuttle, when onboard equipment is operated, or thrusters are fired to maneuver the Shuttle to its proper position. Even slight, atmospheric drag on the Shuttle can create disturbances that mimic gravity. Such minute changes in the orbital environment of the Shuttle can effect sensitive experiments being conducted onboard. Researchers and scientists conducting experiments on the Microgravity Science Laboratory mission will depend on the Space Acceleration Measurement System to record precise measurements of such changes. The system will enable them to adjust their experiments and improve the collection of scientific information during the mission. The system's measurements also aid in determining how vibrations or accelerations affect the results of experiments.

System Operation: The system accurately measures and maps the acceleration environment in orbit, using three remote sensor heads mounted in different locations. Each sensor head has three accelerometers oriented to enable the detection of accelerations three-dimensionally, in the range of .01- to 100- Hertz. For this mission, one sensor head will detect accelerations up to 2.5 Hertz, while others can detect accelerations up to 25 Hertz. Information collected by the sensors is transmitted to the ground through the Shuttle's communications system. This allows scientists to make immediate assessments of the effects of the microgravity environment, and make necessary corrections for their experiments.

Quasi-Steady Acceleration Measurement (QSAM)

Project Scientist: Dr. Hans Hamacher, German Aerospace Research Establishment (DLR)

Objective: Researchers who conduct scientific experiments in the microgravity environment of space require as few disturbances as possible. But even the near-vacuum of space has some forces of gravity and vibration. Among the disturbances encountered on a Space Shuttle mission are rapidly changing movements by the crew or periodic equipment operations. And steady accelerations -- changes in velocity -- such as a slight pull on the Shuttle created by atmospheric drag, also create disturbances making it impossible to achieve complete zero- gravity conditions.

Different experiments conducted in space are sensitive to different types of accelerations. To accurately interpret the results of their experiments, researchers need to know the precise level of accelerations that occur at all times during their experiments.

The Quasi-Steady Acceleration Measurement (QSAM) experiment is primarily designed to detect steady, very low-frequency, residual accelerations between 0 and 0.02 Hertz, or cycles per second.

System Operation: Low-frequency accelerations affect various physical processes more than higher-frequency accelerations. By means of a unique design of its sensor heads, the Quasi-Steady Acceleration Measurement experiment is able to make precise measurements of this important acceleration range.

This system complements three others that are measuring disturbances on the Microgravity Science Laboratory mission. Together, the four systems provide detection of the entire range of accelerations that may affect experiments.

Orbital Acceleration Research Experiment (OARE)
Project Scientist: Dr. Peter Tschen, NASA Lewis Research Center, Cleveland, Ohio

Objective: There is no line -- no hard boundary -- between Earth's atmosphere and space. At the Earth's surface, the atmosphere is thickest, and it gradually thins with increasing elevation. Even altitudes reached by the Space Shuttle are not completely without air. The Shuttle travels very rapidly through this tenuous, near-vacuum atmosphere. But the Shuttle is slightly slowed, or decelerated, by friction with the gas molecules. And because the density of the atmosphere changes from day to night, the amount of friction varies proportionally.

The Orbital Acceleration Research Experiment (OARE) makes extremely accurate measurements of these variations and other disturbances, using a sensor called an accelerometer, and records them for later analysis. Analysis of these and other types of microgravity disturbances enables researchers to assess the influence of Shuttle accelerations on the scientific experiments carried onboard the Microgravity Science Laboratory.

System Operation: The Orbital Acceleration Research Experiment is a self- calibrating instrument that monitors and records extremely small accelerations -- changes in velocity -- and vibrations that are experienced during orbit of the Shuttle. At the heart of the instrument is a miniature electrostatic accelerometer that precisely measures low- frequency, on-orbit acceleration disturbances. The OARE is capable of sensing and recording accelerations on the order of one-billionth the acceleration of Earth's gravity -- 1 nano-g - - at a frequency of less than 1 Hertz, or once per second.

The instrument's principal purpose is to help determine the orientation of the least acceleration disturbance for the Shuttle orbiter during flight. Information is collected and measured by the instrument. Then it is processed, stored and transmitted in near real-time to scientists on Earth. Based on this information, the Shuttle's flight attitude can be adjusted to satisfy the needs of any particular experiment.

Microgravity Measurement Assembly (MMA)
Project Scientist: Dr. Hans Hamacher, German Aerospace Research Establishment (DLR)

Objective: Many experiments onboard the Microgravity Science Laboratory require a very smooth ride through space so that their delicate operations are not disturbed. Yet even in the quiet, low-gravity environment of space, disruptions occur from movements by the crew, equipment operations and occasional firing of thrusters to adjust the orbital position of the Shuttle.

One of the systems developed to measure disruptions to experiments caused by accelerations is the Microgravity Measurement Assembly (MMA).

System Operation: The Microgravity Measurement Assembly determines both high- and low-frequency spacecraft disturbances, collecting measurements from seven sensor heads placed at selected locations in the Spacelab. Four of the sensor heads are placed in the Spacelab experiment racks, where many of the gravity-sensitive investigations are located. Most of the MMA sensors can detect accelerations in the range of 0.1- to 100-Hertz. One sensor, called the Accelerometre Spatial Triaxial Electrostatique, can measure accelerations below 1.0 Hertz.

Information collected from the sensors is sent to the instrument's central computer. It can be transmitted in real- time to researchers on the ground, where they can promptly assess measurements of the microgravity environment vs. the requirements for various experiments. From this, plans can be made for possible corrective actions for particular experiments.

TEMPUS

Electromagnetic Containerless Processing Facility (German: Tiegelfreies Elektromagnetisches Prozessieren Unter Schwerelosigkeit, or TEMPUS.)
Hardware Developer: Wolfgang Dreier, German Space Agency (DARA)

Project Scientists: Dr. Ivan Egry, German Aerospace Research Establishment (DLR), Cologne, Germany and Dr. Jan Rogers, NASA Marshall Space Flight Center, Huntsville, Ala.

The Electromagnetic Containerless Processing Facility -- referred to by its German acronym TEMPUS -- was developed by the German Space Agency. It is an electromagnetic levitation facility that allows scientists on the ground to process metallic samples in a containerless microgravity environment. TEMPUS uses a combination of an electromagnetic field and the microgravity environment to suspend metal alloys in free space within a set of coils so the alloys may be melted and resolidified in an ultra-pure environment. By levitating the sample within the coils, researchers can study the alloy's solidification while ensuring the sample does not touch any container's walls. The facility records information on the alloys while they are molten as they solidify.

The TEMPUS facility first flew on the second International Microgravity Laboratory (IML-2), a Shuttle and Spacelab mission in July 1994.

