NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-87

PRESS KIT
NOVEMBER 1997

UNITED SATES MICROGRAVITY PAYLOAD-4; SPARTAN-201

STS-87 INSIGNIA

STS087-S-001 **--** *The STS-87 insignia is shaped like a space helmet symbolizing the Extravehicular Activity (EVA) on the mission in support of testing of tools for the assembly of the International Space Station (ISS). Earth is shown reflected on the backside of the helmet. The Space Shuttle Columbia forms the interface between the Earth and the heavens, the back and front sides of the helmet in profile. The three red lines emerging from Columbia represent the astronaut symbol as well as the robot arm which will be used to deploy and retrieve the Spartan satellite. The letters "ug" (in Greek "mg") represent the payloads studying microgravity in space on this United States Microgravity Payload (USMP-4) mission. Gold flames outlining the helmet visor represent the corona of the Sun, which will be studied by Spartan. The flag of Ukraine is next to the name of the payload specialist who is the first person from that nation to fly on the space shuttle.*

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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RELEASE: J97-37

SOLAR AND MICROGRAVITY RESEARCH HIGHLIGHT FINAL SHUTTLE MISSION OF 1997

Experiments to study how the weightless environment of space affects various physical processes, observations of the Sun's outer atmospheric layers along with a spacewalk to rehearse future Space Station operations, will highlight NASA's eighth and final Shuttle mission of 1997 with the launch of Shuttle Columbia on Mission STS-87.

The STS-87 crew will be commanded by Kevin R. Kregel, who will be making his third Shuttle flight. The pilot, Steven W. Lindsey, will be making his first flight. There are three mission specialists assigned to this flight. Kalpana Chawla, serving as Mission Specialist-1, is making her first flight. Mission Specialist-2 Winston E. Scott is making his second flight. Takao Doi, from the Japanese space agency (NASDA), will serve as Mission Specialist-3 and is making his first flight. During the flight, Doi will become the first Japanese and second non-U.S. person to perform a Shuttle spacewalk. Leonid K. Kadenyuk from the Ukrainian space agency will be making his first space flight as Payload Specialist-1 and is and is the first Ukrainian to fly aboard the Space Shuttle.

Columbia is targeted for launch on November 19 from NASA's Kennedy Space Center Launch Complex 39-B. The two-hour available launch window opens at 2:46 p.m. EST. The STS-87 mission is scheduled to last 15 days, 16 hours, 34 minutes. An on-time launch on November 19 and nominal mission duration would have Columbia landing back at Kennedy Space Center on December 5 at about 7:20 a.m. EST.

On launch day, Columbia's eight and a half minute climb to orbit will take a different approach from all previous Shuttle launches. Most of the powered flight period will be as before with a "heads down" roll maneuver performed shortly after liftoff and solid rocket booster separation just over two minutes into the launch. However, at about six minutes into the flight, a second roll maneuver to a "heads up" position will be performed. The second roll maneuver, done gradually over a 20 second period, will allow the Shuttle to acquire communications with the Tracking Data Relay Satellite System (TDRSS). Use of the TDRSS will remove the need for Bermuda tracking station support and provide a cost savings to the space agency.

The prime mission objective for the STS-87 mission is the United States Microgravity Payload-4 (USMP-4) payload which is focused on gaining additional understanding of the basic properties and behavior of various materials and liquids being flown in space. While extensive ground-based studies in these areas have been conducted, Earth's gravity overshadows or distorts many measurable results. The near-weightless environment aboard the Space Shuttle unmasks subtle physical processes, giving researchers a clearer look into the laws of nature, a perspective that cannot be seen in laboratories on Earth.

Knowledge gained from these experiments may help produce better semiconductors for complex computers and other high-tech electronics. USMP science also could help produce stronger metal alloys sought by the aircraft and automobile industries to improve their economic competitiveness.

Another payload in Columbia's cargo bay is the Spartan 201-04 free-flyer. Spartan will be deployed and retrieved using the Shuttle's mechanical arm and is designed to investigate physical conditions and processes of the hot outer layers of the Sun's atmosphere, or solar corona. While deployed from the Shuttle, Spartan will gather measurements of the solar corona and solar wind.

Information collected during this mission will lead to a much better understanding of the solar winds that directly influence orbiting satellites and weather conditions on Earth which can in turn impact television and phone communications.

On Flight Day Six, STS-87 astronauts Winston Scott and Takao Doi will perform a 6 1/2-hour spacewalk to evaluate equipment and procedures that will be used during construction and maintenance of the International Space Station. This spacewalk will accomplish all of the primary objectives originally planned as part of the STS-80 mission in November 1996 that were not achieved due to a stuck airlock hatch.

The spacewalk will include an end-to-end demonstration of a maintenance task simulating the changing out of Orbital Replacement Units (ORUs) on the International Space Station. A crane designed for use in moving large ORUs on the space station also will be evaluated as part of the task.

Toward the end of spacewalk activities, the Autonomous Extravehicular Activity Robotic Camera Sprint (AERCam Sprint) payload will undergo an evaluation test as a prototype free-flying television camera that could be used for remote inspections of the exterior of the International Space Station. The sphere, which in appearance looks like an oversized beachball, will be released and fly freely in the forward cargo bay for about 30 minutes. The free-flyer will be remotely controlled by Pilot Steve Lindsey from the Shuttle's aft flight deck.

Other experiments flying in Columbia's cargo bay include several hitchhiker payloads. The SOLSE or Shuttle Ozone Limb Sounding Experiment and the Limb Ozone Retrieval Experiment (LORE) will be gathering vertical profiles of the Earth's ozone layer. Unlike other satellites that only provide a horizontal view of the ozone, the vertical view will help investigators understand the actual distribution of ozone. The Loop Heat Pipe (LHP) experiment is investigating a unique thermal energy management system using a loop heat pipe that is comprised of a passive, two-phase flow device that transports thermal energy through semi-flexible tubes. This type of system will be used on the International Space Station and future satellites. The Sodium Sulfur Battery Experiment (NaSBE) is studying the microgravity operation of sodium and sulfur liquid electrodes. The reaction of the battery cells in simulated geostationary and low Earth orbits will be investigated.

Flying in the middeck area of Columbia is the Collaborative Ukrainian Experiment (CUE), a collection of 10 plant space biology experiments. Kadenyuk will perform the CUE experiments, which seek to discover what, if any, developmental events during plant reproduction fail to function normally in the microgravity environment, along with comparing pollination and fertilization processes done in microgravity with ones performed on ground control subjects.

CUE also features an educational component that involves evaluating the effects of microgravity on the pollination and fertilization of Brassica rapa (Wisconsin Fast Plants) seedlings. As many as 625,000 American students and teachers in the United States and a minimum of 20,500 Ukrainian students and teachers will perform experiments on the ground while Kadenyuk performs the flight experiments in space.

STS-87 will be the 24th flight of Columbia and the 88th 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 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-87 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 its 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.nasa.gov/newsinfo/index.html

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

http://www.nasa.gov/today.html

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

http://www.nasa.gov/ntv

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 Spacelink, a resource for educators, also provides mission information via the Internet. Spacelink may be accessed at the following address:

http://spacelink.nasa.gov

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-87 Payload-Related Web Sites

The following Internet web sites have been established for various STS-87 payloads and mission activities.

http://sspp.gsfc.nasa.gov
http://zeta.lerc.nasa.gov/expr2/gjdfe.htm
http://sspp.gsfc.nasa.gov/g-036.htm
http://atlas.ksc.nasa.gov/education/general/cue.htm
http://fastplants.cals.wisc.edu/cue/cue.html

STS-87 QUICK LOOK

Launch Date	Nov. 19, 1997
Launch Date/Site:	KSC Launch Pad 39-B
Launch Time:	2:46 P.M. EST
Launch Window:	2 hours, 30 minutes
Orbiter:	Columbia, (OV-102), 24th flight
Orbit Altitude/Inclination:	150 nautical miles, 28.5 degrees
Mission Duration:	15 days, 16 hours, 34 minutes
Landing Date:	December 5, 1997
Landing Time:	7:20 A.M. EST
Primary Landing Site:	Kennedy Space Center, Florida
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites - Banjul, The Gambia Ben Guerir, Morocco Moron, Spain Abort-Once Around - Edwards AFB, California
Crew:	Kevin Kregel, Commander (CDR), 3rd flight Steve Lindsey, Pilot (PLT), 1st flight Kalpana Chawla, Mission Specialist 1 (MS 1), 1st flight Winston Scott, Mission Specialist 2 (MS 2), 2nd flight Takao Doi, Mission Specialist 3 (MS 3), 1st flight Leonid Kadenyuk, Payload Specialist 1, 1st flight
EVA Crewmembers:	Winston Scott (EV 1), Takao Doi (EV 2)
Cargo Bay Payloads**:**	SPARTAN-201-04 USMP-4 EDFT Equipment SOLSE NASBE OARE LHP TGDF GAS-036
In-Cabin Payloads:	MGBX CUE Sprint/AERCAM MSX SIMPLEX

CREW RESPONSIBILITIES

Payloads	Prime	Backup
Rendezvous	Kregel	Lindsey
Rendezvous Tools	Doi	Scott
SPARTAN	Chawla	Lindsey
USMP-4	Chawla	Scott
EVA	Scott	Doi
Intravehicular Crewmember	Chawla	Lindsey
SPRINT	Lindsey	Scott, Kregel
RMS	Chawla	Lindsey
CUE	Kadenyuk	Kregel, Chawla
NASBE	Scott	Lindsey
LHP	Scott	Kregel
SOLSE	Scott	Doi
Earth Observations	All Crewmembers	
Ascent Seat on Flight Deck	Chawla	------
Entry Seat on Flight Deck	Doi	------

