NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-59

PRESS KIT
APRIL 1994

SPACE RADAR LABORATORY-1

STS-59 INSIGNIA

STS059-S-001 -- Designed by the crew members, the STS-59 insignia is dominated by Earth, reflecting the focus of the first Space Radar Laboratory (SRL-1) mission upon our planet's surface and atmosphere. The golden symbol of the astronaut corps emblem sweeps over Earth's surface from the space shuttle Endeavour, representing the operation of the SIR-C/Synthetic Aperture Radar (X-SAR) and the Measurement of Air Pollution from Space (MAPS) sensors. The astronaut emblem also signals the importance of the human element in space exploration and in the study of our planet. Using the unique vantage point of space, Endeavour and its crew -- along with scientists from around the world -- will study Earth and its environment. The star field visible below Earth represents the many talents and skills of the international (SRL-1) team in working to make this "Mission to Planet Earth" a scientific and operational success.

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

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PUBLIC AFFAIRS CONTACTS

Ed Campion NASA Headquarters Washington, DC	Policy/Management	202/358-1778
James Hartsfield Johnson Space Center Houston, TX	Mission Operations Astronauts	713/483-5111
Bruce Buckingham Kennedy Space Center, Fl	Launch Processing KSC Landing Information	407/867-2468
June Malone Marshall Space Flight Center Huntsville, AL	External Tank/SRBs/SSMEs	205/544-0034
Nancy Lovato Dryden Flight Research Center Edwards, CA	DFRC Landing Information	805/258-3448

For Information on NASA-Sponsored STS-59 Experiments

Brian Dunbar NASA Headquarters Washington, DC	SRL-1	202/358-1547
Mike Braukus NASA Headquarters Washington, DC	STL Experiments	202/358-1979
Debra Rahn NASA Headquarters Washington, DC	International Cooperation	202/358-1639
Terri Sindelar NASA Headquarters Washington, DC	SAREX Payload	202/358-1977
Tammy Jones Goddard Space Flight Center Greenbelt, MD	GAS Experiments	301/286-5566
Jane Hutchinson Ames Research Center Mountain View, Calif.	TUFI Experiment	415/604-4968

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RELEASE: 94-38

SPACE RADAR HIGHLIGHTS SHUTTLE MISSION STS-59

In April 1994, scientists around the world will be provided a unique vantage point for studying how the Earth's global environment is changing when Space Shuttle Endeavour is launched on Shuttle mission STS-59. During the 9-day mission, the Space Radar Laboratory (SRL) payload in Endeavour's cargo bay will give scientists highly detailed information that will help them distinguish human-induced environmental changes from other natural forms of change.

NASA will distribute the data to the international scientific community so that this essential research is available worldwide to assist people in making informed decisions about protecting the environment.

Leading the STS-59 crew will be Mission Commander Sidney M. Gutierrez who will be making his second flight. Pilot for the mission is Kevin P. Chilton who is making his second flight. The four mission specialists aboard Endeavour are Linda M. Godwin, the STS-59 Payload Commander, who will be making her second flight; Jerome Apt who will be making his third flight; Michael R. "Rich" Clifford who will be making his second flight; and Thomas D. Jones who will be making his first flight.

Launch of Endeavour on the STS-59 mission currently is scheduled for no earlier than April 7, 1994, at 8:07 a.m. EDT. The planned mission duration is 9 days, 5 hours, 7 minutes. An on-time launch on April 7 would produce a landing at 1:14 p.m. EDT on April 16 at the Kennedy Space Center's Shuttle Landing Facility.

The Space Radar Laboratory (SRL) payload is comprised of the Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) and the Measurement of Air Pollution from Satellite (MAPS). The German Space Agency (DARA) and the Italian Space Agency (ASI) are providing the X-SAR instrument.

The imaging radar of the SIR-C/X-SAR instruments have the ability to make measurements over virtually any region at any time, regardless of weather or sunlight conditions. The radar waves can penetrate clouds, and under certain conditions, can also "see" through vegetation, ice and extremely dry sand. In many cases, radar is the only way scientists can explore inaccessible regions of the Earth's surface.

An international team of 49 science investigators and three associates will conduct the SIR-C/X-SAR experiments. Thirteen nations are represented: Australia, Austria, Brazil, Canada, China, the United Kingdom, France, Germany, Italy, Japan, Mexico, Saudi Arabia and the United States.

The MAPS experiment will measure the global distribution of carbon monoxide in the troposphere, or lower atmosphere. Measurements of carbon monoxide, an important element in several chemical cycles, provide scientists with indications of how well the atmosphere can clean itself of "greenhouse gases," chemicals that can increase the atmosphere's temperature.

STS-59 will see the continuation of NASA's Get Away Special (GAS) experiments program. The project gives the average person a chance to perform experiments in space on a Shuttle mission. There are three GAS payloads on this flight: a New Mexico State University experiment to examine the freezing and crystallization process of water in space; an experiment to explore thermal conductivity measurements on liquids in microgravity sponsored by the Matra Marconi Space of Paris, France; and the Society of Japanese Aerospace Companies, Inc., experiment to find out whether small fruiting bodies can be obtained in microgravity.

The STS-59 mission will fly the first cooperative initiative with the National Institutes of Health (NIH). The joint initiative in cell biology will use a special cell culture system developed by the Walter Reed Army Institute of Research, Washington, D.C. The system known as Space Tissue Loss-4/National Institutes of Health-1 will examine the effects of microgravity on muscle and bone cells. Preliminary flight tests using this cell culture system have indicated there may be effects in the rate in which new muscle and bone cells are formed in microgravity. This research will help understand what is happening on the cellular level of astronauts who suffer from bone loss and muscle deterioration during spaceflight. This research also should contribute to scientists understanding of the mechanisms involved in bone loss and muscle atrophy here on Earth .

An advanced cell culture device known as STL-5 will be flown on STS-59. This is the first flight test of this hardware developed by the Walter Reed Army Institute of Research. This new system includes a video-microscope that will allow scientists on the ground to see real-time video images of their experiments in space. The instrument is designed to be controlled by either astronauts in space or individuals on the ground. This telescience from the middeck opens up the possibility for scientists to monitor and control their space experiments from the ground. The objective of this flight is to test the operation of the equipment in microgravity. Fish eggs will be used to test the imaging capability of the system.

The Endeavour crew will take on the role of teacher as they educate students in the United States, Finland and Australia about STS-59 mission objectives and what it is like to live and work in space through the Shuttle Amateur Radio Experiment-II (SAREX-II). Shuttle mission specialists Linda Godwin and Jay Apt will operate the SAREX equipment.

STS-59 will be the 6th flight of Space Shuttle Endeavour and the 62nd flight of the Space Shuttle system.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

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

The schedule for television transmissions from the Shuttle orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Dryden Flight Research Center, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

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

Status Reports

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

Briefings

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

STS-59 QUICK LOOK

Launch Date/Site:	April 7, 1994/Kennedy Space Center, FL - Pad 39A
Launch Time:	8:07 a.m. EDT
Orbiter:	Endeavour (OV-105) - 6th Flight
Orbit/Inclination:	120 nautical miles/57 degrees
Mission Duration:	9 days, 5 hours, 7 minutes
Landing Time/Date:	01:14 p.m. EDT April 16, 1994
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites:	Return to Launch Site: KSC, FL Transatlantic Abort Landing - Zaragoza, Spain Moron, Spain Ben Guerir, Morocco
Crew:	Sidney M. Gutierrez, Commander (CDR) Kevin P. Chilton, Pilot (PLT) Jerome Apt, Mission Specialist 1 (MS1) Michael R. Clifford, Mission Specialist 2 (MS2) Linda M. Godwin, Payload Commander (MS3) Thomas D. Jones, Mission Specialist 4 (MS4) Red shift: Gutierrez, Chilton, Godwin Blue shift: Apt, Clifford, Jones
Cargo Bay Payloads:	Space Radar Laboratory-1 (SRL-1) Consortium for Materials Development in Space Complex Autonomous Payload IV (CONCAP-IV) Get-Away Special Bridge Assembly/Canisters (GAS Bridge/Cans: G-203, G-300, G-458
Middeck Payloads:	Space Tissue Loss (STL) Shuttle Amateur Radio Experiment-II (SAREX-II) Toughened Uni-Piece Fibrous Insulation (TUFI) Visual Function Tester-4 (VFT-4)

Detailed Test Objectives/Detailed Supplementary Objectives

DTO 301D	Ascent Wing Structural Capability
DTO 305D	Ascent Compartment Venting Evaluation
DTO 306D	Descent Compartment Venting Evaluation
DTO 307D	Entry Structural Capability
DTO 312	External Tank Thermal Protection System Performance
DTO 414	Auxiliary Power Unit Shutdown Test
DTO 521	Orbiter Drag Chute System
DTO 653	Evaluation of the MK 1 Rowing Machine
DTO 656	Payload and General Purpose Support Computer Single Event Upset Monitoring
DTO 663	Acoustical Noise Dosimeter Data
DTO 664	Cabin Temperature Survey
DTO 665	Acoustical Noise Sound Level Data
DTO 674	Thermo-electric Liquid Cooling System Evaluation
DTO 700-8	Global Positioning System Development Flight Test
DTO 805	Crosswind Landing Performance
DSO 326	Window Impact Observations
DSO 483	Back Pain in Microgravity
DSO 487	Immunological Assessment of Crewmembers
DSO 488	Measurement of Formaldehyde Using Passive Dosimetry
DSO 603B	Orthostatic Function During Entry, Landing and Egress
DSO 604	Visual-Vestibular Integration as a Function of Adaptation
DSO 608	Effects of Space Flight on Aerobic and Anaerobic Metabolism During Exercise
DSO 611	Air Monitoring Instrument Evaluation and Atmosphere Characterization
DSO 621	In-Flight Use of Florinef to Improve Orthostatic Intolerance Postflight
DSO 624	Pre-and Postflight Measurement of Cardiorespiratory Responses to Submaximal Exercise
DSO 626	Cardiovascular and Cerebrovascular Responses to Standing Before and After Space Flight
DSO 802	Educational Activities
DSO 901	Documentary Television
DSO 902	Documentary Motion Picture Photography
DSO 903	Documentary Still Photography

SPACE SHUTTLE ABORT MODES

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

- Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105- nautical-mile orbit with orbital maneuvering system engines.
- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at White Sands Space Harbor, N. M.
- Transatlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza, Spain; Moron, Spain; or Ben Guerir, Morocco.
- Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, and without enough energy to reach Zaragoza, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-59 contingency landing sites are the Kennedy Space Center, White Sands Space Harbor, Zaragoza, Moron and Ben Guerir.

