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ATLANTIS READY TO FLY SIXTH SHUTTLE-MIR MISSION

The continuing cooperative effort in space exploration between the United States and Russia will be the focus of NASA's fourth Shuttle mission of 1997 with the launch of Space Shuttle Atlantis on Mission STS-84.

This is the sixth of nine planned missions to Mir and the third one involving an exchange of U.S. astronauts. Astronaut Jerry Linenger, who has been on Mir since mid-January, will be replaced by astronaut Mike Foale. Foale will spend more than four months on the orbiting Russian facility. He will return to Earth on Space Shuttle Mission STS-86, scheduled for launch in late September.

Atlantis will again be carrying the SPACEHAB module in the payload bay of the orbiter. The double module configuration will house experiments to be performed by Atlantis' crew along with logistics equipment to be transferred to Mir.

The STS-84 crew will be commanded by Charlie Precourt who will be making his third Shuttle flight. The pilot, Eileen Collins, will be making her second flight. There are five mission specialists assigned to this flight. Jean-Francois Clervoy from the European Space Agency (ESA), serving as Mission Specialist-1, is making his second flight. Mission Specialist-2 Carlos Noriega and Mission Specialist-3 Ed Lu are both making their first space flight. Elena Kondakova from the Russian Space Agency, serving as Mission Specialist-4, is making her first flight on the Shuttle and second space flight having flown previously on the Mir space station. Mike Foale, making his fourth space flight, will be Mission Specialist-5 for launch through docking with Mir. Shortly after docking, Foale and Linenger will conduct their handover with Foale becoming a member of the Mir crew and Linenger becoming STS-84 Mission Specialist-6 through the end of the flight.

Atlantis is targeted for an early morning launch on May 15, 1997 from NASA's Kennedy Space Center Launch Complex 39-A. The current launch time of 4:08 a.m. EDT may vary slightly based on calculations of Mir's precise location in space at the time of liftoff due to Shuttle rendezvous phasing requirements. The STS-84 mission is scheduled to last 9 days, 3 hours, 44 minutes. An on-time launch on May 15 and nominal mission duration would have Atlantis landing back at Kennedy Space Center on May 24 at about 7:52 a.m. EDT.

Atlantis' rendezvous and docking with the Mir actually begin with the precisely timed launch setting the orbiter on a course for rendezvous with the orbiting Russian facility. Over the next two to three days, periodic firings of Atlantis' small thruster engines will gradually bring the Shuttle within closer proximity to Mir.

The STS-84 mission is part of the NASA/Mir program which consists of nine Shuttle-Mir dockings and seven long duration flights of U.S. astronauts aboard the Russian space station. The U.S. astronauts will launch and land on a Shuttle and serve as Mir crew members while the Mir cosmonauts use their traditional Soyuz vehicle for launch and landing. This series of missions will expand U.S. research on Mir by providing resupply materials for experiments to be performed aboard the station as well as returning experiment samples and data to Earth.

The current Mir 23 mission began when cosmonauts Vasily Tsibliev and Alexander Lazutkin and German Researcher Reinhold Ewald of DARA were launched on Feb. 10, 1997, in a Soyuz vehicle and docked with the Mir two days later. Jerry Linenger began his stay on the orbiting Russian facility with the Mir 22 crew in mid-January with the docking of STS-81. He became a member of the Mir 23 crew and continued his science investigations when the Mir 22 crew and Ewald returned to Earth on March 2. After Linenger and Foale complete their handover, Foale will work with the Mir 23 crew until the arrival of Mir 24 cosmonauts Anatoly Solovyev, Pavel Vinogradov and ESA Researcher Leopold Eyharts in August 1997. After the Mir 23 crew and Eyharts return to Earth in a Soyuz vehicle, Foale will complete his tour with the Mir 24 crew. Foale will be replaced by NASA Astronaut Wendy Lawrence when Atlantis again docks with Mir in late September.

The STS-84 mission and the work performed by Foale during his time on the Mir station will include investigations in the fields of advanced technology, Earth sciences, fundamental biology, human life sciences, International Space Station risk mitigation, microgravity sciences and space sciences.