Electromagnetic levitation is commonly used in ground- based experiments to melt and then cool metallic substances below their "freezing" points while preventing solidification from occurring. The process of cooling metallic melts below their normal freezing points without solidification is termed "undercooling." The ability of very pure liquid alloys, in a microgravity environment, to remain liquid at hundreds of degrees below their normal solidification points is due to the absence of contact with other materials.

During the MSL-1 mission, scientists will perform experiments which build upon those conducted during IML-2, studying various thermodynamic and kinetic properties of 18 samples. For each investigation, a small spherical sample, about 5/16 inch round (7-8 mm), will be positioned by the electromagnetic coil, melted, and then cooled. Melting points of the samples range between 1,400-3,362 F (760-1,850 C), with the maximum sample temperature about 3,812 F (2,100 C).

A key phenomenon to be studies is nucleation. This is the initial stage of crystalline solidification, when small, isolated clusters of atoms begin arranging themselves into a regular, repeating structure. Atoms fall into place on these clusters, or nuclei, causing the sites to grow until the entire mass becomes solid.

The TEMPUS system provides the means for physically manipulating samples during processing. Rotations and oscillations can be controlled through the application of an electromagnetic field. Nucleation can be initiated at any desired undercooled temperature by inserting a needle into the sample, causing the entire sample to rapidly solidify. Also, the sample can be squeezed by applying short power pulses to the heating or levitation coils. By observing how the sample reacts, properties such as surface tension and viscosity can be determined.

Experiment: Thermophysical Properties of Undercooled Metallic Melts Facility: Electromagnetic Containerless Processing
Facility (TEMPUS)
Principal Investigator: Dr. Ivan Egry, DLR.
Co-Investigators: Dr. Georg Lohoefer, DLR; Dr. Berndt Feuerbacher, DLR.

To measure surface tension, viscosity, and electrical conductivity of liquid and undercooled alloys, specifically palladium- copper-silicon and cobalt-palladium. This experiment will provide information about the heat transfer properties of undercooled metallic melts. Findings from this study will complement existing information on liquid metals at and above the melting point, providing insight into the largely unexplored state where an undercooled liquid begins to solidify.

Experiment: Thermophysical Properties of Advanced Materials in the Undercooled Liquid State
Facility: TEMPUS
Principal Investigator: Dr. Hans F. Fecht, Technical University Berlin, Germany.
Co-Investigator: Dr. Rainer Wunderlich, Technical University Berlin.

This experiment will measure the heating properties of undercooled metallic substances to help researchers further understand how metallic glass forms in zirconium-based alloys. Comparisons between different alloys should indicate how the glass-forming ability of an alloy is related to its composition. Understanding the fundamentals of undercooling and formation of metallic glasses is vital for designing such materials. They may find applications in many technological areas because of their unique mechanical and physical properties. Some present areas of application include high-powered laser choke switches, transformer cores, brazing alloys, wear- resistant coatings and reinforcing fibers in metal matrices. In the future, these injection- molded, bulk metallic glasses could influence the state of materials science and engineering.

Experiment: Measurements of the Surface Tension of Liquid and Undercooled Metallic Melts by Oscillating Drop Technique Experiment
Facility: TEMPUS
Principal Investigator: Dr. Martin G. Frohberg, Technical University Berlin, Germany.
Co-Investigator: Dr. Michael Roesner-Kuhn, Technical University Berlin.

This experiment studies the surface tension of liquid metal drops, which are levitated and positioned in an electromagnetic field. The physical property of surface tension results from the forces of mutual attraction of the molecules making up a liquid. These forces cause the molecules at the drop's outer surface to be pulled inward. The approximately spherical shape of rain drops, for example, is a result of surface tension. The strength of the force working on the rain drop or any other liquid sample depends on the temperature and purity of the liquid. Scientists currently do not have sufficient data about concentration- and temperature-dependent surface tensions of liquid, and especially undercooled liquid, materials. Industrial processes which may benefit from findings include: metal-gas-slag reactions, filtration of melts, hot sintering of metallic powders, reactions between melts and refractories, solidification processes, and material flow in the interface between two different liquids.

Experiment: Study of the Morphological Stability of Growing Dendrites by Comparative Dendrite Velocity Measurements on Pure Ni and a Dilute Ni-C Alloy in the Earth and Space Laboratory Experiment
Facility: TEMPUS
Principal Investigator: Dr. D. M. Herlach, DLR.
Co-Investigator: Dr. M. Barth, DLR; Dr. B. Feuerbacher, DLR.

This experiment deals with the investigation of the dendritic solidification velocity resulting from small levels of melt undercooling. Dendrites -- from the Greek word for "tree" -- are tiny branching structures that form inside molten metal alloys when they solidify during manufacturing. The size, shape and structure of the dendrites have a major effect on the strength, ductility and usefulness of an alloy. Measurements of the speed of dendritic solidification can be used to test and refine modeling of dendritic growth behavior. This type of experiment must be performed in microgravity because crystal growth can be greatly affected by convective fluid flow, or buoyancy-driven motion, in molten metal. The low-acceleration environment in space effectively eliminates convection. Comparing space experiment data to those obtained on Earth will allow researchers to learn more about the effect convection has on dendrite growth. Information gained from this experiment could have significance in many manufacturing processes, such as welding and casting.

Experiment: Undercooled Melts of Alloys with Polytetrahedral Short-Range Order Experiment
Facility: TEMPUS
Principal Investigator: Dr. D. M. Herlach, DLR
Co-Investigator: Dr. Dirk Holland-Moritz, DLR; Dr. Heinrich Bach, University of Bochum, Germany; Dr. Hans Fecht, Technical University Berlin; Dr. Kenneth Kelton, Washington University, St. Louis; Dr. Berndt Feuerbacher, DLR.

The experiment will investigate the recently discovered and fascinating subject of quasicrystals. The quasicrystalline state, discovered in 1994, is a third state of solid matter -- in addition to the normal crystalline and glassy states. Quasicrystals exhibit excellent structural order based on atom arrangements. This feature provides quasicrystalline materials with a high degree of hardness and novel electrical and physical properties. This experiment is expected to provide a better understanding of nucleation and short-range order phenomena occurring in undercooled melts. Also, measurement of the specific heat (defined as the heat needed to raise one gram of substance one degree Celsius) will enable better analysis of undercooling experiments performed in space, as well as those performed on Earth. Sample materials used in this experiment are three quasicrystal-forming alloys of aluminum-copper-iron and aluminum-copper-cobalt.

Experiment: Thermal Expansion of Glass Forming Metallic Alloys in the Undercooled State
Facility: TEMPUS
Principal Investigator: Dr. K. Samwer, Institute for Physics, University of Augsburg, Germany.
Co-Investigator: Dr. B. Damaschke, Institute for Physics, University of Augsburg; Dr. Ivan Egry, DLR.