STS-59 SUMMARY TIMELINE

Flight Day 1
Ascent OMS-2 burn (120 n.m. x 119 n.m.)
SRL-1 activation/operations GAS activities

Blue Flight Day 2
SRL operations
SAREX-II setup

Red Flight Day 2
SRL operations

Blue Flight Day 3
SRL operations
VFT-4 activities

Red Flight Day 3
SRL operations

Blue Flight Day 4
SRL operations
VFT activities
MS-4 off duty (half-day)

Red Flight Day 4
SRL operations
GAS activities

Blue Flight Day 5
SRL operations
STL activities
MS-2 off duty (half-day)

Red Flight Day 5
SRL operations
MS-3 off duty (half-day)
VFT activities

Blue Flight Day 6
SRL operations
MS-1 off duty (half-day)
VFT activities

Red Flight Day 6
SRL operations
VFT activities
PLT off duty (half-day)

Blue Flight Day 7
SRL operations
VFT activities

Red Flight Day 7
SRL operations
VFT activities
CDR off duty (half-day)

Blue Flight Day 8
SRL operations
VFT activities

Red Flight Day 8
SRL operations
VFT activities

Blue Flight Day 9
SRL operations
VFT activities

Red Flight Day 9
Flight Control Systems checkout
Reaction Control System hot-fire
SRL operations
STL deactivation
GAS deactivation
SRL deactivation
Cabin stow

Blue/Red Flight Day Ten
Final payload deactivation
Cabin stow
Deorbit preparation
Deorbit burn
Entry
Landing

STS-59 VEHICLE AND PAYLOAD WEIGHTS

	Pounds
Orbiter (Endeavour) empty and 3 SSMEs	173,669
Space Radar Lab-1	21,379
Space Radar Lab-1 support equipment	2,417
CONCAP-IV	512
Get-Away Specials and support equipment	1,702
Space Tissue Loss	132
Visual Function Tester	32
Shuttle Amateur Radio Experiment	34
Detailed Supplementary/Test Objectives	113
Total Vehicle at SRB Ignition	4,510,987
Orbiter Landing Weight	221,708

STS-59 ORBITAL EVENTS SUMMARY

Event	Start Time (dd/hh:mm:ss)	Velocity Change (fps)	Orbit n.m.
OMS-2	00/00:33:00	164 fps	120 x 121
Deorbit	09/04:04:12	294 fps	N/A
Touchdown	09/05:07:00	N/A	N/A

STS-59 CREW RESPONSIBILITIES

Task/Payload	Primary	Backups/Others
Shift CDR	Gutierrez (red)	Apt (blue)
SRL-1	Godwin (red)	Jones (blue)
CONCAP	Chilton	Apt GAS cans
Gas Cans	Chilton	Apt
Middeck Payloads:		
SAREX	Apt	Godwin
STL	Chilton	Clifford
VFT	Gutierrez	Apt
Detailed Test Objectives:		
DTO 301D	Chilton	
DTO 305D	Chilton	
DTO 306D	Chilton	
DTO 307D	Chilton	
DTO 312	Apt	
DTO 414	Chilton	
DTO 521	Chilton	
DTO 653	Gutierrez	
DTO 656	Godwin	Jones
DTO 663	Gutierrez	Apt
DTO 664	Gutierrez	Apt
DTO 665	Gutierrez	Apt
DTO 700-8	Jones	
Detailed Supplementary Objectives:		
DSO 326	Chilton, Clifford	
DSO 483	Gutierrez, Apt, Clifford, Godwin	
DSO 487	All	
DSO 488	Gutierrez, Clifford	
DSO 603B	Godwin	
DSO 604-1	Chilton, Clifford	
DSO 604-3	Chilton, Godwin	
DSO 608	Chilton	
DSO 611	Chilton, Apt	
DSO 621	Godwin	
DSO 624	Gutierrez, Apt, Clifford, Jones	
DSO 626	Chilton, Godwin	
DSO 802	Apt	
DSO 901	Apt	Chilton
DSO 902	Apt	Chilton
DSO 903	Apt	Chilton
Other:		
Photography/TV	Apt	Chilton
In-Flight Maintenance	Gutierrez, Chilton (red)	Apt, Clifford (blue)
EVA	Godwin (EV1)	Jones (EV2), Chilton
Earth Observations (SRL)	Jones	Godwin
Earth Observations (other)	Apt	
Medical	Gutierrez	Clifford

SPACE RADAR LABORATORY-1

The Space Radar Laboratory-1 (SRL-1) comprises two elements: a suite of radar instruments called Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) jointly developed by NASA with DARA of Germany and ASI of Italy, and an atmospheric instrument called Measurement of Air Pollution from Satellite (MAPS). SRL is part of NASA's Mission to Planet Earth, the agency's program that is studying how our global environment is changing. SRL is scheduled to fly twice in 1994 aboard the Space Shuttle Endeavour.

From the unique vantage point of space, Mission to Planet Earth flights will observe, monitor and assess large- scale environmental processes with a focus on global change. The spacecraft data, complemented by aircraft and ground studies, will give scientists highly detailed information that will help them distinguish human-induced environmental changes from other natural forms of change. NASA will distribute the Mission to Planet Earth data to the international scientific community so that this essential research is available worldwide to assist people in making informed decisions about protecting their environment.

Why Radar?

The most useful feature of imaging radar is its ability to make measurements over virtually any region at any time, regardless of weather or sunlight conditions. The radar waves can penetrate clouds and under certain conditions, can also “see” through vegetation, ice and extremely dry sand. In many cases, radar is the only way scientists can explore inaccessible regions of Earth's surface.

The SIR-C/X-SAR is a synthetic aperture radar that transmits pulses of microwave energy from the Shuttle toward Earth and measures the strength and time delay of the energy that is scattered back to the SIR-C/X-SAR antenna. The motion of the Shuttle between the transmission of the beam and the receipt of the backscattered radiation is used to “synthesize” or create an antenna (the aperture) much longer than the actual antenna hardware. The effect of the longer antenna is to produce images of finer resolution.

Conditions on the Earth's surface influence how much radar energy is reflected back to the antenna. An area with a variety of surface types, such as hills, trees and large rocks, generally will reflect more energy back to the radar than a less complex area such as a desert. The resulting radar image of the varied terrain will appear brighter overall than the image of the simpler area. The three frequencies of SIR-C/X-SAR will enable scientists to view three different scales of features in the images.

Science Objectives

The SIR-C/X-SAR radar data will provide information about how elements of the complex “Earth system” Q particularly land surfaces, water and life Q work together to create Earth's livable environment. The science team is particularly interested in studying vegetation coverage, the extent of snow packs, wetland areas, geologic features such as rock types and their distribution, volcanic processes, ocean wave heights and wind speeds.

There are more than 400 sites on Earth where data will be taken during the mission. Nineteen of these have been designated as “supersites,” making them the highest priority targets and the focal point for many of the scientific investigators. There are an additional 15 backup supersites.

The supersites were chosen to represent different environments within each scientific discipline, and they are areas where intensive field work will occur before, during and after the flight.

During the mission, “ground truth” teams at different sites will make ground- or sea-based measurements of vegetation, soil moisture, sea state, snow and weather conditions as the Shuttle passes over their sites. These data will be supplemented with information taken from aircraft and ships to ensure an accurate interpretation of the data taken from space. In addition, the STS-59 astronauts will record their personal observations of weather and environmental conditions in coordination with SIR-C/X-SAR operations.

The following are the areas of investigations and supersites for the SRL mission:

Ecology: Manaus, Brazil; Raco, Mich.; Duke Forest, N.C.; Central Europe

Ecologists study life on Earth and how different species of animals and plants interact with one another and their local environment. SIR-C/X-SAR will collect ecological data over the tropical forests of the Amazon basin in South America and over the temperate forests of North America and Central Europe.

The radar images will be used to study land use, the volume, types and extent of vegetation and the effects of fires, floods and clear-cutting. SIR-C/X-SAR’s three radar frequencies interact with the vegetation on different scales, providing three independent views of the forest.

The radar’s multi-polarization ability allows scientists to look beneath the thick vegetation canopy of the forest in cloud-covered regions of the world to study the trunks of the trees, which have stronger reflection of vertically-oriented waves as well as the tree branches, which reflect the horizontal waves more strongly. These data give scientists a more complete picture of the conditions on the ground.

In some cases, SIR-C/X-SAR data will be used to test or validate existing computer models of these areas that identify different kinds of trees, classify crop types and determine the amount of soil moisture available in certain areas.

Seasonal changes in the forest will be studied by comparing data from the two SIR-C/X-SAR flights in April and August. SIR-C/X-SAR data will be used along with ground truth data to understand the impact of the loss of forests on local ecology. Scientists also will use the data to understand the impact on animals.

By studying the short-term and long-term changes in forests, scientists can determine what effects changing environmental conditions and land use have on the forests and in turn, on global climate change.