STS-84 will involve the transfer of 7,314 pounds of water and logistics to and from the Mir. During the docked phase, 1,025 pounds of water, 844.9 pounds of U.S. science equipment, 2,576.4 pounds of Russian logistics along with 392.7 pounds of miscellaneous material will be transferred to Mir. Returning to Earth aboard Atlantis will be 897.4 pounds of U.S. science material, 1,171.2 pounds of Russian logistics, 30 pounds of ESA material and 376.4 pounds of miscellaneous material.

STS-84 will be the 19th flight of Atlantis and the 84th mission flown since the start of the Space Shuttle program in April 1981.

MEDIA SERVICES INFORMATION

NASA Television Transmission

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

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

Status Reports

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

Briefings

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

Internet Information

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

http://shuttle.nasa.gov

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

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

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

http://www.nasa.gov

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

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

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

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

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

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

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

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

http://spacelink.msfc.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-84 QUICK LOOK

Launch Date/Site: May 15, 1997/KSC Launch Pad 39-A
Launch Time: 4:08 A.M. EST
Launch Window: 7 minutes
Orbiter: Atlantis (OV-104), 19th flight
Orbit Altitude/Inclination: 160 nautical miles, 51.6 degrees
213 nautical miles at docking
Mission Duration: 9 days, 3 hours, 44 minutes
Landing Date: May 24, 1997
Landing Time: 7:52 A.M. EDT
Primary Landing Site: Kennedy Space Center, Florida
Abort Landing Sites: Return to Launch Site - KSC
Transoceanic Abort Sites - Zaragoza, Spain
Ben Guerir, Morocco
Moron, Spain
Abort-Once Around - Kennedy Space Center

Crew: Charlie Precourt, Commander (CDR), 3rd flight
Eileen Collins, Pilot (PLT), 2nd flight
Jean-Francois Clervoy (ESA), Mission Specialist 1, 2nd flight
Carlos Noriega, Mission Specialist 2, 1st flight
Ed Lu, Mission Specialist 3, 1st flight
Elena Kondakova (RSA), Mission Specialist 4, 1st flight

Mike Foale, Mission Specialist 5, 4th flight, ascent-docking
Jerry Linenger, Mission Specialist 6, 2nd flight, docking-landing

EVA Crewmembers: Jean-Francois Clervoy (EV 1), Ed Lu (EV 2) (if needed, contingency)

Cargo Bay Payloads: Orbiter Docking System
Spacehab-DM
European Proximity Sensor

In-Cabin Payloads: SIMPLEX
MSX
CREAM
RMEÕs

CREW RESPONSIBILITIES

Payloads	Prime	Backup
Spacehab Systems	Clervoy	Kondakova
Spacehab Science	Clervoy	Lu, Kondakova
Orbiter Docking System	Clervoy	Others
ESA Prox Ops Sensor	Collins	Noriega
Russian Logistics Transfers	Lu	Clervoy
Mir Structural Dynamics Tests	Precourt	Collins
Mir Photographic Surveys	Lu	Collins
SIMPLEX	Collins	Precourt
MSX	Precourt	Collins
Joint U.S.-Russian Science	Kondakova, Foale	Lu, Noriega
EVA	Clervoy (EV 1)	Lu (EV 2)
Intravehicular Crew Member	Noriega	----
Earth Observations	Collins	Noriega
Russian Language	Kondakova	Foale

Developmental Test Objectives
Detailed Supplementary Objectives
Risk Mitigation Experiments

DTO 255: Wraparound DAP Flight Test Verification
DTO 312: External Tank TPS Performance
DTO 416: Water Spray Boiler Quick Restart Capability
DTO 663: Acoustical Noise Dosimeter Data
DTO 700-10 Orbiter Space Vision System Videotaping
DTO 700-12 Global Positioning System/Inertial Navigation System
DTO 700-14: Single String Global Positioning System
DTO 805: Crosswind Landing Performance
DTO 1118: Photographic and Video Survey of Mir Space Station

DSO 331: Integration of the Space Shuttle Launch and Entry Suit
DSO 487: Immunological Assessment of Crewmembers
DSO 802: Educational Activities