To investigate the thermal expansion of multicomponent amorphous alloys in the wide temperature range between the melting point and the glass transition point. Amorphous alloys are alloys consisting of many metals whose atoms are not arranged in the form of crystalline structures. Solids can be subdivided into crystalline or non-crystalline forms based on the internal arrangement of their atoms or molecules. The glass transition point is where this experiment is expected to reveal new information about both a thermodynamic approach to glassy and undercooled metals and the existence of structural changes in the undercooled alloys, which is important for the development of new customized materials.

Experiment: Experiments on Nucleation in Different Flow Regimes
Facility: TEMPUS
Principal Investigator: Dr. Robert Bayuzick, Vanderbilt University, Nashville, Tenn.
Co-Investigators: Dr. William H. Hofmeister, Vanderbilt University; Dr. Michael B. Robinson, NASA Marshall Space Flight Center.

This investigation looks to better understand specific details on how metals solidify and to investigate ways in which the solidification process can be controlled. Scientists hope to pinpoint what phenomenon kicks off solidification. The current understanding of the nucleation of solids is limited to models derived from the classical theory of nucleation. However, the unique environment of Spacelab provides the combination of requirements -- free- floating melts, great control of conditions within the melt and very careful measurement of temperature -- that will allow for an unparalleled opportunity to test the theory. Solidifying metals is one of the most important processes in industry. Learning more about nucleation may provide clues for making different materials. The studies may help determine the nucleation behavior of zirconium, a strong, ductile refractory metal used chiefly in nuclear reactors and chemical processing equipment.

Alloy Undercooling Experiments Experiment
Facility: TEMPUS
Principal Investigator: Dr. Merton Flemings, Massachusetts Institute of Technology (MIT), Cambridge, Mass.
Co-Investigator: Dr. Douglas Matson, MIT; Dr. Wolfgang Lšser, Institut fur Festkoerper und Westoffordchug, Dresden, Germany.

To measure the solidification velocity in steel alloys, using a combination of video and sophisticated temperature measurement techniques. Atoms in molten liquid alloy line up in a specified order as the alloy cools and becomes a solid crystal. Scientists hope to learn more about the order in which atoms attach to each other as they grow into a crystal structure. Investigators also want to study the speed at which the crystallization process occurs. The stainless steels employed in this experiment are the same sort of alloys we are familiar with in everyday life, such as the stainless steel used in pots and pans. However, a unique mode of solidification is being studied in this experiment -- one which will alter the internal structure and properties of the material. This experiment is designed to yield information on the transition phases and the speed at which solidification spreads as the temperature at the start of solidification is changed. The experiment has direct application to the design of steel strip casting facilities on Earth and will help scientists understand how welding processes may be conducted in space. This may help industry make better metals. For example, in the casting of high-performance metal components like jet engine turbine blades, each blade is the result of a crystal grown from a single nucleation site. Improving this process may make it possible to construct turbine blades that would have a greater operating efficiency through being capable to withstand higher temperatures. In another example, in welding stainless steels (where rapid solidification is encountered), unexpected and unexplained structures sometimes occur. The fundamental understanding gained in these experiments should help researchers to understand this behavior and to improve the welding process.

Measurement of Surface Tension and Viscosity of Undercooled Liquid Metals Experiment
Facility: TEMPUS
Principal Investigators: Dr. Julian Szekely (deceased); Dr. Merton Flemings, MIT; Dr. Gerardo Trapaga, MIT.
Co-Investigator: Dr. Robert Hyers, MIT.

This experiment is designed to demonstrate a containerless technique to measure both the viscosity -- or the resistance a gas or liquid has to flowing over a solid surface of other layers of fluid -- and the surface tension of reactive and undercooled liquid metals. The metals include zirconium, gold and metallic glass-forming alloys. The experiment will allow for viscosity measurements that are impossible to achieve in Earth-based experiments because of gravity. In the microgravity environment of space, force and fluid flow velocity is greatly reduced, allowing measurements to be taken. To measure the viscosity of a liquid, the internal flow velocity must be kept below a certain value to prevent a transition to turbulence. In ground-based electromagnetic levitation, the same forces that levitate the sample against gravity cause intensely turbulent internal fluid flows, making the measurement of viscosity impossible. In microgravity, however, the force and fluid flow velocity is greatly reduced. With care, it is possible to reduce the internal fluid flows.

Experiment: AC Calorimetry and Thermophysical Properties of Bulk Glass-Forming Metallic Liquids Experiment
Facility: TEMPUS
Principal Investigator: Dr. W. L. Johnson, California Institute of Technology (Caltech), Pasadena, Calif.
Co-Investigator: Dr. David Lee, Caltech.

The experiment will measure the thermophysical properties of glass-forming metallic alloys. Those properties include specific heat capacity, thermal conductivity, nucleation rates, surface tension, viscosity and thermal expansion. The experiment uses a new experimental method termed "non-contact modulation calorimetry" to measure the heat capacity and thermal conductivity of liquid metallic alloys cooled below the point at which they would normally solidify. The undercooled liquid range is accessible because molten metal alloys remain at liquid temperatures below their freezing point when they are suspended in a containerless manner such as provided by TEMPUS. Results of this investigation may lead to improving methods of processing metallic glasses. An understanding of the undercooling and formation of metallic glasses is vital to the design and processing of such materials. Some present applications for metallic glasses include high-powered laser choke switches, transformer cores, brazing alloys, hard-facing for coal-crusher teeth and oil field drill bits, and fly-ash resistant coatings in boilers. In the future, bulk metallic glasses will be made into increasingly complex shapes and their properties further tailored to applications as wide-ranging as the computer industry, processing plants and recreational sports.

MIDDECK GLOVEBOX

The Middeck Glovebox offers scientists the capability to conduct experiments, test science procedures, and develop new technologies in microgravity. The facility enables crew members to handle, transfer, and manipulate experiment hardware and materials that are not approved for use in the open Spacelab. In addition, the facility is equipped with photographic equipment and video and data recording capability, allowing a complete record of experiment operations.

Coarsening in Solid-Liquid Mixtures
D. Peter Voorhees, North Western University, Chicago, IL

The experiment will examine the process of coarsening in metals and use results developed during the mission to compare with current theoretical models. Coarsening may occur during the high-temperature operation of mechanical devices and may result in degradation of the strength of the materials. During coarsening, small particles shrink by loosing atoms to larger particles, causing the larger particles to grow and resulting in lack of uniform particle distribution . Materials containing larger particles are weaker than materials containing many small ones. Although the driving force for coarsening is well characterized, the speed and mechanisms by which it occurs are not.