Hydrology: Chickasha, Okla.; Otztal, Austria; Bebedouro, Brazil; Montespertoli, Italy

SIR-C/X-SAR hydrology investigations, which study how water circulates on land, will be focused on determining soil moisture patterns. These studies will help scientists develop ways to estimate soil moisture Q the “hidden” water that plays a major role in determining whether a region is wet or dry and influences the global distribution of energy. Combined with information on evaporation rates over large areas, this data ultimately will be incorporated into computer models to help predict a region’s water cycle.

The radars also will acquire snow cover data over Mammoth Lakes, Calif., the Austrian Alps and the Patagonian district in southern Chile. The shorter wavelength X-band data will be useful to scientists for determining snow type, while the longer wavelengths of L-band and C-band will help them estimate snow volume.

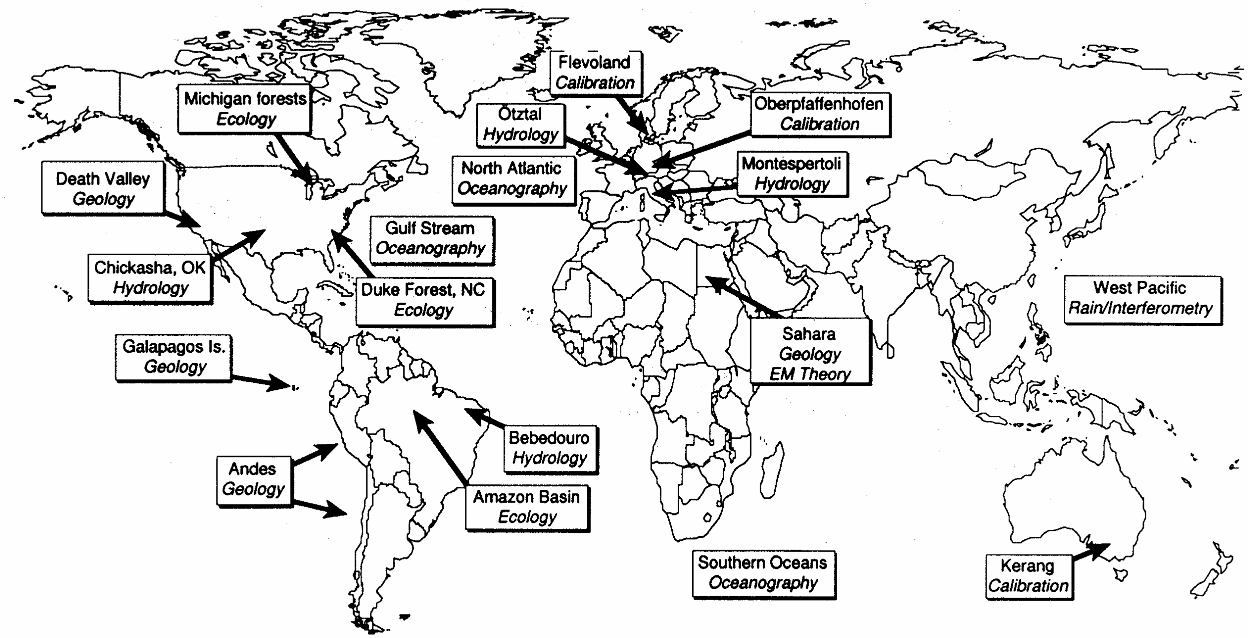
Snow data will help communities determine how much water will be available for human and agricultural use. For many areas, long-term or ground-based snow cover data do not exist, and using radar data is the only way to collect this information.

JPL

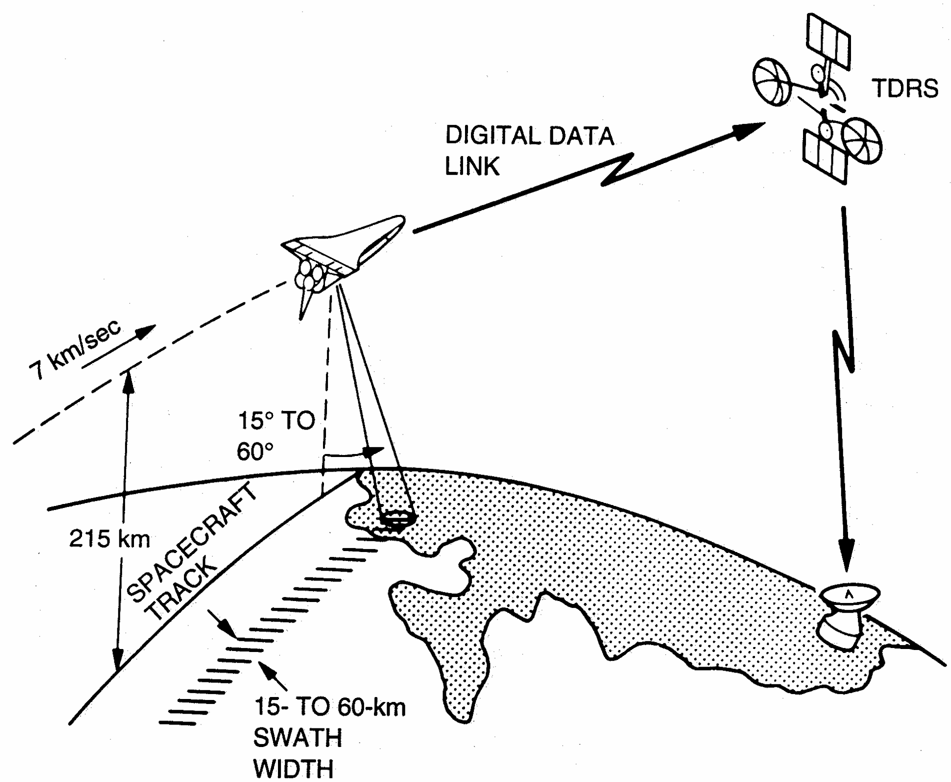
Space Radar Laboratory

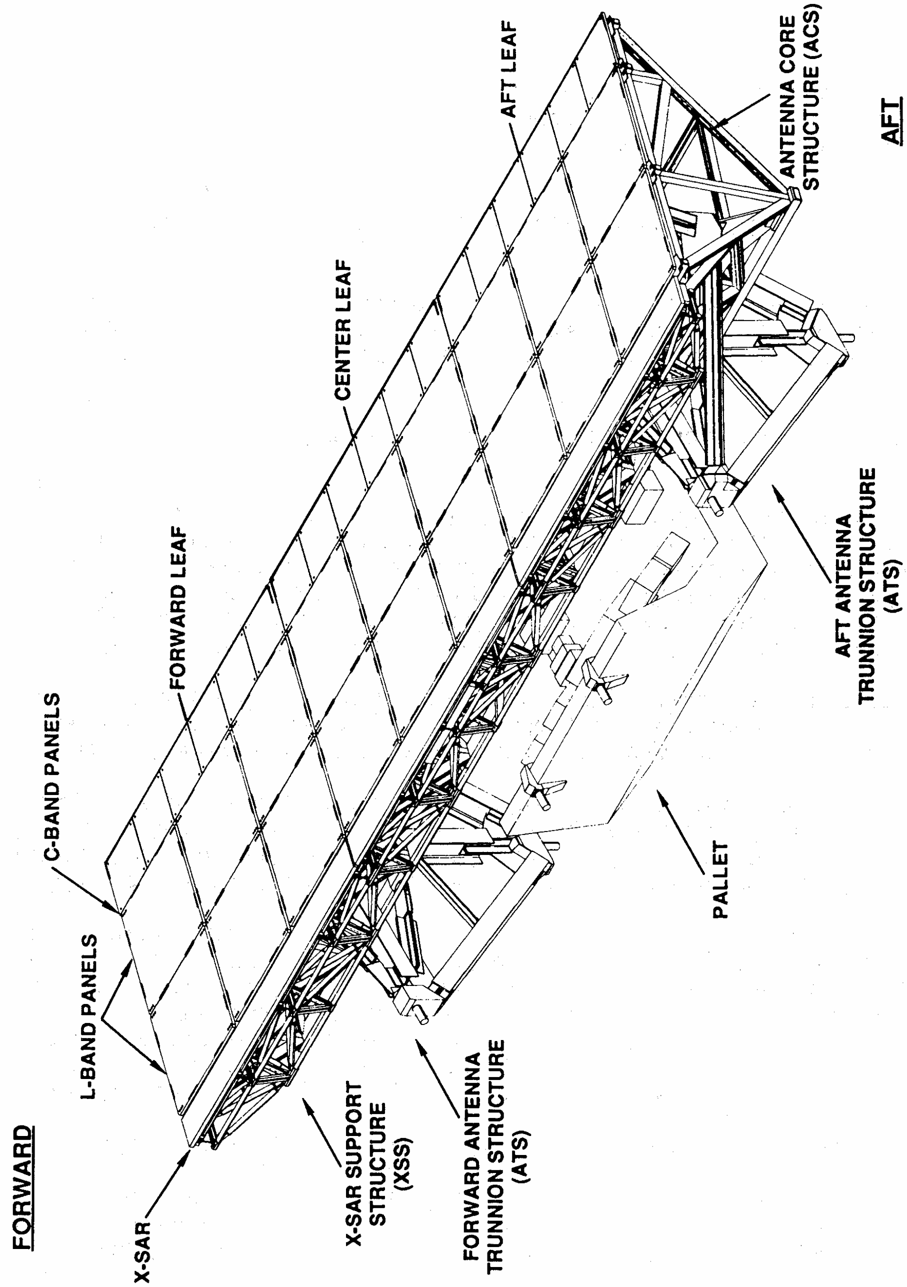
SIR-C / X-SAR SCIENCE

- 49 PRINCIPAL INVESTIGATORS, 3 TEAM ASSOCIATES, 100+ SCIENTISTS, INCLUDING CO-I's
- 13 COUNTRIES REPRESENTED
- 19 PRIMARY OBSERVATION SITES (SUPERSITES)



THE SIR-C/X-SAR MISSION




FORWARD
X-SAR
L-BAND PANELS
C-BAND PANELS
FORWARD LEAF
CENTER LEAF
AFT LEAF
ANTENNA CORE STRUCTURE (ACS)
AFT
X-SAR SUPPORT STRUCTURE (XSS)
FORWARD ANTENNA TRUNNION STRUCTURE (ATS)
PALLET
AFT ANTENNA TRUNNION STRUCTURE (ATS)

SIR-C/X-SAR also will study wetlands -- delicate ecosystems especially vulnerable to changes introduced by humans. Wetlands are the source of many trace gases that play an important part in the global atmospheric cycle. SIR- C/X-SAR will be able to determine the extent and limits of selected wetland areas because radar is extremely sensitive to the presence of standing water, even hidden under vegetation cover. Data from the multiple flights of SIR-C/X- SAR will help scientists observe changes in wetlands over time.