DEVELOPMENTAL TEST OBJECTIVES/ DETAILED SUPPLEMENTARY OBJECTIVES/ RISK MITIGATION EXPERIMENTS

DTO 312:	External Tank TPS Performance
DTO 671:	EVA Hardware for Future Scheduled EVA Missions
DTO 685:	On-Board Situational Awareness Displays for Ascent and Entry
DTO 805:	Crosswind Landing Performance
DTO 844:	RMS Situational Awareness Displays
DSO 206:	Effects of Space Flight on Bone and Muscle (Doi only)
DSO 331:	LES and Sustained Weightlessness on Egress Locomotion
DSO 496:	Individual Susceptibility To Post-Spaceflight Orthostatic Intolerance
DSO 802:	Educational Activities
RME 1309:	In-Suit Doppler Ultrasound for Determining Risk of Decompression
RME 1323:	Autonomous EVA Robotic Camera/SPRINT

PAYLOAD AND VEHICLE WEIGHTS

	Pounds
Orbiter (Columbia) empty and 3 SSMEs	181,796
Shuttle System at SRB Ignition	4,520,785
Orbiter Weight at Landing with Cargo	226,449
SPARTAN	2,980
EDFT Hardware	873
LHP	276
USMP-4	4,704
OARE	249
SOLSE	432
CUE	299

STS-87 ORBITAL EVENTS SUMMARY
(based on a November 19, 1997 Launch)

Event	MET	Time of Day (EST)
Launch	0/00:00	2:46 PM, November 19
SPARTAN Deployment	1/01:14	4:00 PM, November 20
SPARTAN Retrieval	3/04:44	7:30 PM, November 22
EVA	5/03:50	6:36 PM, November 24
Crew News Conference	12/18:05	8:51 AM, December 2
KSC Landing	15/16:34	7:20 AM, December 5

MISSION SUMMARY TIMELINE

Flight Day 1
Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
USMP-4 Activation
MGBX Checkout
RMS Checkout

Flight Day 2
SPARTAN Deploy
USMP Operations
CUE Operations

Flight Day 3
SOLSE Operations
USMP Operations
CUE Operations

Flight Day 4
SPARTAN Retrieval
CUE Operations
USMP Operations

Flight Day 5
EVA Preparations
USMP Operations
CUE Operations

Flight Day 6
EVA (6 hours; Scott and Doi)
CUE Operations
USMP Operations

Flight Day 7-12 (Off-Duty Time on FDs 7 and 11)
USMP Operations
CUE Operations

Flight Day 13
USMP Operations
CUE Operations
Crew News Conference

Flight Day 14
SOLSE Operations
USMP Operations
CUE Operations

Flight Day 15
Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stowage
USMP and CUE Deactivation

Flight Day 16
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-87 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 White Sands Space Harbor, N.M.

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

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

UNITED STATES MICROGRAVITY PAYLOAD-4 (USMP-4)

United States Microgravity Payload-4 research will be conducted in the areas of materials science, combustion science and fundamental physics. The Marshall Space Flight Center in Huntsville, Ala., manages USMP-4 as NASA's lead center for microgravity research. On orbit, crew members will activate the USMP-4 experiment hardware, while science teams in Marshall's Science Operations Area monitor and adjust experiments, based on data downlinked from Columbia. USMP science is a major part of NASA's efforts to use the attributes of the space environment to advance knowledge, improve the quality of life on Earth and strengthen the foundations for continuing exploration and use of space.

Advanced Automated Directional Solidification Furnace (AADSF)
Principal Investigators: Dr. Archibald L. Fripp, NASA Langley Research Center, Hampton, Va.; and Dr. Sandor L. Lehoczky, NASA Marshall Space Flight Center, Huntsville, Ala.

The speed and the amount of information that can be stored and sent by computers and high-tech electronics, using sophisticated semiconductor materials, may be increased by better control of how the semiconductor's crystal structure forms. Extensive research and millions of dollars are invested each year in ground-based efforts to improve semiconductor formation and performance. During the USMP-4 mission, researchers will expand upon these efforts and upon findings from USMP-2 and 3 with further experiments in the Advanced Automated Directional Solidification Furnace (AADSF). The goals are to understand how to develop better material processes, material performance and to reduce production costs.

A semiconductor's usefulness is determined by how atoms are ordered within its underlying three-dimensional structure. These materials, when produced under the influence of gravity, often suffer structural damage that limit the semiconductor's usefulness. This damage is usually the result of buoyancy-induced convection, as well as another undesirable phenomenon -- sedimentation. Both of these processes are greatly reduced in the Shuttle's orbiting microgravity laboratory.

Buoyancy-driven convection and sedimentation occur when fluids are different in density. On Earth, gravity causes the denser, heavier material to sink while the lighter fluid rises. Researchers seek to understand the resulting flows caused by these processes, and how these flows show up as weak points in a semiconductor's structure.

During USMP-4, this specialized furnace will process two different alloys that are used to make infrared detectors and lasers. Lead-tin-telluride and mercury-cadmium-telluride are semiconductor material alloys that will be studied by the investigative technique known as directional solidification. This method involves cooling a molten material, causing a solid to form at one end of the sample. The solidification region grows at the point where the solid and liquid meet, known as the solid/liquid interface. This interface moves from one end of the sample to the other at a controlled rate, resulting in a high degree of structural uniformity.

The facility has multiple temperature zones, ranging from extremely hot -- above the melting point of the material (about 1600 degrees Fahrenheit/870 Celsius) -- to cooler zones below the melting point (about 650 degrees Fahrenheit/340 Celsius). Once a region of the alloy is melted, the sample is slowly moved and directional solidification takes place.

The solid/liquid interface occurs where the flows in the molten material influence the final composition and structure of the semiconductor alloy sample. After the mission, scientists will analyze the solidified sample to determine the extent of defects and the distribution of elements in the resulting alloy.

Advances in the quality of crystals for semiconductor materials may impact normal consumer products such as computers, calculators and high-technology applications such as infrared detectors and lasers.

Confined Helium Experiment (CHeX)
Principal Investigator: Dr. John Lipa, Stanford University, Stanford, Calif.

Better understanding of the effects of miniaturization on material properties should lead to even smaller and even more efficient electronic devices, including computers of the future, with reduced costs for the consumer.

One key research goal of both NASA and its industry partners is to develop successful measurement techniques to analyze the behavior and properties of various materials used in electronics.

Almost daily, the semiconductor industry reduces the size of all its devices, such as computer chips, to try to improve transmission speed and power consumption and to reduce cost. However, electrical performance is affected first by sheer size, then by additional factors such as thickness, irregularities in surface structure, and changes in the part's material properties. Researchers hope to understand the size-dependent changes that take place in various material properties through ultra-precise measurements in cooled liquid helium. Scientists expect these delicate measurements to be more accurate in the near weightlessness of the orbiting Space Shuttle, than when taken under the influence of Earth-bound gravity.

The CHeX facility is comprised of a refrigerated bottle or dewar, with a protective covering. The dewar is covered on the outside by a magnetic shield. For protection of the instrument, a vacuum is created between the magnetic shield and the refrigerated bottle.

Inside the refrigerated container or dewar, the experiment sample includes 392 crystal silicon disks, each two-thousandths of an inch thick. This stack of disks is arranged to force the liquid helium into very thin layers. Through these liquid helium layers, researchers plan to make measurements that take advantage of liquid helium's ability to conduct heat 1000 times more effectively than any other material.

Thermal controls and heater feedback systems, located in the instrument, regulate the temperature of the experiment sample to better than a billionth of a degree over several days.

In space, the experiment is controlled by its onboard computer, and data from the experiment is routed to the investigation team on the ground at Marshall Space Flight Center.

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

Researchers are striving to understand the process of solidification and to improve metal manufacturing techniques. This investigation seeks to unlock advanced processes that will create new alloys that are stronger and have better controlled and more reliable properties than currently available. The experiment may improve manufacturing processes involved in the production of steel, aluminum and superalloys used in the production of automobiles and airplanes.

As many molten materials solidify, they form tiny pine tree- shaped crystals called dendrites, from the ancient Greek for "tree." The size, shape and direction of these crystals, in particular for many commercial metal alloys, dictate the final properties of the resulting solid material, such as its hardness, its ability to bend without breaking and its electrical properties. On USMP-2 and 3, researchers were able to observe dendrites in the absence of convection at extremely small temperature differences below the freezing point, a phenomenon never measured accurately on Earth. USMP-4 investigations will continue to build upon those findings.

The Isothermal Dendritic Growth Experiment apparatus consists of a thermostat that contains the dendrite growth chamber. Dendrite growth begins by cooling a tube, known as a stinger, which is filled with the liquid known as pivalic acid, and extends into the growth chamber. This causes the acid to solidify, and the solidification front to move down the tube to the tip of the stinger and emerge into the main chamber of acid as an individual dendrite.

Two television cameras will allow scientists to watch as dendrites emerge. The images of dendrites growing in space will be viewed in near-real-time by scientists on the ground. When the experiment computer detects dendrites, it will trigger two 35- millimeter cameras to photograph the samples. Researchers will compare photographs of the space-grown dendrites to evaluate growth rates and dendrite shapes.

Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO)
Principal Investigator: Professor Reza Abbaschian, University of Florida, Gainesville, Fla.

A team of international scientists is studying fundamental natural processes with importance implications for the quality and performance of products in use in the home and by industry. The research may improve products ranging from alloys for airplane turbine blades to everyday electronic materials.

The investigation known as MEPHISTO is an international cooperative program between NASA, the French Space Agency, the French Atomic Energy Commission and the University of Florida. The goal of the experiment is to understand how gravity-driven convection affects the production of metals, alloys and electronic materials. MEPHISTO flew on the three previous USMP missions. The fourth flight of MEPHISTO will continue the investigation into how materials solidify in microgravity. Ultimately, the MEPHISTO experiments may bring dramatic improvements in the production process of various materials.