To develop materials with particular lifetimes and predictable characteristics it is necessary to understand the mechanisms and rates of the coarsening process. This experiment may help researchers develop improved manufacturing processes and stronger metal alloys.

Experiment: Bubble and Drop Nonlinear Dynamics
Dr. L. G. Leal, University of California at Santa Barbara, California

Researchers hope to improve the understanding of how the shape and behavior of bubbles change in response to ultrasonic radiation pressure. It may be possible to develop techniques that eliminate or counteract the complications of that bubbles cause during materials processing. Many industrial applications, including the solidification of certain alloys, involve processes where large numbers of bubbles and drops are used. Scientists will assess their ability to control bubble location, manipulate double bubbles and maximize bubble shape. Shape deformation will be studied using ultrasonic pressure.

Experiment: A Study of Fundamental Operation of a Capillary- driven Heat Transfer (CHT) Device in Microgravity
Dr. Kevin P. Hallinan, University of Dayton, Ohio

Researchers hope to gain an improved understanding of the mechanisms leading to the unstable operation and failure of specialized heat transfer devices in space operations. Capillary-pumped loop devices transfer heat from one location to another, specifically those that move heat away from a particular location, such as in spacecraft where they transfer heat from electrical devices to radiators. The transfer of heat is accomplished by evaporating from one liquid surface at the hot side and condensing the vapor produced at the other side of the loop where heat is discharged into the surrounding area. This experiment investigates the fundamental fluid physics phenomena thought to be responsible for the failure of capillary-pumped loop devices in low-gravity operations.

Experiment: Internal Flows in a Free Drop
Dr. S. S. Sadhal, University of Southern California in Los Angeles, California

Researchers will investigate the capability of current non-contact and remote manipulation techniques for controlling the position and motion of liquids in low-gravity. Free single liquid drops will be deployed and positioned actively using ultrasonic pressure. Tracer particles will within the drops will be recorded by video cameras. Acoustic positioning is an important technique used in containerless processing of materials and in non-contact measurements of viscosity and surface tension. This experiment is important to many processes in chemical manufacturing industries, including such industries as petroleum technology, cosmetics and food sciences.

CRYOGENIC FLEXIBLE DIODE (CRYOFD)

The Cryogenic Flexible Diode (CRYOFD) heat pipe experiment is a Hitchhiker payload flying on Space Shuttle Columbia during the STS-83 mission. Flight testing of heat pipes in space is being conducted to gain advances in passive thermal control technology. Engineers hope to transfer any technology achieved in space to commercial applications on Earth.

Spacecraft electronics are packed tightly together and generate heat, which can limit their performance. Heat pipes can remove heat from the electronics and redirect it to other areas that need heating or to radiators that vent that heat outside the spacecraft. Heat pipes are primarily used in spacecraft and play an ever-increasing role in spacecraft telecommunications.

CRYOFD is a flight experiment jointly developed and sponsored by NASA's Goddard Space Flight Center in Greenbelt, Md. and the U.S. Air Force Phillips Laboratory in Albuquerque. The CRYOFD experiment is on the cutting edge of thermal control technology. The payload consists of two heat pipe experiments: the Cryogenic Flexible Diode Heat Pipe (CFDHP) and the American Loop Heat Pipe with Ammonia (ALPHA). Cryogenic heat pipes are used to cool instruments and improve their performance.

There are two CFDHP units: one uses oxygen as the working fluid to operate at temperatures as low as 60 Kelvin; the other uses methane to operate at temperatures as low as 100 Kelvin. These heat pipes incorporate unique flexible wick designs and flexible bellows to permit easier integration into a spacecraft or with an instrument. Since they are flexible, heat pipes also permit pointing of the instrument.

The ALPHA experiment represents the first flight demonstration of the American Loop Heat Pipe. ALPHA will operate near room temperature (20 C) and can transport heat loads of up to 500 watts over distances of 1 - 2 meters with a very small temperature drop (e.g., less than 10 C). Deployable radiators for high power telecommunications spacecraft are a potential application of this technology.

The Hitchhiker Project is managed by the Shuttle Small Payloads Project in the Engineering Directorate at Goddard. Hitchhiker's modular hardware also allows for flexibility in locating and manifesting experiments of different sizes and needs to optimize use of the Shuttle Cargo Bay. Hitchhiker avionics provide power and control data flow between the CRYOFD payload and the Shuttle. The avionics unit also carries the equipment for transmitting the data real-time to Goddard. Experimenters can command their payload and downlink data in real-time from the Payload Operations Control Center located at Goddard.

More information on the CRYOFD mission can be found on the world wide web at: http://sspp.gsfc.nasa.gov/cryofd.htm. The mission manager for the flight of CRYOFD is Susan Olden of Goddard Center and the principal investigator is Marko Stoyanof from USAF Phillips Laboratory in Albuquerque.

SHUTTLE AMATEUR RADIO EXPERIMENT

STS-83 will include Amateur (or "ham") radio, where radio operators and students will attempt to make radio contacts with the orbiting Shuttle as part of a project called Shuttle Amateur Radio EXperiment, or SAREX. Amateur Radio has been flying aboard the Shuttles since 1983.

Ham radio operators from around the world will point their antennas at the Space Shuttle Columbia, hoping to find the astronauts on-the-air. Some of these amateurs have volunteered to assist student groups who have prepared questions to ask the astronauts during specially scheduled contact times. To make their radio contacts, the astronauts will use a radio aboard the Shuttle on frequencies used by ham radio operators.

To operate Amateur Radio from the Space Shuttle, one or more of the astronauts must have an Amateur Radio license. The STS-83 crew members who are licensed Amateur Radio operators include Commander James D. Halsell, Payload Commander Janice E. Voss, and Mission Specialist Donald A. Thomas.

During SAREX missions, the astronauts will typically make the following types of Amateur Radio contacts: * Scheduled radio contacts with schools. * Random radio contacts with the Amateur Radio community. * Personal contacts with the astronauts' families.

SAREX SPONSORS: The Shuttle Amateur Radio EXperiment (SAREX) is sponsored by the American Radio Relay League (ARRL), The Radio Amateur Satellite Corporation (AMSAT) and The National Aeronautics and Space Administration (NASA). SAREX is supported by the Federal Communications Commission.