Oceanography: The Gulf Stream (mid-Atlantic region); Northeast Atlantic Ocean, Southern Ocean.

SIR-C/X-SAR will observe surface and internal waves, wind motion at the sea surface and ocean currents. These data will help scientists study how the Earth's climate is moderated by the ocean, particularly heat-transporting currents like the U.S. Gulf Stream.

Geology: Galapagos Islands; Sahara Desert; Death Valley, Calif.; Andes Mountains, Chile; Mount Pinatubo

SIR-C/X-SAR will map geologic structures and variations in rock types over large areas, including areas of volcanic activity and erosion. These data will be especially useful in areas of heavy vegetation and continuous cloud cover, where field work is often difficult.

The longer L-band radar wavelengths are particularly useful for looking beneath surfaces, and SIR-C/X-SAR will continue the radar penetration studies that began with SIR-A. SIR-A demonstrated the ability of imaging radar to penetrate extremely dry surfaces and discovered ancient river channels in portions of the Sahara, which have evolved from areas of flowing streams to what is now an arid desert. SIR-C/X-SAR will study such paleoclimatic sites in the Sahara Desert and Saudi Arabia.

SIR-C/X-SAR also will study other geologic features that record past climate changes. In Death Valley, Calif., western China and the southern Andes, the radar will map gravel deposits that wash down from the mountains to form alluvial fans. The fans are found throughout the semi-arid deserts of the world in areas where there is a significant amount of geologic activity. Gravel builds up at the base of the mountains during periods of relatively wet climate.

The radar is sensitive to these rocky and rough surfaces, allowing scientists to study climate history and the relative ages of surfaces. As an area ages, it is exposed to weathering. This changes its roughness characteristics. Mapping areas of past climate change will give scientists a stronger base from which to monitor and predict future climate changes.

SIR-C/X-SAR will image volcanoes, including Mount Pinatubo and the volcanoes of the Galapagos Islands. Volcanic eruptions can have a significant impact on Earth's atmosphere, and SIR-C/X-SAR may obtain radar images of erupting volcanoes and fresh lava flows which would help scientists understand volcanic evolution. The likelihood of finding an active volcano during the flight is very good since active volcanoes are observed on nearly 50 percent of Shuttle flights.

Calibration: Flevoland, The Netherlands; Kerang, Australia; Oberpfaffenhofen, Germany; Western Pacific Ocean

Ground equipment will be set up in southern Germany, The Netherlands, Australia and Death Valley, Calif., to measure the amount of SIR-C/X-SAR radar energy received at the ground during the flight. This information will be used after the mission when the radar data are being processed to help scientists calibrate the radar data.

Rain Experiments

There are two SIR-C/X-SAR experiments planned to image rain over the Western Pacific Ocean, an area scientists call the “rainiest place on Earth.”

Although radar can penetrate clouds, it is important to understand how rain can change conditions on the ground and thus, change the radar image. At the shorter wavelengths of X-band and C-band, rain may reduce the strength of the radar or scatter the signals significantly.

The rain experiments offer a unique challenge to the operation of the radar during flight. All the other experiments can be reasonably tied to a specific area, while the rain experiments only require that a “deep” rainstorm be in progress. Weather targets are transitory in both space and time and cannot be scheduled, so finding a good target of opportunity presents challenges. Scientists chose the Western Pacific because there is a high probability that it will be raining there when the Shuttle passes over it.

SIR-C Instrument

Built by NASA’s Jet Propulsion Laboratory (JPL), Pasadena, Calif., and the Ball Communications Systems Division, SIR-C is a two-frequency radar including L-band (23-cm wavelength) and C-band (6-cm wavelength).

SIR-C represents a technological advance from previous imaging radar. Just as color pictures contain more information than do black and white pictures, SIR-C’s multi- frequency, multi-polarization radar imagery provide more information about Earth’s surface features than do single- frequency, single-polarization images.

SIR-C is the first spaceborne radar with the ability to transmit and receive horizontally (H) and vertically (V) polarized waves at both frequencies. Polarization describes how the radar wave travels in space. The interaction between the transmitted waves and the Earth’s surface determines the polarization of the waves received by the antenna. For example, when data are acquired with HH (horizontal- horizontal) polarization, the wave is transmitted from the antenna in the horizontal plane and the antenna receives the backscattered radiation in the horizontal plane. The other polarizations are HV (horizontally transmitted, vertically received), VH (vertical-horizontal) and VV (vertical- vertical).

Multi-polarization data are particularly useful to scientists studying vegetation because the data allow them to see different types of crops and to estimate the volume of trees contained under the canopy of a forest. The multi- frequency, multi-polarization capability creates a new and more powerful tool for studying the environment.

Unlike previous SIR missions, the SIR-C radar beam is formed from hundreds of small transmitters embedded in the surface of the radar antenna. By properly adjusting the energy from these transmitters, the beam can be electronically steered without physically moving the large radar antenna. This feature, combined with maneuvers by the Shuttle, will allow images to be acquired from many directions, allowing the study of how surface features’ reflections characteristically vary as the angle between the surface and the incident radar wave (the incident angle) varies.

The SIR-C antenna is the most massive piece of flight hardware ever built at JPL. Its mass is 23,100 pounds (10,500 kilograms) and it measures approximately 39 feet by 13 feet (12 meters by 4 meters). The instrument is composed of several subsystems: the antenna array, transmitter, receivers, data-handling subsystem and the ground processor. The antenna consists of three leaves, each divided into four subpanels.

SPACEBORNE IMAGING RADAR-C (SIR-C)
X-BAND SYNTHETIC APERTURE RADAR (X-SAR)

	L	C	X
SYSTEM CHARACTERISTICS			
FREQUENCY	1.25 GHz	5.3 GHz	9.6 GHz
WAVELENGTH	24 cm	5.7 cm	3.1 cm
POLARIZATION	HH (L, C)	VV (L, C, X) VH (L, C)	HV (L, C)
LOOK ANGLE	15-55 deg		
IMAGE CHARACTERISTICS			
SWATH WIDTH	15-60 km		
AZIMUTH RESOLUTION	25 m		
RANGE RESOLUTION	60-15 m (Low Resolution),	30-10 m (High Resolution)	
NUMBER OF LOOKS	4		
CALIBRATION GOALS	±1 dB Relative, ±3 dB Absolute		
INSTRUMENT CHARACTERISTICS			
PEAK POWER	3.5 kW	2.2 kw	3.3 kW
ANTENNA DIMENSIONS	12 x 2.95 m	12 x 0.75 m	12 x 0.40 m
BANDWIDTH	10 or 20 MHz		
DATA RATE	45 Mbps/Channel		
ORBIT CHARACTERISTICS			
ALTITUDE	215 km		
INCLINATION	57 deg		
MISSION			
DURATION	8-10 days		
LAUNCH VEHICLE	Shuttle		

X-SAR INSTRUMENT

X-SAR was built by the Dornier and Alenia Spazio companies for the German Space Agency, Deutsche Agentur fur Raumfahrtangelegenheiten (DARA), and the Italian space agency, Agenzia Spaziale Italiana (ASI), respectively. The scientific processing progress is managed by DARA. It is a single-polarization radar operating at X- band (3-cm wavelength).

X-SAR uses a slotted-waveguide antenna, which is finely tuned to produce a narrow, pencil-thin beam of energy. The X-SAR antenna is mounted on a supporting structure that is tilted mechanically to align the X-band beam with the L-band and C-band beams. X-SAR will provide VV polarization images.

The SIR-C and X-SAR instruments can be operated individually or in conjunction. The width of the ground swath varies from 9 to 56 miles (15 to 90 kilometers), depending on the orientation of the antenna beams. The resolution of the radars Q the size of the smallest objects they can distinguish Q can be varied from 33 to 656 feet (10 to 200 meters).

Previous Radar Missions

Since the late 1970s a variety of NASA satellite missions have used imaging radar to study Earth and its planetary neighbors. Perhaps the most familiar example of NASA's success using imaging radar is the Magellan mission to Venus. Magellan's radar pierced the dense clouds covering Venus to map the entire surface of the planet, revealing a world that had previously been hidden to humans.

SIR-C is the latest technological advance in a series of Earth-observing imaging radar missions that began in June 1978 with the launch of Seasat, an L-band SAR and continued with SIR-A in November 1981. Both of those radars observed the Earth from fixed angles. SIR-B was flown aboard the Space Shuttle in October 1984.

The X-SAR antenna is a follow-on to Germany's Microwave Remote Sensing Experiment (MRSE), flown aboard the first Shuttle Spacelab mission in 1983.