Researchers want to know precisely what happens when materials undergo the transition from a liquid to a solid -- the solidification of a molten material --to better understand and control this process on Earth. This process is complicated on Earth by gravity-induced factors such as convection, or flows of material within the liquid. This motion within the liquid material causes physical imperfections that significantly affect the quality of semiconductor and electronic structures. In microgravity, these flows are effectively eliminated and scientists are better able to observe and understand the solidification process.

The MEPHISTO furnace aboard USMP-4 will repeatedly process three samples of bismuth with small additions of tin using directional solidification, a common method for growing semiconductors and metal alloys. As the solidified region grows, the boundary between the solid and liquid material will move from one end of the sample toward the other. Electrical measurements will gauge temperature variations in the solidification front and electrical pulses will mark the shape of the front as it progresses. The temperature variations are expected to show how stable the solidification front is, a factor that is very important to understanding and producing new material properties.

Microgravity Glovebox Facility (MGBX)
MGBX Project Scientist: Dr. Donald Reiss, NASA Marshall Space Flight Center, Huntsville, Ala.

While the preceding experiments operate without crew involvement, one facility that will support science experiments requiring a high degree of crew involvement is the Microgravity Glovebox.

Two materials science investigations and one combustion science experiment will be conducted in the Microgravity Glovebox, located in the Shuttle middeck. This versatile facility offers scientists the capability to conduct experiments, test science procedures and develop new technologies in microgravity. The Microgravity Glovebox enables crew members to handle, transfer and manipulate experiment hardware and materials that are not approved for use in the open cabin environment. The glovebox was developed to provide such capabilities in the Shuttle middeck, on the Mir Space Station and for future use on the International Space Station. When an airtight seal is required, crew members can insert their hands into rubber gloves attached to the glovebox doors, allowing no airflow between the enclosure and the middeck, except through a specially designed filter. The facility provides power, air and particle filtration, light, data collection, real-time monitoring, and sensors for gas, temperature, air pressure and humidity.

Experiment: Enclosed Laminar Flames (ELF) Experiment Facility
Principal Investigator: Dr. Lea-Der Chen, University of Iowa, Iowa City, Iowa

Combustion - the scientific term for burning - plays a key role in home heating, air pollution, transportation, propulsion, global environmental heating and materials processing. Combustion in normal gravity creates convection - flows or movements within a liquid or gas caused when lighter parts rise to the top and heavier parts sink to the bottom. In microgravity, scientists can study subtle processes ordinarily masked by the effects of gravity.

The Enclosed Laminar Flames experiment will examine the effect of different air flow velocities on the stability of laminar - or non-turbulent - flames. Enclosed laminar flames are commonly found in combustion systems such as power plant and gas turbine combustors, and jet engine afterburners. Results of this investigation may help to optimize the performance of industrial combustors, including pollutant emissions and heat transfer.

Experiment: Wetting Characteristics of Immiscibles (WCI) Experiment Facility
Principal Investigator: Dr. Barry Andrews, University of Alabama at Birmingham, Birmingham, Ala.

Special metal alloys - known as immiscibles - contain components that do not mix in the liquid melt (similar to oil and water) before solidification. Potential applications of these metal alloys include ball-bearing, electronic and semiconductor materials. Previous microgravity experiments with these alloys revealed unexpected separation of their components into layers, even though gravity's effects were absent. The Wetting Characteristics of Immiscibles experiment will investigate one possible cause for this segregation - droplet wetting, or coating, along the container walls. The investigation is designed to study ways to control this wetting behavior and ultimately result in improved materials processing on Earth for this potentially important class of alloys.

The experiment will study various concentration mixtures of the substances succinonitrile and glycerin in a glass container with a non stick perimeter wall. Succinonitrile is a transparent substance that behaves in a manner similar to metals during the solidification process and is used to model metallic structures.

The experiment is performed inside a thermal chamber in the Microgravity Glovebox. The mixed alloys are heated until the sample melts and observed through an external microscope during the cooling phase for any wetting phenomena. The observations are recorded on videotape for later study and analysis.

Experiment: Particle Engulfment and Pushing by a Solid/Liquid Interface (PEP) Experiment Facility
Principal Investigator: Dr. Doru Stefanescu, University of Alabama, Tuscaloosa, Ala.

Composite materials - those in which a mixture of two or more materials form a new material with specific properties - are developed in order to take advantage of the properties of each of the component materials. The resulting composite material can be superior in terms of stiffness, strength and similar properties. Processing of metal composite materials uses the properties of various components to attain the desired composite strength, which is dependent upon the even dispersion of particles throughout the metal. As liquid metals solidify, a band of atoms - known as the solidification interface - forms. As the interface moves, particles are either pushed ahead of, or engulfed into, the solid material. Convection - flows or movements in a liquid or gas caused by gravity - has hampered ground-based experiments from providing accurate understanding of the physics of the problem.

The Particle Engulfment and Pushing by a Solid/Liquid Interface Experiment will allow investigators to study the behavior and movement of particles as the sample is solidified from one end to the other in a convection-free microgravity environment. This research could lead to improved materials processing to benefit the automotive and aerospace industries.

Samples will be enclosed between two glass slides. The mixture will be melted in a thermal chamber inside the Microgravity Glovebox. The interaction between a moving solid- liquid interface and the glass bead particles will be observed and recorded.

Space Acceleration Measurement System (SAMS)
Project Scientist: Ms. Melissa Rogers, NASA Lewis Research Center, Cleveland, Ohio

The effects of Earth's gravity on the Space Shuttle and its cargo are markedly reduced when in orbit. However, the effects are never completely eliminated. Disturbances occur when crew members move about the Shuttle, when onboard equipment is operated, or when 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 affect sensitive experiments being conducted onboard. Researchers and scientists conducting experiments on the Fourth U.S. Microgravity Payload mission will depend on the Space Acceleration Measurement System to record and downlink in near real-time, precise measurements of such changes. The system will enable them to adjust their experiments and improve the collection of scientific information during the mission. Post-mission, the system's measurements aid in determining how vibrations or accelerations affected the results of experiments.

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. For this mission, five sensor heads will be used to detect accelerations over a wide range of frequencies.

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.

Orbital Acceleration Research Experiment (OARE)
Project Scientist: Ms. Melissa Rogers, NASA Lewis Research Center, Cleveland, Ohio

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 Fourth U.S. Microgravity Payload.

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.

SPARTAN 201-04

The goal of the Spartan 201-04 mission is to investigate physical conditions and processes of the hot outer layers of the Sun’s atmosphere, or solar corona. Deployed during STS-87, Spartan 201-04 will perform measurements of the solar corona and solar wind.

The Spartan spacecraft is a carrier for two instruments that will investigate the heating of the solar corona and the acceleration of the solar wind that originates in the corona. These complementary instruments, the Smithsonian Astrophysical Observatory’s Ultraviolet Coronal Spectrometer (UVCS) and the Goddard Space Flight Center/High Altitude Observatory White Light Coronagraph (WLC), have flown aboard the Spartan carrier on three previous missions.

Spartan 201-04 flight operations are expected to benefit from the addition of the Technology Experiment Augmenting Spartan, known as TEXAS. This experiment was designed to be used by the scientists as a visual reference for the WLC instruments after the Spartan spacecraft is deployed. Scientists should be able to adjust the alignment of the WLC instrument while it is in orbit for optimal performance.

Astronaut Kalpana Chawla will use the Shuttle’s robotic arm to deploy the Spartan 201-04 spacecraft during Flight Day 2 of the mission. The two instruments aboard Spartan will determine the physical condition of our Sun’s corona by remote sensing methods. The WLC is a specialized telescope that produces an artificial eclipse of the Sun to image the solar corona. The UVCS performs spectroscopic measurements of the primary light emitted by highly ionized atoms. These measurements will be used to determine velocities, temperatures and densities of the coronal plasma. During the two days that Spartan is deployed, all WLC and UVCS observations will be coordinated with the ongoing Solar and Heliospheric Observatory (SOHO). These joint observations will provide scientists an expanded picture of the existing conditions within the Sun’s corona and offer verification of collected data.

Information collected during the mission will lead to a better understanding of the solar flares and solar winds that directly impact orbiting satellites and weather conditions on Earth. Upon completion of the Spartan 201-04 mission, the Shuttle will retrieve the Spartan spacecraft and return it to Earth.

Spartan 201-04 is a primary Shuttle payload mission managed by the Spartan Project at Goddard in Greenbelt, Md. Craig Tooley of Goddard is Spartan’s Mission Manager. The Principal Investigator for the UVCS instrument is Dr. John Kohl of the Smithsonian Astrophysical Observatory, Cambridge, Mass. Dr. Richard Fisher of Goddard is the STS-87 Payload Scientist and Principal Investigator for the WLC instrument.

Automated Rendezvous and Capture Video Guidance Sensor Flight Experiment
Project Manager: Gene Beam, Marshall Space Flight Center, Huntsville, Ala.

A key element of a new system for development of an automated space rendezvous and capture capability by the U.S. will be tested during the STS-87 mission. A technology demonstration of the Automated Rendezvous and Capture Video Guidance Sensor is one of the experiments associated with the Spartan flight.

Part of the expense of current missions relates to the high cost of ground operations supporting space vehicles on orbit. The cost of mission operations could be reduced significantly if rendezvous operations were automated.

Until now, NASA missions involving spacecraft rendezvousing in orbit and one spacecraft capturing or connecting to another have relied on human control throughout those operations. The alternative is relying on an automated rendezvous and capture capability. System elements are being designed, developed and tested by NASA to enable performing the task of spacecraft rendezvous and capture without having human operators at the controls.

The Automated Rendezvous and Capture technology under development at the Marshall Space Flight Center in Huntsville, Ala., requires little or no ground support. Onboard sensors, computers and navigation inputs from satellites provide the intelligence to complete docking maneuvers through automated operations.

The Video Guidance Sensor, also developed at Marshall, is a key component of the technology. It is the first element to be tested under space flight conditions and the only element to be studied during the STS-87 mission.