SHUTTLE TRACKING: Current Keplerian elements to track the Shuttle are available from the following sources:

* NASA Spacelink computer information system
  BBS: (205) 895-0028 [VT-100, 8-N-1]
  Telnet, FTP, and Gopher: spacelink.msfc.nasa.gov
  World Wide Web: http://spacelink.msfc.nasa.gov
  Internet TCP/IP address: 192.149.89.61

* NASA SAREX WWW Home Page: http://www.nasa.gov/sarex/sarex_mainpage.html

* ARRL
  W1AW news bulletins (frequencies and times listed under "FOR FURTHER INFORMATION")
  BBS: (860) 594-0306
  ARRL World Wide Web: http://www.arrl.org/sarex/

* AMSAT
  World Wide Web: http://www.amsat.org

* Johnson Space Center Amateur Radio Club
  World Wide Web: http://www.phoenix.net/mbordel/jscarc/index.html
  BBS: (713) 244-5625

* Goddard Amateur Radio Club
  BBS: (301) 286-4137
  World Wide Web: http://garc.gsfc.nasa.gov/www/garc- home-page.html
  Packet: WA3NAN on 145.090 MHz in DC area

CONFIGURATION: During STS-83, the SAREX hardware will be flown in configuration C.

FOR FURTHER INFORMATION:
Contact the American Radio Relay League
Educational Activities Department 225
Main Street, Newington CT 06111-1494 USA
Telephone (860) 594-0301, FAX (860) 594-0259, ARRL BBS (860) 594-0306
Internet sarex@arrl.org
World Wide Web http://www.arrl.org/
CompuServe 70007,3373
America Online HQARRL1

ARRL's (Newington, CT) Amateur Radio station (call sign W1AW) transmits news bulletins (9:45 PM, 12:45 AM EST) on HF bands at 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59 megahertz (MHz).

Members of the Goddard Amateur Radio Club (Greenbelt, MD) re- transmit live, Shuttle air-to-ground audio over the amateur frequencies from their club station, WA3NAN. To listen-in, tune to Amateur Radio high frequency (HF) bands at 3.86, 7.185, 14.295, 21.395, and 28.65 megahertz (MHz) and in the Maryland/DC area, on a very high frequency (VHF) band at 147.45 MHz.

STS-83 CREWMEMBERS

STS083-S-002 -- Five NASA astronauts and two scientists comprise the crew for the STS-83 mission in support of the first Microgravity Sciences Laboratory (MSL-1). On the front: left to right: Janice E. Voss, James D. Halsell Jr. , Susan L. Still and Donald Thomas. Back row: Roger K. Crouch, Gregory T. Linteris and Michael L. Gernhardt. Halsell is mission commander, with Still assigned as pilot. Voss, Gernhardt and Thomas are all mission specialists. Dr. Crouch and Dr. Linteris, payload specialists, are experts in several disciplines which will be treated on MSL-1.

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PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

BIOGRAPHICAL DATA

JAMES DONALD HALSELL Jr.: STS-83 Mission Commander: (Lieutenant Colonel, USAF)

BIRTH DATE/PLACE: Born September 29, 1956, in Monroe, Louisiana. Considers West Monroe, Louisiana, his home.

EDUCATION: Graduated from West Monroe High School, West Monroe, Louisiana, in 1974; received a bachelor of science degree in engineering from the United States Air Force (USAF) Academy in 1978, a master of science degree in management from Troy University in 1983, and a master of science degree in space operations from the Air Force Institute of Technology in 1985.

RECREATIONAL INTERESTS: Enjoys snow skiing, water skiing, light aircraft flying, running and exercising.

ORGANIZATIONS: Member of the Society of Experimental Test Pilots (SETP).

SPECIAL HONORS: Graduated first in test pilot school class and awarded the Liethen/Tittle Trophy for the Best Overall Record for Flying and Academic Performance (1986). Recipient of the USAF Flying Safety Award (1980), and the USAF Pilot Training Academic Award (1979).

EXPERIENCE: Halsell graduated from the USAF Academy in 1978, and from Undergraduate Pilot Training at Columbus Air Force Base, Mississippi, in 1979. Assigned to Nellis Air Force Base, Las Vegas, Nevada, from 1980-1981, he served as an F-4D aircraft commander, qualified in conventional and nuclear weapons deliveries. From 1981-1984, he was stationed at Moody Air Force Base, Valdosta, Georgia, where he served as an F-4E flight lead and instructor pilot. In 1984-1985, he was a graduate student at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. His thesis, sponsored by JSC Crew Systems Division, prototyped a space rescue transfer vehicle using off-the-shelf equipment. He then attended the Air Force Test Pilot School at Edwards Air Force Base, California, and during the next four years he performed test flights in the F- 4, the F-16, and the SR-71 aircraft.

Selected by NASA in January 1990, Halsell became an astronaut in July 1991. Assigned to the Astronaut Office Mission Support Branch, Halsell initially served as a spacecraft communicator (CAPCOM) in the Mission Control Center (MCC). Subsequently, he was assigned to the Astronaut Support Personnel team which helps to prepare the Space Shuttle vehicles for flights at the Kennedy Space Center, Florida.

Halsell was the pilot on STS-65. The seven-member crew aboard Space Shuttle Columbia launched from Kennedy Space Center in Florida on July 8, 1994, and returned there on July 23, 1994, setting a new flight duration record for the Space Shuttle program. The STS-65 mission flew the second International Microgravity Laboratory (IML-2). During the 15- day flight the crew conducted more than 80 experiments focusing on materials and life sciences research in microgravity. The mission was accomplished in 236 orbits of the Earth, traveling 6.1 million miles.

Most recently, Halsell served as pilot on STS-74, NASA's second Space Shuttle mission to rendezvous and dock with the Russian Space Station Mir. During the 8 day flight the crew aboard Space Shuttle Atlantis successfully attached a permanent docking module to Mir and transferred over 2,000 pounds of food, water and scientific supplies for use by the cosmonauts. The STS-74 mission was accomplished in 129 orbits of the Earth, traveling 3.4 million miles in 196 hours, 30 minutes, 44 seconds.

BIOGRAPHICAL DATA

SUSAN LEIGH STILL: STS-83 Pilot (Lieutenant Commander, USN)

BIRTHDATE/PLACE: Born October, 24, 1961, in Augusta, Georgia. Her parents, Joe and Sue Still, reside in Martinez, Georgia. Her mother, Jean Ann Batho Still, is deceased.

PHYSICAL DESCRIPTION: Blonde hair; brown eyes; 5 feet 6 inches; 120 pounds.

EDUCATION: Graduated from Walnut Hill High School, Natick, Massachusetts, in 1979. Bachelor of science degree in aeronautical engineering from Embry-Riddle University, 1982. Master of science degree in aerospace engineering from Georgia Institute of Technology, 1985.

RECREATIONAL INTERESTS: Enjoys triathlons, martial arts, and playing the piano.

ORGANIZATIONS: Association of Naval Aviation.

SPECIAL HONORS: Distinguished Naval Graduate of Aviation Officer Candidate School; Distinguished Graduate of the United States Naval Test Pilot School, Class 103; Awarded the Navy Commendation Medal, Navy Achievement Medal, and National Defense Service Medal.