Technological Advances in NASA Earth-Observing Radars

Mission	Date	Available Angle of Incidence	Frequencies	Available Polarizations
Seasat	June 1978	23 degrees	L-band	HH
SIR-A	Nov. 1981	50 degrees	L-band	HH
SIR-B	Oct. 1984	Variable	L-band	HH
SIR-C	April 1994 Aug. 1994	15-55 degrees	L-band C-band	HH HV, VH, HH

Data Collection, Processing and Image Releases

SIR-C/X-SAR is designed to collect 50 hours of data, covering approximately 18 million square miles (50 million square kilometers). All data will be stored onboard the Shuttle using a new generation of high-density, digital, rotary-head tape recorders. There will be 180 digital tape cartridges (similar to VCR tape cassettes) carried aboard the Shuttle to record the data. Portions of data also will be downlinked to the ground via NASA's Tracking and Data Relay Satellite System.

Ultimately, the mission will return 32 terabits (32 trillion bits) of data, the equivalent of 20,000 encyclopedia volumes. To think of it another way, the radars together can produce 225 million bits of data per second, or the equivalent of 45 simultaneously operating television stations.

The raw data will be processed into images using digital SAR processors at JPL (Pasadena, Calif.) DARA/DLR (Oberpfaffenhofen, Germany) and ASI/CGS (Matera, Italy) Historically, processing SAR data has required a great deal of computer time on special-purpose computer systems. SIR- C/X-SAR scientists will benefit, however, from rapid advances in computer technology that make it possible to process the images with a standard super mini-class computer.

Even with these advances, it still will take 5 months to produce a complete set of survey images from the large volume of data acquired. Detailed processing will take another 9 months to complete. Data will be exchanged among Italy, Germany and the United States to meet the needs of the science investigators.

NASA, DARA and ASI will attempt to release some radar images to the press during the Shuttle flight. If this proves feasible, the images will be processed at JPL and sent electronically via Internet to the Johnson Space Center, where the image will be released on NASA Select Television. Hard copy prints will be released simultaneously to the wire services at JPL. In Germany, the images will be processed in high resolution by DLR.

Science Team

An international team of 49 science investigators and three associates will conduct the SIR-C/X-SAR experiments. Thirteen nations are represented: Australia, Austria, Brazil, Canada, China, the United Kingdom, France, Germany, Italy, Japan, Mexico, Saudi Arabia and the United States.

Dr. Diane Evans of the JPL is the U.S. Project Scientist. Dr. Herwig Ottl of DLR is the German Project Scientist and Prof. Mario Calamia of the University of Florence is the Italian Project Scientist. Dr. Miriam Baltuck of NASA Headquarters is the Program Scientist.

Management

The SIR-C mission is managed by JPL for NASA Headquarters Office of Mission to Planet Earth. Michael Sander is the JPL Project Manager. Richard Monson of the Office of Mission to Planet Earth is the SIR-C Program Manager; Jim McGuire of NASA Headquarters is the SRL Program Manager.

X-SAR is managed by the Joint Project Office located near Bonn, Germany. Dr. Manfred Wahl of DARA is the Project Manager and Dr. Paolo Ammendola of ASI is the Deputy Project Manager.

MEASUREMENT OF AIR POLLUTION FROM SATELLITE (MAPS)

The MAPS experiment measures the global distribution of carbon monoxide in the troposphere, or lower atmosphere. Measurements of carbon monoxide, an important element in several chemical cycles, provide scientists with indications of how well the atmosphere can clean itself of “greenhouse gases,” chemicals that can increase the atmosphere’s temperature.

Why do we measure carbon monoxide?

Today, humanity’s technological and agricultural activities are generating carbon monoxide in large and increasing quantities. This colorless, odorless gas is produced whenever most fuels are burned, most abundantly by automobile engines and as a result of the burning forests and grasslands.

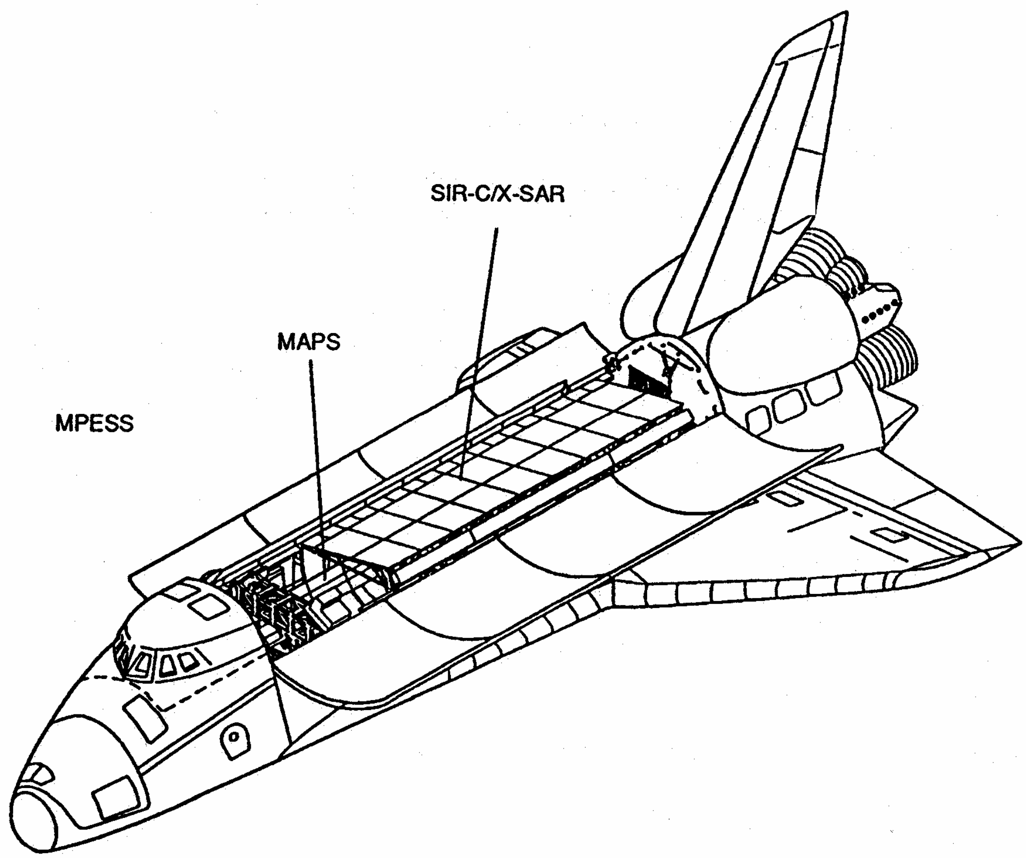
Once carbon monoxide enters the atmosphere, it is transported over long distances and ultimately, is converted to carbon dioxide by a chemical called the hydroxyl, “OH,” radical. The OH radical is the key participant in the breakdown and removal of greenhouse gases such as methane, which in turn is important in the chemistry of stratospheric ozone.

It appears that as carbon monoxide emissions increase and react with the OH radical, the amount of OH available to convert other gases in the atmosphere will decrease. If concentrations of OH are reduced, the breakdown and removal of greenhouse gases also will be reduced. Reduction of the OH radical thus will have long-term influence on stratospheric ozone, the destruction of greenhouse gases and potentially, on climate.

The actual size of sources of carbon monoxide, the way that they change over the course of the year and the patterns of the movement of the gas away from the sources are not now well known. The MAPS data are very useful in the study of these factors.

Data collection and processing

MAPS’ primary goal is to measure the distribution of carbon monoxide in the atmosphere between the altitudes of 2 and 10 miles (4 and 15 kilometers). The data
are recorded on a tape recorder and transmitted directly to the ground using the Space Shuttle telemetry system. The signals will be processed at the Payload Operations Control Center to produce “quick look” maps of the carbon monoxide distribution. These “quick look” data will be used to plan the exact periods of data acquisition during the flight.
Following the flight, the recorded data will be processed using more refined techniques, and the data will be combined with ground- and aircraft-based data obtained by collaborating scientists from several countries. This will present a more detailed description of the distribution of the gas than can be obtained by any single technique.


SIR-C/X-SAR
MAPS
MPESS

Results from previous flights

The MAPS instrument first flew on the second flight of the Space Shuttle in November 1981. It obtained 12 hours of data that showed that most of the carbon monoxide in the atmosphere at the altitudes measured by MAPS was located in the Earth's tropical regions rather than in the Northern Hemisphere. Further, the amount of carbon monoxide changed much more rapidly east to west than had been expected. The results implied that forest and grassland burning in the tropics is more important as a source of carbon monoxide than had been thought.

The MAPS experiment again flew on the Space Shuttle during early October 1984. About 80 hours of data were obtained. That clearly confirmed that burning in South America and southern Africa was a major source of carbon monoxide.

Because of MAPS' previous flights on board the Space Shuttle, scientists now know that carbon monoxide concentrations in the troposphere are highly variable around the planet, and that widespread burning in the South American Amazon region and the African savannahs is a major global source of carbon monoxide in the troposphere.

MAPS instrument

The MAPS hardware consists of an optical box, an electronics box, a tape recorder and a camera, all mounted to a single base plate. This assembly is mounted to a Multi- purpose Experiment Support Structure near the forward end of the cargo bay. The instrument is about 36 inches long, 30 inches wide and 23 inches high. It weighs 203 pounds and consumes about 125 watts of electrical power.