The system includes a video camera and dual-frequency lasers. A sensor will be mounted in the cargo bay of the Space Shuttle and an optical target on the Spartan spacecraft. The lasers illuminate reflectors on Spartan -- the Video Guidance Sensor's target -- and the reflected video images define the exact position of the spacecraft and its distance from the Space Shuttle.

The laser-video system offers improved accuracy over the use of radio frequency control systems for docking maneuvers. In ground testing, the system has homed in on its target at pinpoint accuracy -- down to one-tenth of an inch.

The Automated Rendezvous and Capture Video Guidance Sensor experiment is intended to demonstrate on-orbit operation of a laser-video docking sensor system. The experiment will collect tracking data both when the target is moving and static. The Video Guidance Sensor's performance will be tested under different lighting conditions, positions and distances ranging from 3 to 220 yards between Spartan and the Shuttle.

Tracking data will be recorded while Spartan is in free flight and during retrieval. The Remote Manipulator System -- the Shuttle's robot arm -- will place Spartan in 16 pre-determined positions while the Space Shuttle rotates to study performance under various lighting angles.

Collection of data for the experiment will involve only minimal adjustments to the standard Shuttle procedure for rendezvous and capture of a satellite -- in this case, Spartan. The Shuttle crew will continue to have primary control over the process. In parallel, a crew member will operate and monitor the Video Guidance Sensor during all phases of the experiment.

The Video Guidance Sensor and other Automated Rendezvous and Capture elements have been ground tested at the Marshall Center's Flight Robotics Laboratory. The Video Guidance Sensor and related technologies are being developed to support the International Space Station, Reusable Launch Vehicles and other space vehicles. In addition, the Automated Rendezvous and Capture capability could play a role in future missions to Mars.

STS-87 EXTRAVEHICULAR ACTIVITIES

Astronauts Winston Scott and Takao Doi will perform a six- hour spacewalk on Flight Day 6 of STS-87 to evaluate equipment and procedures that will be used during construction and maintenance of the International Space Station. This spacewalk will accomplish all of the primary objectives originally planned as part of the STS-80 mission in November 1996 that were not be achieved due to a stuck airlock hatch.

The spacewalk is the sixth in a continuing series of Extravehicular Activities (EVAs) called the EVA Development Flight Tests (EDFT). This flight test series of spacewalks is designed to evaluate equipment and procedures planned for the station and to build spacewalking experience in preparation for assembly of the station. Scott is designated Extravehicular Crewmember 1 (EV-1) and will be distinguished by red bands worn on the legs of his spacesuit. Doi is designated EV-2. STS-87 Mission Specialist Kalpana Chawla will serve as the Intravehicular (IV) crewmember, assisting Scott and Doi from inside Columbia’s crew cabin. Pilot Steve Lindsey also will assist with the spacewalks, controlling the robotic arm from inside the cabin.

The spacewalk will include an end-to-end demonstration of a maintenance task simulating the changing out of an International Space Station battery. A crane designed for use in moving large Orbital Replacement Units (ORUs) on the space station will be evaluated as part of the task. ORUs can be any piece of equipment that may be replaced on the station’s exterior, and, for this evaluation, the simulated station battery will be moved using the crane. The evaluation of using the crane to move the simulated battery is planned to take almost three hours. Following the large ORU evaluation, use of the crane for moving a small ORU, a cable caddie that previously was used during an STS-72 spacewalk, will be evaluated by Doi for about 45 minutes.

Scott will evaluate working with the simulated large ORU from a Portable Foot Restraint (PFR), a work platform for spacewalkers, attached to the end of Columbia’s robotic arm. Among the evaluations conducted during the spacewalk will be use of several temporary ORU handling and restraint aids, some of which are attached to the Crane. The spacewalk also will evaluate the carrier for the simulated ORU, a carrier that simulates a standard International Space Station ORU work site.

Later in the spacewalk, Scott will evaluate working with the simulated large ORU from a Portable Foot Restraint (PFR), a work platform for spacewalkers. The spacewalk also will evaluate a variety of other work aids and tools designed for use during station operations, including a Body Restraint Tether (BRT), a type of "third hand" stabilizing bar for spacewalkers; a Multi-Use Tether (MUT), a type of stabilizing tether similar to the BRT but that can be anchored to either round U.S. handrails or square Russian handrails; and a Power Tool designed for the station. Detailed descriptions of the major items to be evaluated include:

Crane

The 156-pound crane is six feet tall and has a boom that telescopes from four feet long to an extended length of 17.5 feet. It is designed to aid spacewalkers in transporting ORUs with a mass as great as 600 pounds from translation carts on the exterior of the International Space Station to various worksites on the truss structure. The crane boom’s attachment mechanism may also provide a temporary stowage location for large units during maintenance work. The crane will be unstowed and installed to a socket along the left middle side of Columbia’s cargo bay for the evaluations. The crane’s boom may be extended by turning a ratchet fitting using a power tool or by using a backup manually operated hand crank. The crane also can be moved from side to side and up and down by respective manually operated hand cranks.

Battery Orbital Replacement Unit

A simulated battery for the International Space Station will be used for evaluations performed during STS-87 because the batteries will be among the most massive station ORUs. The station batteries will be mounted on the truss near the solar arrays and will provide power when the station moves into night on each orbit. The object to be used during STS-87 is not a real battery, although its size, 41 x 39 x 19 inches, and mass, about 354 pounds, closely imitate a station battery. It is also stowed in Columbia's cargo bay in fittings similar to those planned for stowing such replacement units during space station operations. The ORU carrier simulates a standard International Space Station work site.

Cable Caddie

The Cable Caddie is a small carrier device planned to hold about 20 feet of replacement electrical line for the space station. The operations of the Cable Caddie were flight-tested on STS-72 and on STS-87 it will be used only to simulate a small ORU for the space station. No cable will be unwound. The Cable Caddie has a mass of almost 50 pounds.

Body Restraint Tether

The Body Restraint Tether (BRT) is designed to hold a spacewalker steady when clamped to a handrail in order to free his hands for working. It was first flown on STS-69 and further evaluated on STS-72. The BRT is planned to provide a quick method of supplying stability for a spacewalker in a variety of locations where a foot restraint is not available. The 15-inch long tether essentially seeks to provide the astronaut with a "third hand" to add stability while working. During STS-87, the BRT will be evaluated by Doi.

Multi-Use Tether

The Multi-Use Tether (MUT) is a device similar to the BRT, but it has the capability to perform a greater variety of tasks. Different end effectors can be attached to the tether to grip station ORUs, various spacewalking tools or handrails. During STS- 87, Scott will use the MUT and evaluate it while using it to assist with the other planned spacewalk evaluations.

Handling Aids

Two Scoops, handholds designed to attach to square robotics fittings on the ORU, will be evaluated for use with the simulated battery. Also, a D-handle, which looks somewhat like a small, half steering wheel, may be attached to one of the Scoops and evaluated as a tool to assist with manually maneuvering the ORU. The D- handle evaluation is a continuation of handling studies originally conducted during Space Shuttle mission STS-69.

Restraint Aids

An ORU Tether, a flexible, spring-loaded, retracting tether that automatically can hold an ORU firmly against a steadying bracket, will be attached to the crane. During the crane evaluations, the simulated battery will be detached from its carrier and attached to the ORU tether to evaluate it as a temporary restraint. Such temporary restraints may be needed by spacewalkers to hold ORUs during changeout activities on the station when two ORUs must be attached to the crane for a short period of time. Another type of restraint attached to the crane will be a Ballstack, a rigidizing tether similar to the BRT with two EVA Changeout Mechanisms (ECOM) at either end. The use of the Ballstack as a temporary restraint for the simulated battery will be evaluated in a manner similar to the ORU tether.

Near the end of the spacewalk, Scott will release the Autonomous EVA Robotic Camera (AERCam Sprint) for a 30 minute long free-flight evaluation. AERCam Sprint is a small, remotely controlled free-flying camera to be evaluated as a prototype of future such systems on the station. During the evaluation AERCam will be controlled from inside the shuttle cabin. At its conclusion, Scott will retrieve the free-flyer.

AUTONOMOUS EXTRAVEHICULAR ACTIVITY ROBOTIC CAMERA SPRINT

The Autonomous Extravehicular Activity Robotic Camera Sprint (AERCam Sprint) is an experiment planned to demonstrate the use of a prototype free-flying television camera that could be used for remote inspections of the exterior of the International Space Station.

The AERCam Sprint free-flyer is a 14-inch diameter, 35-pound sphere that contains two television cameras, an avionics system and 12 small nitrogen gas-powered thrusters. The sphere, which looks like an oversized soccer ball, will be released by Mission Specialist Winston Scott during the planned spacewalk and will fly freely in the forward cargo bay for about 30 minutes. The free- flyer will be remotely controlled by Pilot Steve Lindsey from the Shuttle's aft flight deck using a hand controller, two laptop computers and a window-mounted antenna.
The AERCam is designed to fly very slowly at a rate of less than one-quarter of a foot per second. Remote control of the AERCam is performed through two-way Ultra High Frequency radio communications, with data regarding the status of the free-flyer's systems transmitted back to the operator. Television images are transmitted back to the operator via a one-way S-band communications link. During the experiment operations, live television images also will be relayed via Columbia to Mission Control. Two miniature color television cameras are mounted on the free-flyer, one with a 6 millimeter lens and another with a 12 millimeter lens. The exterior of the free-flyer sphere is covered with a sixth-tenths of an inch-thick layer of Nomex felt to cushion any inadvertent contact with a spacecraft surface and prevent damage.

Most of the free-flyer's systems are derived from the development of the Simplified Aid for EVA Rescue (SAFER) backpack. The AERCam's thrusters, basic avionics, solid-state rate sensors, attitude hold electronics, nitrogen tank and hand controller are identical to those used on the SAFER. The AERCam thrusters, however, produce eight-hundredths of a pound of thrust while the SAFER thrusters produced eight-tenths of a pound of thrust.