RME 1302: Mir Electrical Characteristics
RME 1303: Shuttle/Mir Experiment Kit Transport
RME 1312: Realtime Radiation Monitor Device
RME 1314: ESA Proximity Operations Sensor
RME 1317: Mir Structual Dynamics Experiment
RME 1318: Treadmill Vibration Isolation System B

PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Atlantis) empty and 3 SSMEÕs	152,178
Shuttle System at SRB Ignition	4,512,109
Orbiter Weight at Landing with Cargo	221,087
Spacehab-DM	9,231
Orbiter Docking System	4,016

STS-84 ORBITAL EVENTS SUMMARY
(based on a May 15, 1997 launch)

EVENT	MET	TIME OF DAY (EDT)
Launch	0/00:00	4:08 AM, May 15
Docking	1/18:30	10:38 PM, May 16
Hatch Opening	1/20:20	12:28 AM, May 17
Crew News Conference	6/02:00	5:08 AM, May 21
Undocking	6/16:56	9:04 PM, May 21
KSC Landing	9/03:44	7:52 AM, May 24

(Mission Elapsed Time for all events will change for launch dates beyond May 15 because of rendezvous requirements for Atlantis to reach the Mir Space Station)

MISSION SUMMARY TIMELINE

Flight Day One:
Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
Spacehab Activation
Rendezvous Maneuvers

Flight Day 2:
Spacehab Experiment Operations
Centerline Camera Mount
Rendezvous Tool Checkout
VHF Radio Setup and Checkout
Rendezvous Maneuvers
Water Bag Fills

Flight Day 3:
Rendezvous Maneuvers
Mir Docking
Hatch Opening/Welcoming Ceremony
Soyuz Seatliner and Installation
Crew Transfer
Spacehab Experiment Operations

Flight Day 4:
Spacehab Experiment Operations
Elektron Transfer
Logistics Transfers
Foale/Linenger Handover

Flight Day 5:
Logistics Transfers
Spacehab Experiment Operations
Mir Structual Dynamics Tests
Foale/Linenger Handover

Flight Day 6:
Logistics Transfers
Spacehab Experiment Operations
Foale/Linenger Handover

Flight Day 7:
Mir Tour
Final Logistics Transfers
Final Foale/Linenger Handover
Crew News Conference and Farewell Ceremony
Hatch Closing

Flight Day 8:
Mir Undocking and Seperation
Transfer Item Stowage
Off-Duty Time

Flight Day 9:
Flight Control System Checkout
Reaction Control System Hot-Fire

Cabin Stowage
Deorbit Preparation and Entry Review

Flight Day 10:
Spacehab Deactivation
Recumbent Seat Setup
Deorbit Preparation
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-84 include:

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

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

* Transoceanic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza or Moronin 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.

STS-84 MIR RENDEZVOUS, DOCKING & UNDOCKING

Atlantis' rendezvous and docking with the Russian Space Station Mir actually begins with the precisely timed launch of the shuttle on a course for the Mir, and, over the next two days, periodic small engine firings that will gradually bring Atlantis to a point eight nautical miles behind Mir on docking day, the starting point for a final approach to the station.

Mir Rendezvous & Docking-- Flight Day 3

About two hours before the scheduled docking time on Flight Day Three of the mission, Atlantis will reach a point about eight nautical miles behind the Mir Space Station and conduct a Terminal Phase Initiation (TI) burn, beginning the final phase of the rendezvous. Atlantis will close the final eight nautical miles to Mir during the next orbit. As Atlantis approaches, the shuttle's rendezvous radar system will begin tracking Mir and providing range and closing rate information to Atlantis. Atlantis' crew also will begin air-to-air communications with the Mir crew using a VHF radio.

As Atlantis reaches close proximity to Mir, the Trajectory Control Sensor, a laser ranging device mounted in the payload bay, will supplement the shuttle's onboard navigation information by supplying additional data on the range and closing rate. As Atlantis closes in on the Mir, the shuttle will have the opportunity for four small successive engine firings to fine-tune its approach using its onboard navigation information. Identical to prior Mir dockings, Atlantis will aim for a point directly below Mir, along the Earth radius vector (R-Bar), an imaginary line drawn between the Mir center of gravity and the center of Earth. Approaching along the R-Bar, from directly underneath the Mir, allows natural forces to assist in braking Atlantis' approach. During this approach, the crew will begin using a hand-held laser ranging device to supplement distance and closing rate measurements made by other shuttle navigational equipment.