The Program Manager is Louis Caudill, and Dr. Michael Kurylo is the Program Scientist, both at NASA Headquarters, Washington, D.C. The Principal Investigator for MAPS is Dr. Henry G. Reichle Jr., and the Project Manager is John Fedors, both from the NASA Langley Research Center. The experiment is guided by a science team whose members are Dr. V. Connors, NASA Langley Research Center; W. Hesketh, SpaceTec, Inc.; Dr. P. Kasibhatla, Georgia Institute of Technology; Dr. V. Kirchhoff, INPE, Brazil; Dr. J. Logan, Harvard University; Dr. R. Newell, Massachusetts Institute of Technology; Dr. R. Nicholls, York University, Canada; Dr. L. Peters, Virginia Polytechnic Institute and State University; Dr. W. Seiler, IFU, Germany; and H. Wallio, NASA Langley Research Center.

GET AWAY SPECIAL PAYLOADS

The Get Away Special (GAS) project is managed by the Goddard Space Flight Center (GSFC), Greenbelt, Md. NASA began flying these small self-contained payloads in 1982. The project gives the average person a chance to perform experiments in space on a Shuttle mission. Students, individuals and people from the private industry have taken advantage of this unique project. In February, STS-60 flew the 100th GAS payload. This milestone demonstrates that the program is still viable and thriving. Space is available for upcoming flights, and GAS presents an educational opportunity for students.

There are three GAS payloads on this flight: G-203, New Mexico State University; G-300, Matra Marconi Space; and G-458, The Society of Japanese Aerospace Companies, Inc. Following is a brief description of each.

G-203
Customer: New Mexico State University, Las Cruces, N.M.
Customer: Dr. Harold Daw
NASA Technical Manager: Charlie Knapp

The purpose of this experiment is to examine the freezing and crystallization process of water in spaceflight. Experimenters will study growth patterns of ice crystals in a microgravity condition. Growth pattern data will be captured by a video recorder. A vapor valve is opened to initiate the experiment allowing the water vapor in the chamber to be adsorbed rapidly (the adhesion of extremely thin layers of molecules to the surface of solid bodies or liquids with which they are in contact) into the pores of the dry zeolite contained in the chamber. The rapid adsorption of the water vapor causes the water temperature to drop to a point of freezing. Other water freezing experiments have flown on Shuttle flights but this experiment is unique in its freezing technique and is predicted to produce very different ice crystal growth patterns.

G-300
Customer: Matra Marconi Space, Paris, France
Customer: Daniel Kaplan
NASA Technical Manager: Rick Scott

The objective of this experiment is to explore thermal conductivity measurements on liquids in microgravity. Measurements will be performed on three silicone oils having different viscosities. The experimenters will use a modified “hot plate” method with a simplified guard ring to reduce heat losses. The experimental cells are assembled in three tandems: Each tandem includes two cells filled with the same liquid but of different thicknesses. The convective motions are expected to be strongly reduced in orbit unless large gravitational variations occur.

The three modes of heat transfer in liquids (conduction, radiation and convection) are inherently linked in a 1g environment and are empirically difficult to perform on fluids because of thermal motions induced by convection. In orbit, assuming a near-zero gravity, the convection, due to buoyancy, must disappear and the accuracy of the thermal conductivity data will be improved, especially with low viscosity liquids. Furthermore, the convection effects can be determined by comparing results from spaceflight and on Earth.

This is the first GAS payload from France. It had flown previously on STS-47 but an unforeseen event caused the experiment to be turned on before flight.

G-458
Customer: The Society of Japanese Aerospace Companies, Inc., Tokyo, Japan
Customer: Dr. S. Hosaka
NASA Technical Manager: Charlie Knapp

The objective of this experiment is to determine whether small fruiting bodies can be obtained in microgravity. The information will be obtained by taking a culture of Dictysotelium Discoideum in microgravity. The cellular slime mold is one of the most interesting organisms, due to its characteristic properties. It assumes unicellular, multicellular, plant-like and animal-like properties during its life cycle. Still, it is a very simple organism because it is composed of only two kinds of cells, even when it is fully developed. Because of this, its response to altered gravity can be regarded as a typical representative of gravi-response of organisms.

The cellular slime mold is a small organism with a body length of several millimeters and is rather resistant to a wide variety of environmental conditions. Ground experiments proved that the height of fruiting bodies of Dictysotelium Discoideum was gravity-dependent. The height decreased as the gravity decreased. This contradicts the prediction that microgravity favors the growth of organisms resulting in larger height. It is believed that this experiment will conclude that in some cases more gravity is favorable and microgravity is unfavorable for vertical growth.

CONSORTIUM FOR MATERIALS DEVELOPMENT IN SPACE COMPLEX AUTONOMOUS PAYLOAD

The Consortium for Materials Development in Space - Complex Autonomous Payload (CONCAP-IV) will be carried in Get Away Special hardware in Endeavour's cargo bay. CONCAP-IV is contained in a 5-cubic-foot GAS canister mounted to an adapter beam. The Autonomous Payload Control System allows a crew member to control the payload with a small, hand-held controller.

CONCAP-IV produces crystals and thin films through physical vapor transportation. Non-Linear Optical (NLO) organic materials are used in the CONCAP experimentation. The payload takes advantage of the free-fall environment of low-Earth orbit to grow the NLO crystals. It is expected that the lack of significant gravity-driven convection will result in more highly ordered films and crystals.

CONCAP-IV was developed by the University of Alabama- Huntsville.

VISUAL FUNCTION TESTER-4

The Visual Function Tester-4 (VFT-4) is designed to measure near and far points of clear vision as well as the ability to change focus within the range of clear vision. VFT-4 will provide data to evaluate on orbit refractive and accommodative changes in vision over a period of several days.

The VFT-4 payload consists of the experiment unit, a cable connecting VFT-4 to a computer serial port, 2 self- booting floppy disks containing a software program and serving as a data storage medium, a payload and general support computer with power and data cables and a standard 28-volt power cable.

Prelaunch, three sessions are required with crew as test subjects. The sessions occur at L-14 days, L-7 days and as close to launch as possible. On orbit, VFT-4 is unstowed by the crew for test sessions lasting up to 30 minutes each. The first test session is early in the payload operation period. Subsequent tests are separated by 24 hours. Preferably, these tests are conducted soon after post-sleep. The VFT-4 hardware will be restowed between sessions. Crew members who participate in VFT-4 sessions on orbit will be retested post-flight.
VFT-4 is operated by NASA and the U. S. Air Force Space and Missile Systems Center.

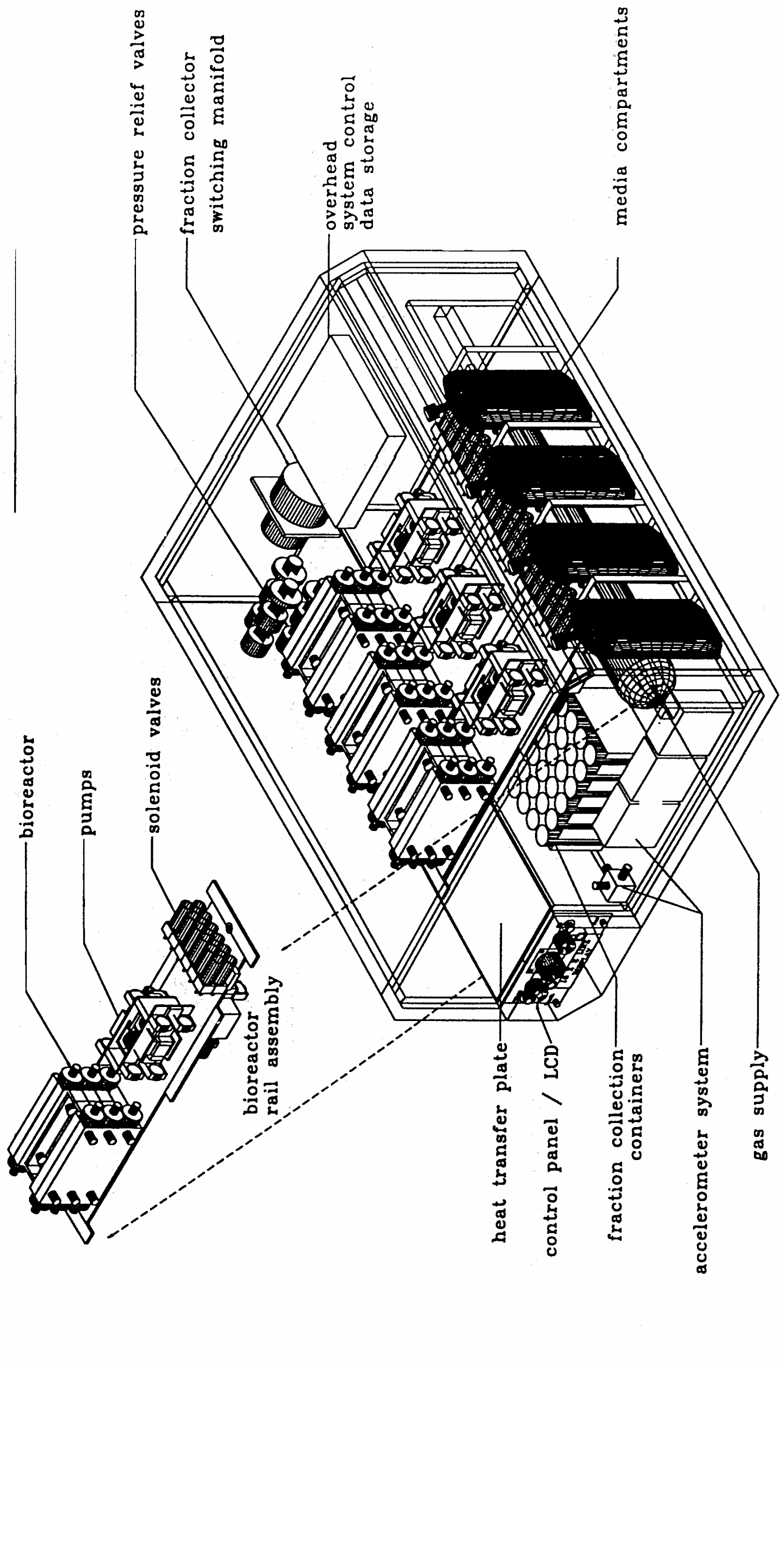
SPACE TISSUE LOSS-4/NATIONAL INSTITUTES OF HEALTH-1

STS-59 will fly the first cooperative initiative with the National Institutes of Health (NIH), sponsored by NASA's Office of Life and Microgravity Sciences and Applications Small Payloads Program. The joint initiative in cell biology will use a special cell culture system developed by the Walter Reed Army Institute of Research, Washington, D.C. The system, known as Space Tissue Loss-4 (STL-4), is fully automated and provides fluid replenishment, oxygen/carbon dioxide and temperature controls to provide for cell growth in microgravity. The cells will be analyzed post-flight. The experiments on this first NIH/NASA cooperative flight will examine the effects of microgravity on muscle and bone cells. Preliminary flight tests using this cell culture system have indicated there may be effects in the rate in which new muscle and bone cells are formed in microgravity. This research will help understand what is happening on the cellular level to astronauts who suffer from bone loss and muscle deterioration in spaceflight. This research also should contribute to understanding of the mechanisms involved in bone loss and muscle atrophy on Earth. The STL-4 experiments are being managed by the Ames Research Center, Mountain View, Calif.