The free-flyer is powered by lithium batteries. Its electrical supply and nitrogen supply are designed to last at least seven hours, the maximum length of a normal spacewalk. The AERCam sphere has a small floodlight built in that is identical to floodlights used on the helmets of spacesuits. Spaced equally around the sphere also are six, small, flashing yellow light- emitting diode lights that make the free-flyer visible to the operator in darkness.

The front of the sphere is marked by stripes and arrows while the back is marked by dots. These markings assist the operator in determining the orientation of the AERCam. A small fabric strap on the sphere serves as a handhold for the spacewalker while deploying and retrieving the free flyer.

During the time it is deployed during STS-87, evaluations will be performed of the AERCam's rotation and translation capabilities, its ability to observe a spacewalking task, and its ability to move along the edge of the Shuttle cargo bay while maintaining a fixed distance from the structure.

The AERCam free-flyer will be stowed inside Columbia's airlock.

HITCHHIKER PAYLOADS ON STS-87

Flying on the STS-87 Space Shuttle mission will be two hitchhiker payloads which were manifested by the Shuttle Small Payloads Project (SSPP) at the Goddard Space Flight Center in Greenbelt, Md.

SOLSE/LORE

The first payload consists of the SOLSE, the Shuttle Ozone Limb Sounding Experiment, which will demonstrate that vertical profiles of ozone can be measured with high resolution from solar ultraviolet (UV) scattering from the Earth's atmospheric limb. SOLSE will record continuous UV wavelengths in the 290-340 nanometer range to measure the ozone profile between 15 miles (25 kilometers) and 34 miles (55 kilometers). This demonstration flight will verify the viewing orientation for ozone retrieval and the use of Charge-Coupled Device array technology for ultraviolet imaging applications.

Current instruments that monitor ozone provide either limited vertical resolution, like the Solar Backscatter UV Experiment (SBUV) or limited coverage like the Stratospheric Aerosol and Gas Experiment (SAGE). Limb scattering should provide vertical resolution similar to SAGE with global coverage similar to SBUV.

LORE, the Limb Ozone Retrieval Experiment, is a complementary instrument to SOLSE. LORE will demonstrate that vertical profiles of ozone can be measured with high resolution using sunlight scattered in the Earth's atmospheric limb. LORE records this light in five discrete wavelength bands throughout the ultraviolet, visible, and near infrared. These measurements will extend SOLSE's knowledge of the limb down to six miles (10 kilometers) above the surface of the Earth.
SOLSE and LORE will generate overall ozone coverage images and cross sections of the atmosphere showing ozone concentrations at different altitudes. The ability to determine where ozone depletion has occurred will aid in determining man-made versus natural causes that effect the ozone layer. SOLSE uses the Hitchhiker-Junior Carrier System which is managed and operated by Goddard is a modular hardware system that accommodates experiments on the Space Shuttle. Hitchhiker experiments can be mounted in the cargo bay with this modular hardware. These experiments may receive orbiter power, but do not get command or telemetry interfaces to the Goddard Payload Operations and Control Center. Instead, the Shuttle crew may send commands to and receive telemetry from experiments via the Payload General Support Computer laptop computer.

The Mission Manager for SOLSE is Tom Dixon. Tammy Brown is the SOLSE Payload Manager and Dr. Richard McPeters is the SOLSE Principal Investigator. Dr. Ernest Hilsenrath is the Principal Investigator for LORE. All four personnel are located at Goddard.

LHP/NaSBE

STS-87 marks the flight of two premiere space application technology experiments, the Loop Heat Pipe (LHP) and the Sodium Sulfur Battery Experiment (NaSBE). Both experiments also use the Hitchhiker Carrier System.

The LHP experiment, sponsored by the Center for Space Power (Texas A & M University in Corpus Cristi, Texas) and managed by Dynatherm Corporation (Kelton, Pa.), is investigating a unique thermal energy management system using a loop heat pipe. The system is comprised of a passive, two-phase flow device that transports thermal energy through semi-flexible tubes. The use of passive heat transport devices will greatly enhance thermal management on small satellites.

NaSBE, sponsored by USAF Phillips Laboratory, (Albuquerque, N.M.) and managed by the Naval Research Laboratory, Washington, D.C., is studying the microgravity operation of sodium and sulfur liquid electrodes. The reaction of the battery cells in simulated geostationary and low Earth orbits will be investigated.

By using the Hitchhiker Carrier System, LHP/NaSBE makes full use of Hitchhiker's power, data, and command services. LHP/NaSBE will receive power from the orbiter and real time telemetry during the mission. The payload is operated out of the Goddard Payload Operations Control Center where commands are sent to the experiment. The LHP/NaSBE experiments are mounted in two locations on the sidewall of the cargo bay and they are connected to one Hitchhiker avionics box which maximizes the Shuttle's carrier capabilities.

The Mission Manager for LHP/NaSBE is Dr. Ruthan Lewis. The
Principal Investigator for LHP is Dr. Walter Bienert of Dynatherm and the Project Engineer for NaSBE is Chris Garner from NRL.

More information on SOLSE, LORE, LHP/NaSBE, is available on the Shuttle Small Payloads Project web site at http://sspp.gsfc.nasa.gov.

TGDF

The Turbulent Gas-Jet Diffusion Flames (TGDF) experiment is a Hitchhiker CAP payload that will use the Get Away Special (GAS) canister. The TGDF experiment will fly as part of Goddard Space Flight Center Shuttle Small Payloads Project.

The objective of the TGDF experiment is to gain an improved understanding of the characteristics of transitional and turbulent gas-jet diffusion flames. TGDF hopes to understand the combustion processes of turbulent furnaces and engines to make the design of these devises more efficient for our use on Earth. Due to their random nature, turbulent flames are very difficult to study, whether experimentally or theoretically. As a simplification, the TGDF experiment will study the interaction of a steady, laminar flame with artificially-imposed flow vortices. The experiment cannot be conducted in normal gravity because buoyant (gravity-driven) convection causes flow instabilities that interfere with the experiment. For example, the flicker of a candle flame in a draft- free room is due to gravity through its generation of buoyant flow.

The flame will be taped by two video cameras contained within the combustion chamber. Three detectors will be used to measure the thermal radiation from the flame, both globally and at two discrete regions. The data resulting from the TGDF experiment will be used to validate computer models of the behavior of transitional and turbulent gas-jet diffusion flames under normal and microgravity environments.

The TGDF payload is completely automated, with the exception of activation and deactivation. The experiment will be activated by a crewmember (or a built-in timer), after being enabled by the Goddard-supplied baroswitch. Data acquisition, fuel flow, ignition, and iris operation are pre-programmed. The flame will burn for approximately two minutes. When data acquisition is completed, the experiment will be deactivated by a crewmember. There is no downlink of data during the mission. However, experiment data will be downloaded when the payload is deintegrated from the Space Shuttle at the end of the mission.

The TGDF experiment was proposed by investigators Dr. M. Yousef Bahadori (InnoTech, Inc.) and Dr. Uday Hegde (NYMA, Inc.). The flight hardware was designed, built, and functionally tested by the engineers and technicians of the NASA Lewis Research Center (in Cleveland, Ohio) under the direction of Project Manager Frank Vergilii, with guidance by Project Scientist Dennis Stocker. The Goddard Mission Manager for TGDF is Ben Lui.

More information on TGDF is available at the TGDF website at:

http://zeta.lerc.nasa.gov/expr2/gjdfe.htm.

GET AWAY SPECIAL PAYLOAD

Get Away Special canister G-036, sponsored by El Paso (Texas) Community College and Goddard, contains four separate experiments.

The Cement Mixing Experiment (CME) will allow cement samples to mix with water. These samples will be compared with others produced on Earth to analyze the effects of microgravity on the combination of cement and water, as well as to study the potential of using cement or similar materials in outer space.

Configuration Stability of Fluid Experiment (CSFE) is a study designed to investigate the effects of microgravity on the configuration stability of a two phase fluid system. CSFE will be videotaped while in orbit to aid in understanding what occurs during flight. Three accelerometers, instruments designed to measure acceleration and vibration, will monitor the microgravity conditions to ensure the required parameters for the experiment are met. The data recorded aboard the Shuttle will be compared with hypotheses on the subject.

Computer (Compact) Disc Evaluation Experiment (CDEE) will investigate the effects of the exosphere, the outer fringe region of the atmosphere of a planet, on the ability of discs to retain their information. Both computer discs are bit mapped, but only one is coated with a protective material. The compact discs are not coated at all. The discs aboard STS-87 will be compared with discs that have not been exposed to the exosphere to ascertain the results of the experiment. CDEE's objective is to find out if the information stored on such discs will be compromised with exposure to the exosphere. With CD-ROM's becoming the wave of the future, experimenters want to know if they can be trusted to retains its data in space.

The Asphalt Evaluation Experiment (AEE) is an investigation that will explore the effects of exposure to the exosphere on asphalt. Investigators hope the experiment will help determine better, more durable ways to make asphalt . The results of AEE will be compared with an asphalt sample not exposed to the exosphere to form a final conclusion.

The G-036 Mission Manager is Lee Shiflett at Goddard . The Principal Investigator is Emil J. Michal at El Paso Community College.

More information on GAS-036, is available on the Shuttle Small Payloads Project web site at:

http://sspp.gsfc.nasa.gov/g-036.htm.

COLLABORATIVE UKRAINIAN EXPERIMENT (CUE)

The Collaborative Ukrainian Experiment (CUE) is a collection of 10 plant space biology experiments (five primary and five secondary) that will fly in Columbia's middeck during STS-87. Ukrainian Payload Specialist Cosmonaut Colonel Leonid Kadenyuk will perform the CUE experiments during the 16-day mission. CUE also features an educational component that involves evaluating the effects of microgravity on the pollination and fertilization of Brassica rapa (Wisconsin Fast Plants) seedlings. As many as 625,000 American students and teachers in the United States and a minimum of 20,500 Ukrainian students and teachers will perform experiments on the ground while Kadenyuk performs the flight experiments in space.