EXPERIENCE: After graduating from undergraduate school, Susan worked as a Wind Tunnel Project Officer for Lockheed Corporation in Marietta, Georgia and earned her graduate degree. She was commissioned in 1985 and designated a naval aviator in 1987. Still was selected to be a flight instructor in the TA-4J Skyhawk. She later flew EA-6A Electric Intruders for Tactical Electronic Warfare Squadron 33 in Key West, Florida. After completing Test Pilot School, she reported to Fighter Squadron 101 in Virginia Beach, Virginia for F-14 Tomcat training. She has logged over 2,000 flight hours in more than 30 different aircraft.

NASA EXPERIENCE: Selected by NASA in December 1994, Susan reported to the Johnson Space Center in March 1995, has completed a year of training and evaluation, and is currently qualified for assignment as a shuttle pilot. She is presently working technical issues for the Vehicle Systems and Operations Branch of the Astronaut Office while awaiting her first flight assignment.

JANICE VOSS: STS-83 Payload Commander / Mission Specialist-1 (Ph.D.)

BIRTH DATE/PLACE: Born October 8, 1956, in South Bend, Indiana, but considers Rockford, Illinois, to be her hometown. Her parents, Dr. & Mrs. James R. Voss, reside in Dupont, Indiana.

PHYSICAL DESCRIPTION: Light brown hair; brown eyes; 5 feet 6 inches; 130 pounds.

EDUCATION: Graduated from Minnechaug Regional High School, Wilbraham, Massachusetts, in 1972; received a bachelor of science degree in engineering science from Purdue University in 1975, a master of science degree in electrical engineering and a doctorate in aeronautics/astronautics from the Massachusetts Institute of Technology in 1977 and 1987, respectively. From 1973 to 1975 she took correspondence courses at the University of Oklahoma. She also did some graduate work in space physics at Rice University in 1977 and 1978.

RECREATIONAL INTERESTS: Reading science fiction, dancing, volleyball, flying.

ORGANIZATIONS: Member of the American Institute of Aeronautics and Astronautics (AIAA).

SPECIAL HONORS: NASA Space Flight Medals (1993, 1995); Zonta Amelia Earhart Fellowship (1982); Howard Hughes Fellowship (1981); National Science Foundation Fellowship (1976).

EXPERIENCE: Dr. Voss was a co-op at the NASA Johnson Space Center from 1973 to 1975. During that time she did computer simulations in the Engineering and Development Directorate. In 1977 she returned to the Johnson Space Center and, for a year, worked as a crew trainer, teaching entry guidance and navigation. She completed her doctorate in 1987 and accepted a job with Orbital Sciences Corporation. Her responsibilities there included mission integration and flight operations support for an upper stage called the Transfer Orbit Stage (TOS). TOS launched the Advanced Communications Technology Satellite (ACTS) from the Space Shuttle in September 1993, and the Mars Observer from a Titan in the Fall of 1992.

Selected by NASA in January 1990, Dr. Voss became an astronaut in July 1991. She is qualified for assignment as a mission specialist on future Space Shuttle flight crews. Her technical assignments have included working Spacelab/Spacehab issues for the Astronaut Office Mission Development Branch, and robotics issues for the EVA/Robotics Branch. Dr. Voss first flew on STS-57 (June 21 to July 1, 1993). Mission highlights included retrieval of the European Retrievable Carrier (EURECA) with the Shuttle's robotic arm, a spacewalk by two crew members, and an assortment of experiments in the first flight of the Spacehab middeck augmentation module. More recently, she flew on STS-63 (February 3-11, 1995). Mission highlights included the rendezvous with the Russian Space Station, Mir, the deployment and retrieval of Spartan 204, and the third flight of Spacehab. In completing her second flight, Dr. Voss has logged over 438 hours in space.

MICHAEL L. GERNHARDT: STS-83 Mission Specialist-2 (Ph.D.)

BIRTH DATE/PLACE: Born May 4, 1956, in Mansfield, Ohio. His father, George M. Gernhardt, resides in Marco Island, Florida. His mother, Suzanne C. Winters, resides in Whitestone, Virginia.

PHYSICAL DESCRIPTION: Blond hair; blue eyes; 6 feet 2 inches; 175 pounds.

EDUCATION: Graduated from Malabar High School, Mansfield, Ohio, in 1974; received a bachelor of science degree in physics from Vanderbilt University in 1978; master of science degree and a doctorate in bioengineering from University of Pennsylvania, in 1983 and 1991, respectively.

RECREATIONAL INTERESTS: Enjoys running, swimming, triathlons, flying, fishing, snow skiing, tennis, and scuba diving.

ORGANIZATIONS: Member, American Institute of Aeronautics and Astronautics (AIAA), and the Undersea and Hyperbaric Medical Society.

EXPERIENCE: From 1977 to 1984, Gernhardt worked as a professional deep sea diver and project engineer on a variety of subsea oil field construction and repair projects around the world. He has logged over 700 deep sea dives and has experience in air, mixed gas, bounce bell and saturation diving. During his diving career Gernhardt attended graduate school at the University of Pennsylvania and developed a new theoretical decompression model based on tissue gas bubble dynamics. He then participated in the development and field implementation of a variety of new decompression tables. From 1984 to 1988, Gernhardt worked as Manager and then Vice President of Special Projects for Oceaneering International. During this time he led the development of a telerobotic system for subsea platform cleaning and inspection as well as a variety of new diver and robot tools. In 1988 he founded Oceaneering Space Systems, a wholly owned subsidiary of Oceaneering International. From 1988 until his selection by NASA in 1992, he worked on the development of new astronaut and robot-compatible tools for performing maintenance on Space Station Freedom. He also worked on the development of new portable life support systems and decompression procedures for extravehicular activity.

NASA EXPERIENCE: Dr. Gernhardt was selected by NASA in March 1992, and reported to the Johnson Space Center in August 1992. His technical assignments include having served in the Astronaut Office Mission Support Branch, detailed to flight software verification in the Shuttle Avionics Integration Laboratory (SAIL). He also worked on the development of nitrox diving to support training for the Hubble Space Telescope repair and on a variety of Space Station EVA developments. Most recently, Dr. Gernhardt was a mission specialist on STS-69 which launched on September 7, 1995. The primary objective was the successful deployment and retrieval of a SPARTAN satellite and the Wake Shield Facility (WSF). The WSF is designed to evaluate the effectiveness of using this free- flying experiment to grow semiconductors, high temperature superconductors and other materials using the ultra-high vacuum created behind the spacecraft near the experiment package. Dr. Gernhardt was one of two astronauts to perform a spacewalk to evaluate future Space Station tools and hardware. Following 171 orbits of the Earth, Endeavour landed at the Kennedy Space Center on September 18, 1995. In completing his first space flight, Mike logged a total of 260 hours, 29 minutes, and 8 seconds in space, including 6 hours and 46 minutes of EVA.