Space Tissue Loss - 5

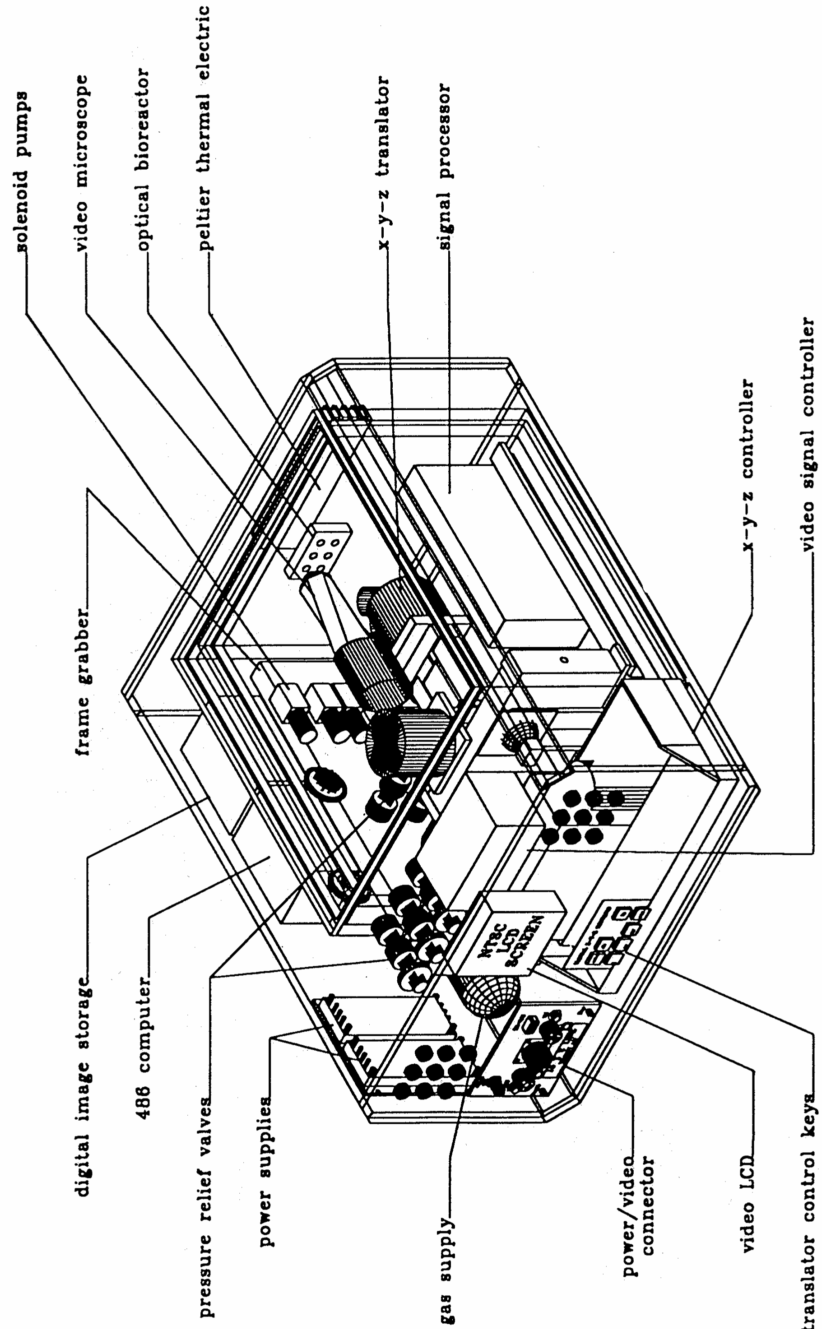
An advanced cell culture device known as STL-5 will be flown on STS-59. This is the first flight test of this hardware developed by the Walter Reed Army Institute of Research, Washington, D.C. This new system includes a video- microscope that will allow scientists on the ground to see real-time video images of their experiments in space. The instrument is designed to be controlled by either astronauts in space or individuals on the ground. This telescience from the middeck opens up the possibility for scientists to monitor and control their space experiments from the ground. The objective of this flight is to test the operation of the equipment in microgravity. Fish eggs will be used to test the imaging capability of the system.

STL-4 MODULE



bioreactor
pumps
solenoid valves
pressure relief valves
fraction collector switching manifold
overhead system control data storage
media compartments
bioreactor rail assembly
heat transfer plate
control panel / LCD
fraction collection containers
accelerometer system
gas supply

STL-5 MODULE



solenoid pumps
video microscope
optical bioreactor
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x-y-z translator
signal processor
frame grabber
x-y-z controller
video signal controller
NTSC LCD SCREEN
digital image storage
486 computer
pressure relief valves
power supplies
gas supply
power/video connector
video LCD
translator control keys

SHUTTLE AMATEUR RADIO EXPERIMENT (SAREX)

Students in the United States, Finland and Australia will have a chance to speak via amateur radio with astronauts aboard the Space Shuttle Endeavour during STS-59. Ground- based amateur radio operators ("hams") will be able to contact the Shuttle through automated computer-to-computer amateur (packet) radio links. There also will be voice contacts with the general ham community as time permits.

Shuttle mission specialists Linda Godwin (call sign N5RAX) and Jay Apt (N5QWL) will talk with students in 9 schools in the United States, Finland and Australia using "ham radio."

Students in the following schools will have the opportunity to talk directly with orbiting astronauts for approximately 4 to 8 minutes:

- Ealy Elementary School, West Bloomfield, Mich. (W8JXU)
- Kanawha Elementary School, Davisville, W.V. (KD8YY)
- Alcatel Amateur Radio Associates and Circle Ten Council, BSA, Richardson, Texas (K2BSA/5)
- Anthony Elementary School, Anthony, Kan. (KB0HH)
- St. Bernard High School, Playa Del Rey, Calif. (AB6UI)
- Country Club School, San Ramon, Calif. (KE6YD)
- Deep Creek Middle School, Baltimore, Md. (WA3Z)
- Paltamo Senior High School, Paltamo, Finland (OH8AK)
- Ogilvie School, Western Australia (VK6IU)

The radio contacts are part of the SAREX (Shuttle Amateur Radio Experiment) project, a joint effort by NASA, the American Radio Relay League (ARRL), and the Radio Amateur Satellite Corporation (AMSAT).

The project, which has flown on 12 previous Shuttle missions, is designed to encourage public participation in the space program and support the conduct of educational initiatives through a program to demonstrate the effectiveness of communications between the Shuttle and low- cost ground stations using amateur radio voice and digital techniques.

Information about orbital elements, contact times, frequencies and crew operating schedules will be available during the mission from NASA, ARRL (Steve Mansfield, 203/666- 1541) and AMSAT (Frank Bauer, 301/ 286-8496). AMSAT will provide information bulletins for interested parties on INTERNET and amateur packet radio.

The ham radio club at the Johnson Space Center, (W5RRR), will be operating on amateur short wave frequencies, and the ARRL station (W1AW) will include SAREX information in its regular voice and teletype bulletins.

There will be a SAREX information desk during the mission in the Johnson Space Center newsroom. Mission information will be available on the computer bulletin board (BBS). To reach the bulletin board, use JSC BBS (8 N 1 1200 baud): dial 713-483-2500, then type 62511.

The amateur radio station at the Goddard Space Flight Center, (WA3NAN), will operate around the clock during the mission, providing SAREX information and retransmitting live Shuttle air-to-ground audio.

STS-59 SAREX Frequencies

Routine SAREX transmissions from the Space Shuttle may be monitored on a worldwide downlink frequency of 145.55 MHz.

The voice uplink frequencies are (except Europe):	144.91 MHz
	144.93
	144.95
	144.97
	144.99
The voice uplink frequencies for Europe only are:	144.70
	144.75
	144.80

Note: The astronauts will not favor any one of the above frequencies. Therefore, the ability to talk with an astronaut depends on selecting one of the above frequencies chosen by the astronaut.

The worldwide amateur packet frequencies are:

Packet downlink 145.55 MHz
Packet uplink 144.49 MHz

The Goddard Space Flight Center amateur radio club planned HF operating frequencies:

3.860 MHz	7.185	14.295	21.395	28.650

TOUGHENED UNI-PIECE FIBROUS INSULATION

NASA will test an improved thermal protection tile on the STS-59 mission. Known as Toughened Uni-Piece Fibrous Insulation (TUFI), the new tile material is an advanced version of the material that protects the Space Shuttles from the intense heat that builds up as they re-enter Earth's atmosphere. The tiles were processed by Rockwell International, Downey, Calif., which built and maintains the orbiters. TUFI was developed at NASA's Ames Research Center, Mountain View, Calif.