Of all resources available at this point in space exploration, plants are the only regenerative source of food for long-duration flight. Plants are also used for regeneration of oxygen, removal of carbon dioxide, and distillation of water by transpiration and condensation. It is critical to know how to grow plants in space in order to facilitate these human requirements.

Also, in order to better understand the effects of gravity on living systems, microgravity offers scientists an environment where they can analyze plant growth and functions without the influence of gravity.

As part of the CUE experiment, primary objectives include comparing changes in ultrastructure, biochemical composition and function induced by the spaceflight environment on the photosynthetic apparatus of Brassica rapa seedlings at different stages of vegetative development. Specifically, the principal scientists seek to discover what, if any, developmental events during plant reproduction fail to function normally in the microgravity environment.

Another objective of CUE is to compare pollination and fertilization processes in microgravity with ground controls. This should yield important information on pollen generation and maturation in microgravity, pollen-stigma interactions, pollen tube growth, fertilization and early embryo development.

Primary experiments to be performed on the mission in order to reach these objectives include Brassica rapa Photosynthetic Apparatus in Chamber (B-PAC) , Brassica rapa Seed Terminal growth In Chamber (B-STIC), Soybean Metabolism (SOYMET), Soybean - Pathogen Interactions (SOYPAT), and Space Moss Experiment (SPM), parts A and B. Secondary experiments include AMINO, Gene Expression Experiment (GENEX), LIPID, Phytohormonal Content Experiment (PHYTO), and ROOTS. CUE will use three different types of hardware during the mission to perform these experiments: the Plant Growth Facility, Biological Research in Canisters, and Biological Research in Canisters-Light Emitting Diode.

B-PAC and B-STIC utilize the Plant Growth Facility, SOYMET and SOYPAT use the Biological Research in Canisters, and SPM-A and SPM-B use the Biological Research In Canisters-Light Emitting Diode.

The remaining secondary experiments will use both the Plant Growth Facility and the Biological Research In Canisters flight hardware.

More detailed information on the CUE experiments can be found on the World Wide Web at

http://atlas.ksc.nasa.gov/education/general/cue.htm.

CUE - Teachers and Students Investigating Plants in Space (CUE-TSIPS)

During the STS-87 mission, high school students in the United States and Ukraine will perform special plant biology science experiments. Students will have the opportunity to view interactive downlinks with an astronaut who will conduct the experiment in microgravity on board the Space Shuttle Columbia.

The educational component of CUE, Teachers and Students Investigating Plants in Space, known as CUE-TSIPS, will allow students in the United States and Ukraine to perform pollination of the Brassica rapa plant on the ground, and the STS-87 crew will perform the same experiments with plants on board the Shuttle. Comparison of Shuttle and classroom results will continue after the mission via the Internet at the following URL:

http://fastplants.cals.wisc.edu/cue/cue.html.

Through scheduled downlink sessions from the Shuttle, the crew will speak to the students and answer questions. The CUE- TSIPS educational activities focus on questions developed by U.S. and Ukrainian scientists. CUE-TSIPS is sponsored by NASA's Life Sciences Division and Education Division at NASA Headquarters.

STS-87 DEVELOPMENT TEST OBJECTIVES

DTO 312 -- **External tank (ET) thermal protection system (TPS) performance**. Photographs will be taken of the external tank and solid rocket boosters after separation to determine TPS charring patterns, identify regions of TPS material spallation, evaluate overall TPS performance, and identify TPS or other problems that may pose a debris hazard to the orbiter. The camera is located on the flight deck (hand-held 300 mm Nikon). This DTO is required on each flight of each vehicle. This DTO has previously been manifested on 64 flights.

DTO 671 -- **EVA hardware for future scheduled EVA missions**. Prior flight experience has revealed limitations in our ability to fully assess hardware operability during ground simulations or to predict on-orbit EVA performance with new and infrequently used hardware and/or associated techniques. The information collected will be used to modify hardware design and/or associated EVA techniques to increase the probability of success for future scheduled EVA missions. Required instrumentation and hardware include two extravehicular mobility units and flight-standard EVA tools and support equipment, videotape cassettes to cover the duration of the scheduled EVA, and an orbiter operational recorder to record crew comments after the EVA. This DTO is required on all flights in which an EVA can be accommodated on a noninterference basis with primary mission objectives. It has previously been manifested on 10 flights.

DTO 685 -- **On-board situational awareness displays for ascent and entry**. This DTO will evaluate and test different hardware and software displays for usability and suitability during dynamic phases of flight. In addition, this DTO will demonstrate the capability of providing real-time advanced displays using the orbiter downlisted data stream from the pulse code master modulation unit (PCMMU) on ascent and entry. This is the first flight of DTO 685.

DTO 805 -- **Crosswind landing performance**. This DTO will continue to gather data to demonstrate the capability to perform a manually controlled landing with a 90-degree, 10- to 15-knot steady-state crosswind. This DTO can be performed regardless of landing site or vehicle mass properties. Following a crosswind landing, the drag chute will be deployed after nose gear touchdown when the vehicle is stable and tracking the centerline. This DTO has previously been manifested on 53 flights.

DTO 844 -- **Remote manipulator system (RMS) situational awareness displays (RSAD)**. The objective of this DTO is to demonstrate the use of RSAD before it is used operationally on International Space Station assembly flights. RSAD will integrate information pertaining to RMS from various sources, such as PCMMU; the Canadian Space Vision System; the Johnson Space Center Vision System; and any other system that may be developed to determine the position and attitude of a payload. This is the third flight of DTO 844.

STS-87 DETAILED SUPPLEMENTARY OBJECTIVES

DSO 206 -- **Effect of space flight on bone and muscle**. Space flight induces a negative calcium balance, a decrement of bone mineral content, and muscle atrophy; but the cause of bone loss and muscle atrophy in space is still unclear. The primary objective of this study is to investigate the basic mechanism of the effects of space flight on the musculoskeletal system in order to counter these effects during long-term space flight. The accumulation of these baseline data will lead to the development of countermeasures to reduce bone loss and muscle atrophy during long-term space flight.

DSO 331 -- **Interaction of the space shuttle launch and entry suit (LES) and sustained weightlessness on egress locomotion**. Previous flight experience has shown that astronauts' energy expenditure increases when they move around while wearing the LES. The purpose of this DSO is to investigate the effect of the LES/advanced crew escape suit on egress locomotion and to directly assess the emergency egress capacity of crew members at wheel stop. Before beginning deorbit preparations, the crew members will instrument themselves with the egress monitor assembly, which measures oxygen consumption, body temperatures, heart rate, and ventilatory equivalent.

DSO 496 -- **Individual susceptibility to post-space flight orthostatic intolerance**. The occurrence of post-space flight orthostatic hypotension in some, but not all, astronauts is contributed to by preflight, gender-related differences in autonomic regulation of arterial pressure, and by space flight- induced changes in autonomic function that precipitate orthostatic hypotension in predisposed individuals. This DSO will study the preflight and postflight differences in susceptible and nonsusceptible astronauts.

DSO 802 -- **Educational activities**. This DSO has two objectives. The first is to produce educational products that will capture the interest of students and motivate them toward careers in science, engineering, and mathematics. These products will include video lessons with scenes recorded both on orbit and on the ground of educational activities performed by the flight crew. The second objective is to support the live television downlink of educational activities performed by the flight crew.

RISK MITIGATION EXPERIMENTS

RME 1309 - In-suit Doppler ultrasound for determining the risk of decompression sickness (DCS) during extravehicular activities. The overall objective of this RME is to evaluate the possibility of reduced prebreathe requirements for EVA, without compromising operational safety or increasing the risk of DCS to astronauts. The process will be defined in three steps: (1) develop an in-suit Doppler system to quantify the free gas phase in microgravity during EVA; (2) measure the incidence of microbubbles during operational EVA by using the in-suit Doppler ultrasound system; (3) conduct additional ground-based studies to evaluate risk of DCS with reduced prebreathe. This is the first flight of RME 1309.

RME 1323 - **Autonomous EVA robotic (AER) camera/Sprint**. Sprint is a small, unobtrusive free-flying camera platform for use outside the vehicle. It is spherical in shape, covered in soft cushioning material to prevent damage in the event of an impact, moves slowly, at approximately 0.15 fps, and is controlled from inside an intravehicular activity (IVA) cabin. The AER is an International Space Station (ISS) RME whose purpose is to assess the maneuverability and control of the free-flyer by the IVA pilot, assess the usefulness of a free-flying camera on orbit, and evaluate overall crew acceptance and work impact. This is the first flight of RME 1323.

RME-1332 - **Space Station-test of portable computer system (TPCS) hardw**are. Portable computational devices and associated microelectronic equipment are often susceptible to on- orbit radiation, which can cause anomalies ranging from memory upsets to microcomponent failure. This RME will test the suitability of PCS hardware in an ISS radiation environment. This is the second flight of RME 1332.

STS-87 CREWMEMBERS

STS087-S-002 -- Five astronauts and a payload specialist take a break from training at the Johnson Space Center (JSC) to pose for the STS-87 crew portrait. Wearing the orange partial pressure launch and entry suits, from the left, are Kalpana Chawla, mission specialist; Steven W. Lindsey, pilot; Kevin R. Kregel, mission commander; and Leonid K. Kadenyuk, Ukrainian payload specialist. Wearing the extravehicular mobility unit (EMU) space suits are astronauts Winston E. Scott and Takao Doi, both mission specialists. Doi represents the National Space Development Agency (NASDA) of Japan. The flight is scheduled as a 16-day mission aboard the space shuttle Columbia in late November.

BIOGRAPHICAL DATA

KEVIN R. KREGEL -- STS-87 MISSION COMMANDER

PERSONAL DATA - Born September 16, 1956. Grew up in Amityville, New York. Married to the former Jeanne F. Kammer of Farmingdale, New York. They have four children. His parents, Alfred H. Kregel Jr., and Frances T. Kregel, are deceased.