DONALD A. THOMAS: STS-83 Mission Specialist-3 (Ph.D.)

BIRTH DATE/PLACE: Born May 6, 1955, in Cleveland, Ohio. His mother, Mrs. Irene M. Thomas, resides in Bloomington, Indiana.

PHYSICAL DESCRIPTION: Brown hair; brown eyes; 5 feet 10 inches; 160 pounds

EDUCATION: Graduated from Cleveland Heights High School, Cleveland Heights, Ohio, in 1973; received a bachelor of science degree in Physics from Case Western Reserve University in 1977, and a master of science degree and a doctorate in Materials Science from Cornell University in 1980 and 1982, respectively. His dissertation involved evaluating the effect of crystalline defects and sample purity on the superconducting properties of niobium.

MARITAL STATUS: Married to the former Simone Lehmann of Geppingen, Germany. Her parents, Margrit and Gerhard Lehmann, reside in Geppingen, Germany.

CHILDREN: Son, Kai, February 16, 1995.

RECREATIONAL INTERESTS: Swimming, biking, camping, flying.

ORGANIZATIONS: Member, American Institute of Aeronautics and Astronautics (AIAA), and Tau Beta Pi.

SPECIAL HONORS: Graduated with Honors from Case Western Reserve University in 1977. Recipient of NASA Sustained Superior Performance Award, 1989. Recipient of NASA Group Achievement Awards in 1990, 1992, and 1994 for his work on the Microgravity Disturbances Experiment, the Shuttle System Safety Review Panel, and development of the Microgravity Measurement Device.

EXPERIENCE: Following graduation from Cornell University in 1982, Dr. Thomas joined AT&T Bell Laboratories in Princeton, New Jersey, working as a Senior Member of the Technical Staff.

His responsibilities there included the development of advanced materials and processes for high density interconnections of semiconductor devices. He was also an adjunct professor in the Physics Department at Trenton State College in New Jersey. He holds two patents and has authored several technical papers. He left AT&T in 1987 to work for Lockheed Engineering and Sciences Company in Houston, Texas, where his responsibilities involved reviewing materials used in Space Shuttle payloads. In 1988 he joined NASA's Lyndon B. Johnson Space Center as a Materials Engineer. His work involved lifetime projections of advanced composite materials for use on Space Station Freedom. He was also a Principal Investigator for the Microgravity Disturbances Experiment, a middeck crystal growth experiment which flew on STS-32 in January 1990. This experiment investigated the effects of Orbiter and crew-induced disturbances on the growth of crystals in space. He is a private pilot with over 250 hours in single engine land aircraft and gliders, and over 500 hours flying as mission specialist in NASA T-38 jet aircraft. Selected by NASA in January 1990, Dr. Thomas became an astronaut in July 1991. He has worked in the Safety and Operations Development Branches of the Astronaut Office working on issues relating to Shuttle Orbiter systems, and was also a spacecraft communicator (CAPCOM) for Shuttle missions STS-47, 52 and 53. A veteran of two space flights, he flew as a mission specialist on STS-65 in 1994, and STS-70 in 1995, and has logged 568 hours and 15 minutes in space. He is scheduled to fly aboard Columbia on STS-83 in the Spring of 1997. STS-65 flew the second International Microgravity Laboratory (IML-2) Spacelab module. The seven-member crew aboard Space Shuttle Columbia launched from Kennedy Space Center in Florida on July 8, 1994, and returned there on July 23, 1994, setting a new flight duration record for the Space Shuttle program. During the 15-day flight the crew conducted more than 80 experiments focusing on materials and life sciences research in microgravity. The mission was accomplished in 236 orbits of the Earth, traveling 6.1 million miles. Dr. Thomas next served on STS-70, and was responsible for the deployment of the sixth and final Tracking and Data Relay Satellite from the Space Shuttle. The five-member crew aboard Space Shuttle Discovery launched from the Kennedy Space Center July 13, 1995, and returned there July 22, 1995. During this 8 day 22 hour mission, the crew completed 142 orbits of the Earth, traveling 3.7 million miles.

ROGER K. CROUCH: STS-83 Payload Specialist-1

BIRTHPLACE AND DATE: Considers Jamestown, TN, where he was born September 12, 1940, as his hometown. Currently resides in Laurel, MD. His mother, Mrs. Maxine S. Crouch, lives in Jamestown. His father, Willard Crouch is deceased.

PHYSICAL DESCRIPTION: Brown hair; hazel eyes; 6 feet; 195 pounds.

EDUCATION: Earned a bachelor of science in physics from Tennessee Polytechnic Institute in 1962, a master of science and a doctor of philosophy in physics from Virginia Polytechnic Institute in 1968 and 1971, respectively. He was a visiting scientist at Massachusetts Institute of Technology in 1979-80.

EXPERIENCE: As the Chief Scientist of the NASA Microgravity Space and Applications Division since 1985 he has served as the manager for a research program that supports materials science, fluid physics, low temperature microgravity physics, combustion science, and biotechnology. He had responsibility for assuring that experiments in the flight program achieved the highest levels of scientific results possible. He served as Program Scientist on Spacelab J, the second International Microgravity Laboratory Program (IML-2), the first United States Microgravity Laboratory (USML-1) and a Program Scientist (Materials Sciences) IML-1. In addition, he helped organize and has served as co-chairman for Microgravity Science Working Groups between NASA and the European Space Agency, France, Germany, Japan and Russia. He was the co-chair of the International Microgravity Science Strategic Planning Group. He was the co-chair for the IML Science Working Group from 1985-1989. He has served on several governmental interagency panels on Materials Science, most recently as a team member assessing the potential for collaborative efforts between the U.S. and China. He was a co- principal investigator on an experiment that flew in the Materials Experiment Apparatus on the D-1 mission. Prior to working in NASA Headquarters, he had been at the Langley Research Center since 1962. His last position there was group leader of a research group investigating the effects of convection on semiconductor properties. He was a principal investigator in the MSAD flight program from 1977-1985. He has done research in various types of semiconductor crystal growth, electrical and optical properties of materials, electronic devices for remote sensing and flat panel displays and heat shield protection for reentry space vehicles. He trained as the Alternate Payload Specialist on STS-42 (First International Microgravity Laboratory).

PUBLICATIONS: Published over 40 technical papers and more than 40 technical presentations in various areas of research, concentrating since 1978 on semiconductor crystal growth and the influence of gravitational forces on materials properties.