During preparations for this mission, Rockwell technicians at Kennedy Space Center placed several TUFI tiles on Endeavour's base heat shield, between the three main engines. At the end of the mission, NASA and Rockwell technicians will examine the tiles and compare the damage with that seen on previous missions using the originally designed tile material.

The current tiles are a rigid glass fiber composite with a thin, fully dense glass coating that sits on top. When it gets hit with a rock or other debris, the coating cracks or chips. This requires either patching or replacement, depending on the extent of damage.

Because TUFI permeates the pores nearer the surface of the insulation material, providing reinforcement to the composite surface, it is less subject to impact damage. The porous surface also stops cracks from spreading, which limits damage to the tile. Because there is less damage, repair is easier and faster, and fewer tiles should need replacement. This should result in lower repair costs.

TUFI has been certified for six Shuttle flights, on all four orbiters. If the tests are successful, TUFI may be used to replace tiles in specific, limited areas of the orbiter susceptible to significant impact damage. These might include the base heat shield between the engines, near the landing gear doors and near the thrusters used for orbital maneuvering.

STS-62 CREWMEMBERS

STS059-S-002 **--** *This is the official STS-59 preflight crew portrait. Sidney M. Gutierrez, mission commander is standing (right) along with Kevin P. Chilton, pilot. Others, left to right are Linda M. Godwin, payload commander; and Thomas D. Jones, Jerome (Jay) Apt and Michael R. (Rich) Clifford, all mission specialists. All are wearing orange launch and entry suits.*

PHOTO CREDIT: NASA or National Aeronautics and Space Administration.

BIOGRAPHICAL DATA

SIDNEY M. GUTIERREZ, 42, Col., USAF, will be commander (CDR) of STS-59. He was selected to be an astronaut in 1984 and will be making his second flight aboard the Space Shuttle.

Gutierrez was born in Albuquerque, N.M. He graduated from Valley High School, Albuquerque, in 1969; received a bachelor's degree in aeronautical engineering from the Air Force Academy in 1973; and received a master's degree in management from Webster College in 1977.

Following graduation from the Air Force Academy, where he was a member of the National Championship USAFA Parachute Team and completed more than 550 jumps, Gutierrez completed pilot training at Laughlin Air Force Base, Del Rio, Tex. He then served as an instructor pilot in T-38 aircraft at Laughlin from 1975-77, and in 1978, was assigned to the 7th Tactical Fighter Squadron, Holloman Air Force Base, Alamogordo, N.M., flying the F-15 Eagle aircraft. Gutierrez attended the Air Force Test Pilot School in 1981, and after graduating, served as the primary test pilot for airframe and propulsion testing on the F-16 aircraft.

Gutierrez' first Shuttle flight was as pilot of STS-40, the first Spacelab Life Sciences flight, aboard Columbia in June 1991. Gutierrez has logged more than 218 hours in space and more than 4,000 hours in flying time in 30 different types of aircraft, sailplanes, rockets and balloons.

KEVIN P. CHILTON, 39, Col., USAF, will serve as pilot (PLT). He was selected to be an astronaut in 1988 and will be making his second space flight.

Chilton was born in Los Angeles, Calif. He graduated from St. Bernard High School, Playa del Rey, Calif., in 1972; received a bachelor's degree in engineering sciences from the Air Force Academy in 1976; and received a master's degree in mechanical engineering from Columbia University in 1977.

Chilton received his wings at Williams Air Force Base, Ariz., in 1978, and was assigned to the 15th Tactical Reconnaissance Squadron at Kadena Air Base, Japan, flying the RF4 Phantom II aircraft. In 1981, he was assigned to the 67th Tactical Fighter Squadron at Kadena Air Base flying the F-15 Eagle aircraft. Chilton attended the Air Force Squadron Officer School in 1982 and served as an F-15 weapons officer, instructor pilot and flight commander until 1984 at Holloman Air Force Base, N.M. He completed the Air Force Test Pilot School in 1984 and later served as weapons and systems test pilot in the F-15 and F-4.

Chilton's first space flight was as pilot of Endeavour's maiden flight on STS-49, a mission that repaired a stranded INTELSAT communications satellite, in May 1992. He has logged more than 213 hours in space.

LINDA M. GODWIN, 41, is payload commander and mission specialist 3 (MS-3). She is a member of the astronaut class of 1985 and will be making her second Shuttle flight.

Godwin was born in Cape Girardeau, Missouri, and considers Jackson, Mo., her hometown. She graduated from Jackson High School in 1970 and received a bachelor of science degree in mathematics and physics from Southeast Missouri State in 1974. In 1976 and 1980 she earned master of science and doctorate degrees in physics from the University of Missouri.

She joined NASA in 1980 working in the payload integration office of the Mission Operations Directorate. Before being selected an astronaut, Godwin served in Mission Control as a flight controller and payloads officer on several Shuttle missions. Her first Shuttle mission was aboard Atlantis on the STS-37 mission in April 1991. The primary task of the crew during the flight was to deploy the Compton Gamma Ray Observatory and to evaluate translation techniques during two spacewalks. Godwin has logged more than 143 hours in space. She also has logged approximately 500 hours in light aircraft.

BIOGRAPHICAL DATA

JAY APT, 44, will be mission specialist 1 (MS-1) and the commander of the blue shift on STS-59. He was chosen to be an astronaut in 1985 and will be making his third Space Shuttle flight.

Apt was born in Springfield, Massachusetts, but considers Pittsburgh, Pennsylvania, his hometown. He graduated from Shady Side Academy in Pittsburgh in 1967; received a bachelor of arts degree in physics from Harvard College in 1971; and received a doctorate in physics from the Massachusetts Institute of Technology in 1976.

He joined NASA in 1980 and worked in the Earth and Space Sciences Division at the Jet Propulsion Laboratory, doing planetary research as part of the Pioneer Venus Orbiter Infrared team. In 1981, he became the manager of JPL's Table Mountain Observatory. He served as a flight controller and payloads officer in Mission Control from 1982 through 1985.

Apt flew on the Shuttle first as a mission specialist on Atlantis' eighth mission, STS-37 in April 1991, to deploy the Compton Gamma Ray Observatory. During that mission, he conducted two spacewalks to release a stuck antenna on the Compton Gamma Ray Observatory and to evaluate translation techniques for possible use during future spacewalks and spacecraft assembly in orbit.

His second flight, also as a mission specialist, was aboard Endeavour in September 1992. This mission was a cooperative effort between the U.S. and Japan to perform life sciences and materials processing experiments in the Spacelab pressurized module housed in the payload bay. He was the flight engineer and commanded the blue shift during the mission.

In addition to his two Shuttle missions totaling 334 hours, Apt has logged more than 3,000 hours in 25 different types of aircraft.

MICHAEL R. "RICH" CLIFFORD, 41, Lt. Col., USAF, is mission specialist 2 (MS-2). Selected as an astronaut in 1990, he will be making his second flight aboard the Space Shuttle.

Clifford was born in San Bernardino, Calif., but considers Ogden, Utah, his hometown. He graduated from Ben Lomond High School in Ogden in 1970. In 1974, Clifford received his bachelor of science degree from the U.S. Military Academy, West Point, N. Y. He earned a master of science degree in aerospace engineering in 1982 from the Georgia Institute of Technology.

After graduation from the Naval Test Pilot School in 1986, he was designated an experimental test pilot. He was assigned to the Johnson Space Center in 1987 as a military officer and served as a Space Shuttle vehicle integration engineer. He was involved in design certification and integration of the Shuttle crew escape system.

Clifford's first Shuttle mission aboard Discovery, STS- 53, was a Department of Defense flight in December 1992 giving him more than 175 hours in space. He has logged more than 2,900 flying hours in a wide variety of fixed and rotary winged aircraft.

BIOGRAPHICAL DATA

THOMAS D. JONES, 39, will serve as mission specialist 4 (MS-4). He was selected to be a member of the astronaut corps in 1990 and will be making his first flight aboard the Space Shuttle.

Jones was born in Baltimore, Md. He graduated from Kenwood Senior High School, Essex, Md., in 1973. He received a bachelor of science degree in basic sciences from the U.S. Air Force Academy in Colorado Springs in 1977, and a doctorate in planetary science from the University of Arizona, Tucson, in 1988.

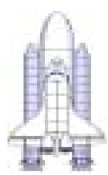
He served on active duty as an Air Force officer for six years flying strategic bombers at Carswell AFB, Texas. While serving as a pilot and commander of a B-52D Stratofortress, he led a combat crew of six, accumulating more than 2,000 hours of jet experience. He resigned his commission in 1983 with the rank of captain.

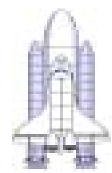
Prior to his selection as an astronaut, Jones was a program management engineer in the Office of Development and Engineering, CIA, and a senior scientist with Science Applications International Corp. (SAIC), Washington, D.C. At SAIC, his tasks included advanced program planning for the Solar System Exploration Division at NASA Headquarters, concentrating on future robotic missions to Mars, asteroids, and the outer solar system.

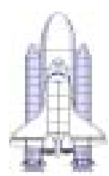
In addition to the STS-59 mission, Jones is training as the payload commander for the second Space Radar Laboratory mission (SRL-2) scheduled for launch in August 1994 (STS-68).

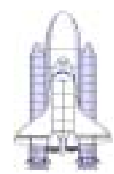
SHUTTLE FLIGHTS AS OF APRIL 1994

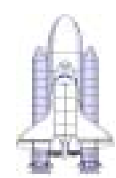
61 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 36 SINCE RETURN TO FLIGHT











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