EDUCATION - Graduated from Amityville Memorial High School, Amityville, New York, in 1974; received a bachelor of science degree in astronautical engineering from the U.S. Air Force Academy in 1978; master's degree in public administration from Troy State University in 1988.

SPECIAL HONORS - Air Force Meritorious Service Medal; Air Force Commendation Medal; Navy Commendation Medal; two NASA Space Flight Medals.

EXPERIENCE - Kregel graduated from the U.S. Air Force Academy in 1978, and earned his pilot wings in August 1979 at Williams Air Force Base, Arizona. From 1980 to 1983 he was assigned to F111 aircraft at RAF Lakenheath. While serving as an exchange officer flying A-6E aircraft with the U.S. Navy at NAS Whidbey Island, Seattle, and aboard the USS Kitty Hawk, Kregel made 66 carrier landings during a cruise of the Western Pacific. His next assignment was an exchange tour at the U.S. Naval Test Pilot School at Patuxent River, Maryland. Upon graduation he was assigned to Eglin AFB, Florida, conducting weapons and electronic systems testing on the F111, F15, and the initial weapons certification test of the F15E aircraft. Kregel resigned from active duty in 1990 in order to work for NASA. He has logged over 5,000 flight hours in 30 different aircraft.

NASA EXPERIENCE - In April 1990, Kregel was employed by NASA as an aerospace engineer and instructor pilot. Stationed at Ellington Field, Houston, Texas, his primary responsibilities included flying as an instructor pilot in the Shuttle Training Aircraft (STA) and conducting the initial flight test of the T38 avionics upgrade aircraft.

Selected by NASA in March 1992, Kregel reported to the Johnson Space Center in August 1992. He completed one year of training and qualified for assignment as a pilot on future Space Shuttle flight crews. Initially assigned to the Mission Support Branch of the Astronaut Office, Kregel served on the Astronaut Support Personnel team at the Kennedy Space Center in Florida supporting Space Shuttle launches and landings. A veteran of two space flights, Kregel has logged over 618 hours in space.

Kregel will command the crew of the fourth U.S. Microgravity Payload flight scheduled for an November 1997 launch on board Columbia on mission STS-87.

STS-70 launched from the Kennedy Space Center, Florida, on July 13, 1995, and returned there July 22, 1995. The five-member crew aboard Space Shuttle Discovery performed a variety of experiments in addition to deploying the sixth and final NASA Tracking and Data Relay Satellite. During this 8 day 22 hour mission, the crew completed 142 orbits of the Earth, traveling 3.7 million miles. STS-70 was the first mission controlled from the new combined control center.

STS-78 launched June 20, 1996 and landed July 7, 1996 becoming the longest Space Shuttle mission to date. The Life and Microgravity Spacelab mission served as a model for future studies onboard the International Space Station. The mission included studies sponsored by ten nations, five space agencies, and the crew included a Frenchman, a Canadian, a Spaniard and an Italian.

BIOGRAPHICAL DATA

STEVEN W. LINDSEY (MAJOR, USAF) -- STS-87 PILOT

PERSONAL DATA - Born August 24, 1960, in Arcadia, California. Considers Temple City, California, to be his hometown. Married to the former Diane Renee Trujillo. They have three children. He enjoys reading, water and snow skiing, scuba diving, windsurfing, camping, running, and racket sports. His parents, Arden and Lois Lindsey, reside in Arcadia, California. Her parents, Gene and Marcene Trujillo, reside in Temple City, California.

EDUCATION - Graduated from Temple City High School, Temple City, California, in 1978; received a bachelor of science degree in engineering sciences from the U.S. Air Force Academy in 1982, and a master of science degree in aeronautical engineering from the Air Force Institute of Technology in 1990.

ORGANIZATIONS - Member, Society of Experimental Test Pilots, USAF Academy Association of Graduates.

SPECIAL HONORS - Distinguished Graduate Air Force Undergraduate Pilot Training (1983). Distinguished Graduate and recipient of the Liethen-Tittle Award as the outstanding test pilot of the USAF Test Pilot School Class 89A (1989). Awarded Air Force Meritorious Service Medal, Air Force Commendation Medal, Air Force Achievement Medal and Aerial Achievement Medal.

EXPERIENCE - Lindsey was commissioned a second lieutenant at the United States Air Force Academy, Colorado Springs, Colorado, in 1982. In 1983, after receiving his pilot wings at Reese Air Force Base, Texas, he qualified in the RF-4C Phantom II and was assigned to the 12th Tactical Reconnaissance Squadron at Bergstrom Air Force Base, Texas. From 1984 until 1987, he served as a combat-ready pilot, instructor pilot, and academic instructor at Bergstrom. In 1987, he was selected to attend graduate school at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, where he studied aeronautical engineering. In 1989, he attended the USAF Test Pilot School at Edwards Air Force Base, California. In 1990, Lindsey was assigned to Eglin Air Force Base, Florida, where he conducted weapons and systems tests in F-16 and F-4 aircraft. While a member of the 3247th Test Squadron, Lindsey served as the deputy director, Advanced Tactical Air Reconnaissance System Joint Test Force and as the squadron’s F-16 Flight Commander. In August of 1993 Lindsey was selected to attend Air Command and Staff College at Maxwell Air Force Base, Alabama. Upon graduation in June of 1994 he was reassigned to Eglin Air Force Base, Florida as an Integrated Product Team leader in the USAF SEEK EAGLE Office where he was responsible for Air Force weapons certification for the F-16, F-111, A-10, and F-117 aircraft. In March of 1995 he was assigned to NASA as an astronaut candidate.

He has logged over 2700 hours of flying time in 49 different types of aircraft.

NASA EXPERIENCE - Selected by NASA in December 1994, Lindsey became an astronaut in May 1996, qualified for assignment as a pilot on future Space Shuttle flight crews. Initially assigned to flight software verification in the Shuttle Avionics Integration Laboratory (SAIL), Lindsey also served as the Astronaut Office representative working on the Multifunction Electronic Display System (MEDS) program, a glass cockpit Space Shuttle upgrade program, as well as a number of other advanced upgrade projects.

He will serve as pilot on the crew of the fourth U.S. Microgravity Payload flight scheduled for an November 1997 launch on board Columbia on mission STS-87.

BIOGRAPHICAL DATA

KALPANA CHAWLA (PH.D.) -- STS-87 MISSION SPECIALIST

PERSONAL DATA - Born in Karnal, India. Dr. Chawla enjoys flying, hiking, back-packing, and reading. She holds Certificated Flight Instructor's license and Commercial Pilot's licenses for single- and multi-engine land airplanes and single-engine seaplanes, instrument rating, and Private Glider. She enjoys flying aerobatics and tail-wheel airplanes.

EDUCATION - Graduated from Tagore School, Karnal, India, in 1976. Bachelor of science degree in aeronautical engineering from Punjab Engineering College, India, 1982. Master of science degree in aerospace engineering from University of Texas, 1984. Doctorate of philosophy in aerospace engineering from University of Colorado, 1988.

EXPERIENCE - Dr. Chawla was hired by MCAT Institute, San Jose, California, as a Research Scientist to support research in the area of powered lift at NASA Ames Research Center, California, in 1988. She was responsible for simulation and analysis of flow physics pertaining to the operation of powered lift aircraft such as the Harrier in ground effect. She modeled and numerically simulated configurations that include important components of realistic powered lift aircraft, both in hover and landing mode, using Navier-Stokes solvers on Cray YMP. Following completion of this project she supported research in mapping of flow solvers to parallel computers such as the Intel iPSC-860, the Intel Paragon, and the TMC CM-2, and testing of these solvers by carrying out powered lift computations. In 1993 Dr. Chawla joined Overset Methods Inc., Los Altos, California, as Vice President and Research Scientist to form a team with other researchers specializing in simulation of moving multiple body problems. She was responsible for development and implementation of efficient techniques to perform aerodynamic optimization. Results of various projects that Dr. Chawla participated in are documented in technical conference papers and Journals.

NASA EXPERIENCE - Selected by NASA in December 1994, Dr. Chawla reported to the Johnson Space Center in March 1995. After completing a year of training and evaluation, she was assigned to work technical issues for the Astronaut Office EVA/Robotics and Computer Branches. Dr. Chawla will serve as a mission specialist on the crew of the fourth U.S. Microgravity Payload flight scheduled for an November 1997 launch on board Columbia on mission STS-87.

BIOGRAPHICAL DATA

WINSTON E. SCOTT (CAPTAIN, USN) -- STS-87 MISSION SPECIALIST

PERSONAL DATA - Born August 6, 1950, in Miami, Florida. Married to the former Marilyn K. Robinson.

They have two children. He enjoys martial arts and holds a 2nd degree black belt in Shotokan karate. He also enjoys music, and plays trumpet with a Houston-based Big Band. In addition to flying general aviation aircraft, he is an electronics hobbyist.

Winston's father, Alston Scott, resides in Miami, Florida. His mother, Rubye Scott, is deceased. Marilyn's parents, Albert and Josephine Robinson, reside in Chipley, Florida.

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

ORGANIZATIONS - American Institute of Aeronautics & Astronautics; National Naval Officers Association; Naval Helicopter Association; Alpha Phi Alpha Fraternity; Phi Mu Alpha Sinfonia Fraternity; Skotokan Karate Association; Association of International Tohgi Karate-Do; Bronze Eagles Association of Texas.