The manual phase of the rendezvous will begin just as Atlantis reaches a point about a half-mile below Mir. Commander Charlie Precourt will fly the shuttle using the aft flight deck controls as Atlantis begins moving up toward Mir. Because of the approach from underneath Mir, Precourt will have to perform very few braking firings. However, if such firings are required, the shuttle's jets will be used in a mode called "Low-Z," a technique that uses slightly offset jets on Atlantis' nose and tail to slow the spacecraft rather than firing jets pointed directly at Mir. This technique avoids contamination of the space station and its solar arrays by exhaust from the shuttle steering jets.

Using the centerline camera fixed in the center of Atlantis' docking mechanism, Precourt will center Atlantis' docking mechanism with the Docking Module mechanism on Mir, continually refining this alignment as he approaches within 300 feet of the station.

At a distance of about 30 feet from docking, Precourt will stop Atlantis and stationkeep momentarily to adjust the docking mechanism alignment, if necessary. At that time, a final go or no- go decision to proceed with the docking will be made by flight control teams in both Houston and Moscow.

When Atlantis proceeds with docking, the shuttle crew will use ship-to-ship communications with Mir to inform the Mir crew of the shuttle's status and to keep them informed of major events, including confirmation of contact, capture and the conclusion of damping. Damping, the halt of any relative motion between the two spacecraft after docking, is performed by shock absorber-type springs within the docking device. Mission Specialist Jean-Francois Clervoy will oversee the operation of the Orbiter Docking System from onboard Atlantis.

Undocking and Separation

Once Atlantis is ready to undock from Mir, the initial separation will be performed by springs that will gently push the shuttle away from the docking module. Both the Mir and Atlantis will be in a mode called "free drift" during the undocking, a mode that has the steering jets of each spacecraft shut off to avoid any inadvertent firings.

Once the docking mechanism's springs have pushed Atlantis away to a distance of about two feet from Mir, where the docking devices will be clear of one another, Atlantis' steering jets will be turned back on and fired in the Low-Z mode to begin slowly moving away from Mir.

For the STS-84 mission, Atlantis will continue away from Mir until it reaches a distance of 3,000 feet below the Mir in order to test a European laser docking sensor. Unlike previous Shuttle-Mir flights, there will be no fly-around of the station for photo documentation. When Atlantis reaches the 3,000 foot distance, instead of firing jet thrusters to perform a separation maneuver, the Shuttle will depend on the natural forces of one spacecraft being in a lower orbit than another which will cause the Shuttle to move ahead of the Mir.

Testing of new rendezvous and docking technology

New ESA-developed technology will be tested during the Shuttle's approach and departure from Mir. A GPS receiver and an optical rendezvous sensor on the Shuttle, together with equipment already installed on Mir, will be operated for the

first time in space in an enactment of how ESA's unmanned Automated Transfer Vehicle (ATV) will approach and depart the International Space Station when it delivers supplies to it early in the next century.

During the long-range approach to Mir (starting 3 hours before docking), ESAÕs European Proximity Operations Sensor GPS receivers on Atlantis and Mir will receive data from Navstar Global Positioning Satellites on the position of the other craft. The accuracy of that relative navigational data will later be compared with true data from the ShuttleÕs rendezvous radar.

When the Shuttle is at 170 feet from Mir, the short-range experiment will begin. Navigation will be handed over to the optical rendezvous sensor. Data will again later be compared to true figures, this time supplied by the NASA Trajectory Control System (TCS), a laser ranging device in the payload bay.

The experiments will be repeated during the departure. To allow that, the method that Atlantis will use to move away from Mir had to be changed. For the first time, the Shuttle will stay on the vertical, dropping to 1000 metres below Mir before resuming its traditional path.