SPECIAL HONORS: Floyd Thompson Fellowship 1979; Quality Increase 1972, 1986, 1988; Exceptional Service Award 1989; Outstanding Performance Rating, 1985, 1986, 1987, 1989, Certificates of Recognition 1973, 1975, 1976, 1977, 1979, 1980, 1981, 1984 (2), 1985, 1986, 1987 (3), Special Achievement Award, 1983, Sustained Superior Performance Award, 1989, Superior Accomplishment Award 1992, NASA Exceptional Achievement Medal 1995.

ORGANIZATIONS: Member of American Physical Society, American Association for Crystal Growth, Sigma Pi Sigma, Kappa Mu Epsilon.

RECREATIONAL INTERESTS: Hobbies include traveling, photography, basketball, softball, camping, hiking, fishing, and whitewater rafting.

GREGORY T. LINTERIS: STS-83 Payload Specialist-2 (Ph.D.)

BIRTHPLACE AND DATE: Born October 4, 1957, in Demarest, New Jersey, where his parents, Lino Luigi Linteris and Helen Mary Linteris reside.

PHYSICAL DESCRIPTION: Brown hair; brown eyes; 5 feet 7 inches; 135 pounds.

EDUCATION: Graduated from Northern Valley Regional High School at Demarest, New Jersey in 1975; received a bachelor of science degree in chemical engineering from Princeton University in 1979; obtained a master of science degree from the design division of the mechanical engineering department at Stanford University in 1984; and was awarded a doctorate in mechanical and aerospace engineering from Princeton University in 1990.

RECREATIONAL INTERESTS: He enjoys running, skiing, board sailing, hiking, backpacking, and reading, and was a member of Princeton's wrestling team.

ORGANIZATIONS: Member of American Institute of Aeronautics and Astronautics, American Physical Society, Combustion Institute, Sigma Xi.

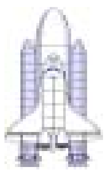
PUBLICATIONS: Dr. Linteris has over 40 publications in the areas of combustion, chemical kinetics, spectroscopy, and heat transfer.

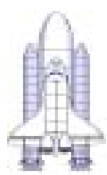
SPECIAL HONORS: Graduated with honors from Princeton University (1979). Awarded a Mechanical Engineering Department Fellowship from Stanford University (1983), and received Fourth Place in the James F. Lincoln National Design Competition (1984). At Princeton, he was the recipient of a Guggenheim Fellowship (1985), a Grumman Prize for excellence in Research (1988), and the Luigi Crocco Award (1988) for outstanding performance as an Assistant in Instruction.

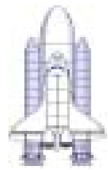
EXPERIENCE: At Princeton from 1985 to 1990, Dr. Linteris studied the high temperature chemical kinetics of combustion reactions in a turbulent chemical kinetic flow reactor using laser induced fluorescence and laser absorption. As a research staff member at the University of California, San Diego, from 1990 to 1992, he studied droplet dynamics and performed numerical and analytical modeling of the chemistry important in the gas-phase reaction region of solid rocket propellants. Since 1992 he has been at the National Institute of Standards and Technology where he has been developing a research program on advanced fire suppressants and studying the inhibition mechanisms of chemical inhibitors. He is Principle Investigator on a NASA microgravity combustion experiment: "Chemical Inhibitor Effects on Diffusion Flames in Microgravity."

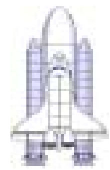
SHUTTLE FLIGHTS AS OF APRIL1997

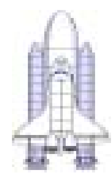
82 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 57 SINCE RETURN TO FLIGHT











OV-102 Columbia (21 flights)	OV-099 Challenger (10 flights)	OV-103 Discovery (22 flights)	OV-104 Atlantis (18 flights)	OV-105 Endeavour (11 flights)
		STS-82 02/11//97 - 02/21/97		
STS-80 11/19/96 - 12/07/96		STS-70 07/13/95 - 07/22/95		
STS-78 06/20/96 - 07/07/96		STS-63 02/03/95 - 02/11/95		
STS-75 02/22/96 - 03/09/96		STS-64 09/09/94 - 09/20/94		
STS-73 10/20/95 - 11/05/95		STS-60 02/03/94 - 02/11/94	STS-81 01/12/97 - 01/22/97	
STS-65 07/08/94 - 07/23/94		STS-51 09/12/93 - 09/22/93	STS-79 09/16/96 - 09/26/96	
STS-62 03/04/94 - 03/18/94		STS-56 04/08/83 - 04/17/93	STS-76 03/22/96 - 03/31/96	
STS-58 10/18/93 - 11/01/93		STS-53 12/02/92 - 12/09/92	STS-74 11/12/95 - 11/20/95	
STS-55 04/26/93 - 05/06/93		STS-42 01/22/92 - 01/30/92	STS-71 06/27/95 - 07/07/95	
STS-52 10/22/92 - 11/01/92		STS-48 09/12/91 - 09/18/91	STS-66 11/03/94 - 11/14/94	
STS-50 06/25/92 - 07/09/92		STS-39 04/28/91 - 05/06/91	STS-46 07/31/92 - 08/08/92	
STS-40 06/05/91 - 06/14/91		STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92	STS-77 05/19/96 - 05/29/96
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-72 01/11/96 - 11/20/96
STS-32 01/09/90 - 01/20/90	STS-61A 10/30/85 - 11/06/85	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91	STS-69 09/07/95 - 09/18/95
STS-28 08/08/89 - 08/13/89	STS-51F 07/29/85 - 08/06/85	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91	STS-67 03/02/95 - 03/18/95
STS-61C 01/12/86 - 01/18/86	STS-51B 04/29/85 - 05/06/85	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90	STS-68 09/30/94 - 10/11/94
STS-9 11/28/83 - 12/08/83	STS-41G 10/05/84 - 10/13/84	STS-51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90	STS-59 04/09/94 – 04/20/94
STS-5 11/11/82 - 11/16/82	STS-41C 04/06/84 - 04/13/84	STS-51G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89	STS-61 12/02/93 - 12/13/93
STS-4 06/27/82 - 07/04/82	STS-41B 02/03/84 - 02/11/84	STS-51D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89	STS-57 06/21/93 - 07/01/93
STS-3 03/22/82 - 03/30/82	STS-8 08/30/83 - 09/05/83	STS-51C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88	STS-54 01/13/93 - 01/19/93
STS-2 11/12/81 - 11/14/81	STS-7 06/18/83 - 06/24/83	STS-51A 11/08/84 - 11/16/84	STS-61B 11/26/85 - 12/03/85	STS-47 09/12/92 - 09/20/92
STS-1 04/12/81 - 04/14/81	STS-6 04/04/83 - 04/09/83	STS-41D 08/30/84 - 09/05/84	STS-51J 10/03/85 - 10/07/85	STS-49 05/07/92 - 05/16/92