EXPERIENCE - Scott entered Naval Aviation Officer Candidate School after graduation from Florida State University in December 1972. He completed flight training in fixed-wing and rotary-wing aircraft and was designated a Naval Aviator in August 1974. He then served a 4-year tour of duty with Helicopter Anti-Submarine Squadron Light Thirty Three (HSL-33) at the Naval Air Station (NAS) North Island, California, flying the SH-2F Light Airborne Multi-Purpose System (LAMPS) helicopter. In 1978 Scott was selected to attend the Naval Postgraduate School at Monterey, California, where he earned his master of science degree in aeronautical engineering with avionics. After completing jet training in the TA-4J Skyhawk, Scott served a tour of duty with Fighter Squadron Eighty Four (VF-84) at NAS Oceana, Virginia, flying the F-14 Tomcat. In June 1986 Scott was designated an aerospace engineering duty officer.

He served as a production test pilot at the Naval Aviation Depot, NAS Jacksonville, Florida, flying the F/A-18 Hornet and the A-7 Corsair aircraft. He was also assigned as Director of the Product Support (engineering) Department which consisted of 242 engineers, technicians, logistics managers, and administrative personnel. He was next assigned as the Deputy Director of the Tactical Aircraft Systems Department at the Naval Air Development Center at Warminster, Pennsylvania. As a research and development project pilot, he flew the F-14, F/A-18 and A-7 aircraft. Scott has accumulated more than 3,000 hours of flight time in 20 different military and civilian aircraft, and more than 200 shipboard landings. Additionally, Scott was an associate instructor of electrical engineering at Florida A&M University and Florida Community College at Jacksonville, Florida.

NASA EXPERIENCE - Scott was selected by NASA in March 1992, and reported to the Johnson Space Center in August 1992. He was initially assigned to the Astronaut Office Mission Support Branch, serving with the Astronaut Support Personnel team supporting Space Shuttle launches and landings at the Kennedy Space Center in Florida. Most recently, Scott served as a mission specialist on STS-72 (January 11-20, 1996).

During the 9-day flight the crew aboard Endeavour retrieved the Space Flyer Unit (launched from Japan 10-months earlier), deployed and retrieved the OAST-Flyer, and conducted two spacewalks to demonstrate and evaluate techniques to be used in the assembly of the International Space Station. In completing his first space flight, Scott orbited the Earth 142 times, traveled 3.7 million miles, and logged a total of 214 hours and 41 seconds in space, including a spacewalk of 6 hours and 53 minutes. Scott will serve as a mission specialist on the crew of the fourth U.S. Microgravity Payload flight scheduled for an November 1997 launch on board Columbia on mission STS-87.

BIOGRAPHICAL DATA

TAKAO DOI (PH.D.) -- STS-87 MISSION SPECIALIST

PERSONAL DATA - Born September 18, 1954 in Minamitama, Tokyo, Japan. Married to the former Hitomi Abe of Toukamachi, Niigata, Japan. He enjoys flying, soaring, playing tennis, jogging, soccer, and observing stars as an amateur astronomer.

EDUCATION - Graduated from Ousaka-phu, Mikunigaoka High School in 1973. Bachelor of engineering degree from University of Tokyo, 1978. Master of engineering degree from University of Tokyo, 1980. Doctorate in aerospace engineering from University of Tokyo, 1983.

ORGANIZATIONS - The Japan Society of Microgravity Application, the Japan Society for Aeronautical and Space Science, American Institute of Aeronautics and Astronautics.

SPECIAL HONORS - Received Minister of State for Science and Technology's Commendation, Science Council of Japan's Special Citation, and National Space Development Agency of Japan's Outstanding Service Award in 1992.

EXPERIENCE - Takao Doi studied space propulsion systems as a research student in the Institute of Space and Astronautical Science in Japan from 1983 to 1985. He worked for the National Aeronautics and Space Administration (NASA) Lewis Research Center as a National Research Council research associate in 1985.

He joined the National Space Development Agency (NASDA) of Japan in 1985 and has been working in the Japanese manned space program since then. He conducted research on microgravity fluid dynamics at the University of Colorado from 1987 to 1988, and at National Aerospace Laboratory in Japan in 1989 as a visiting scientist.

In 1992, he served as a backup payload specialist for the Spacelab Japan mission (STS-47). In 1994, he worked as a project scientist on the International Microgravity Laboratory 2 mission (STS-65).

NASA EXPERIENCE - Dr. Doi was selected by NASDA in 1985. He participated in payload specialist training from 1990 to 1992 in preparation for the Spacelab Japan mission. He reported to the Johnson Space Center in March 1995. On completing a year of training and evaluation he was assigned technical duties in the Vehicle Systems/Operations Branch of the Astronaut Office. Dr. Doi will serve as a mission specialist on the crew of the fourth U.S. Microgravity Payload flight scheduled for an November 1997 launch on board Columbia on mission STS-87. During the 16-day mission Dr. Doi will become the first Japanese astronaut to conduct a spacewalk.

BIOGRAPHICAL DATA

LEONID K. KADENYUK -- STS-87 PAYLOAD SPECIALIST

PERSONAL DATA - Born January 28, 1951, in the Chernivtsi region of Ukraine. Married to Vera Kadenyuk (nee Kosolapinkova). They have two sons. He enjoys family time, running, athletics.

EDUCATION - Graduated from secondary school in 1967, from the Chernigov Higher Aviation School in Chernigov, Ukraine, in 1971, and from GNIKI VVS USSR (State Scientific Research Institute of the Russian Air Forces Center for test pilot training) in 1977, and the Yuri Gagarin Cosmonaut Training Center in 1978. He earned a master of science in mechanical engineering from the Moscow Aviation Institute, Department of Aircraft Construction, Moscow, Russia, in 1989.

EXPERIENCE - Colonel Kadenyuk has been a member of the USSR Cosmonaut Team since 1976. He underwent complete engineering and flight training for Soyuz, Soyuz-TM, orbital station Salyut, orbital complex Mir, including special training as a commander of Buran reentry space vehicle. He has flown 54 different types and modifications of aircraft, has logged more than 2400 hours flying time, and holds the qualifications of Test Pilot, 1st Class, and Military Pilot, 2nd Class, and Test Pilot. As a pilot-instructor he was responsible for the graduation of fifteen students.

In 1971, he graduated from Chernigov Higher Aviation School, Chernigov, Ukraine, as a pilot-engineer. In 1976 he was selected to join the cosmonaut team at Yuri Gagarin Cosmonaut Training Center, Star City, Moscow, Russia. He attended test pilot training at GNIKI VVS USSR (State Scientific Research Institute of the Russian Air Force). He graduated in 1977, proficient in test aircraft piloting, aerodynamics, aircraft construction and exploitation. The following year, was spent at the Yuri Gagarin Cosmonaut Training Center where he successfully completed general space training. The course included biology, ecology, medicine, meteorology, space geology and geobotany. As a Test Cosmonaut he is trained to perform scientific research, tests and experiments in any of the above-named disciplines, both in-flight and on the ground.

From 1978-1983 he served as a Test Cosmonaut/Pilot in the Multiple Usage Space System Group at the Yuri Gagarin Cosmonaut Training Center. While there he underwent advanced training in the conduct of in-flight scientific experiments. He is trained in survival techniques, EVA activities, and work in simulated weightlessness.

He was involved in experimental investigations and testing of space technology for the Buran reentry vehicle system. He has performed numerous sky dives including some live, in-flight, reporting.

From 1984-1988 he was a Test Pilot at GLIC VVS Russia (former GNIKI VVS USSR) Russian State Test Flight Center, Russian Air Force. During that time, he performed test flights for three State airplane tests on the SU-27, SU-27UB and MIG-25, was promoted to 1st Class Pilot, flight tested the SU-27, MIG-23, MIG-25, MIG-27 and MIG-31 military spacecraft, and performed tests in lowering and landing the “Buran” space ship on MIG-31 and MIG-25.

In 1985, he served as Chairman of the State Committee on SU- 27M cockpit design.

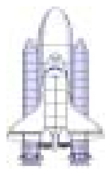
In 1990, following the Ukrainian-USSR State Agreement on a Collaborative Space Program, he was appointed to command the Ukrainian space crew. In the following two years, he trained to command Soyuz-TM-S during its docking with unmanned Buran and Mir station (mission was canceled due to financial difficulties), completed the full course of space training for a commander of the SOYUZ-TM, and also took the full course of manual docking of space ships, using special training equipment. In subsequent years, he underwent engineering and flight training courses as commander of the Buran Space System. Using MIG-31 and MIG-25 he mastered and improved the trajectory for lowering and landing the Buran spacecraft.

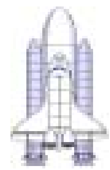
In 1996, he transferred to the Institute of Botany, National Academy of Sciences of Ukraine, Kiev, as a scientific investigator developing the collaborative Ukrainian-American experiment in space biology.

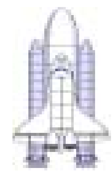
NASA EXPERIENCE - Colonel Kadenyuk is one of the first NSAU Astronaut group selected in 1996 by the National Space Agency of Ukraine. In November 1996, NSAU and NASA assigned him to be one of two payload specialists for the Collaborative Ukrainian Experiment (CUE) to be flown on STS-87 aboard Space Shuttle Columbia. He currently participates in payload specialist training at the Johnson Space Center and will serve as the prime payload specialist for STS-87, scheduled for launch in November 1997.

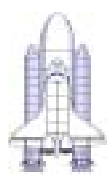
SHUTTLE FLIGHTS AS OF NOVEMBER 1997

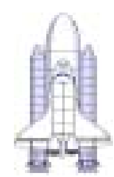
87 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 62 SINCE RETURN TO FLIGHT











STS-94 07/01/97 - 07/17/97		STS-85 08/07/97 - 08/19/97		
STS-83 04/04/97 - 04/08/97		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-86 09/25/97 - 10/06/97	
STS-75 02/22/96 - 03/09/96		STS-64 09/09/94 - 09/20/94	STS-84 05/15/97 - 05/24/97	
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
OV-102 Columbia (23 flights)	**OV-099 Challenger (10 flights)**	**OV-103 Discovery (23 flights)**	**OV-104 Atlantis (20 flights)**	**OV-105 Endeavour (11 flights)**