This test is one in a series of three flight demonstrations. The GPS elements of the system were tested on STS-80 in November 1996 and a further full flight test will be on the seventh Shuttle-Mir docking mission in September.

SHUTTLE-MIR SCIENCE

The NASA/Mir program is now into the Phase 1B portion, which consists of nine Shuttle-Mir dockings and seven long-duration flights of U.S. astronauts aboard the Russian space station between early 1996 and late 1998. The U.S. astronauts will launch and land on a Shuttle and serve as a Mir crewmember for flight durations ranging from 127 to 187 days, while the Mir cosmonauts stay approximately 180 days and use their traditional Soyuz vehicle for launch and landing. This series of missions will expand U.S. research on Mir by providing resupply materials for experiments to be performed aboard Mir as well as returning experimental samples and data to Earth.

The Mir 23 mission began when the Cosmonaut crew launched on February 10, 1997, in a Soyuz vehicle and docked with the Mir two days later. Jerry Linenger joined the Mir 22 crew with the January 14, 1997 docking of Atlantis during Mission STS-81. The return of Atlantis on STS-84 will conclude some experiments, continue others and commence still others. Data gained from the mission will supply insight for the planning and development of the International Space Station, Earth-based sciences of human and biological processes, and the advancement of commercial technology.

Science Overview

As scientists learn more about the effects of the space environment, they continue to develop questions from the fields of human life sciences, fundamental biology, biotechnology, material sciences, and spacecraft structural and environmental dynamics. Valuable scientific information regarding these subjects will be returned from the NASA/Mir Program disciplines of advanced technology, Earth sciences, fundamental biology, human life sciences, International Space Station risk mitigation, microgravity sciences and space sciences. This knowledge will assist researchers in developing future space stations, science programs, procedures for those facilities, and advance the knowledge base of these areas to the benefit of all people on Earth.

The advanced technology discipline will evaluate new technologies and techniques using the Space Shuttle as a test bed. An increased understanding of fluid handling and control can lead to enhanced an technological base for implementation on the International Space Station and other future space vehicles.

Earth sciences research in ocean biochemistry, land surface hydrology, meteorology, and atmospheric physics and chemistry also will be performed. Observation and documentation of transient natural and human-induced changes will be accomplished with the use of passive microwave radiometers, a visible region spectrometer, a side-looking radar, and hand-held photography. Residence in Earth orbit will allow for documentation of atmospheric conditions, ecological and unpredictable events, and seasonal changes over long time periods.

Fundamental biology research continues developmental investigations in the study of the effects of the space environment on the biological systems of plants. Prolonged exposure to microgravity provides an ideal opportunity to determine the role gravity has on plant cell regulation and how this affects development and growth. Other investigations under this discipline will study the effect of space flight on circadian rhythms in the black-bodied beetle and will characterize the internal radiation environment of the Mir space station.

Human life sciences research consists of investigations that focus on the crewmember's adaptation to weightlessness in terms of skeletal muscle and bone changes, neurosensory function, psychological interactions, and the role of sleep during space flight in the observed changes in circadian rhythmicity. vestibular function, and immune system function. In the Space Medicine Program, environmental factors such as water quality, air quality, surface assessment for microbes, and crew microbiology will be assessed. These ambitious investigations will continue the characterization of the integrated human responses to a prolonged presence in space.

The International Space Station risk mitigation discipline consists of several technology demonstrations associated with human factors and maintenance of crew health and safety aboard the space station. In order to improve the design and operation of the International Space Station, information is gathered to fully evaluate the Mir interior and exterior environments. This discipline includes investigations of radio interference, crew force impacts to structures, particle impact on the station, docked configuration stability, water microbiological monitoring and radiation monitoring.

Microgravity research will advance scientific understanding through research in biotechnology, fluid physics, and materials science. The ambient acceleration and vibration environment of Mir will be characterized to support future research programs.

Most of the Mir 24/NASA research will be conducted on the Mir; however, Shuttle-based experiments will be conducted in the middeck and SPACEHAB modules of STS-84.

Fundamental Biology

The microgravity environment on a long duration mission provides an ideal opportunity to determine the role gravity plays in molecular mechanisms at a cellular level and in regulatory and sensory mechanisms. An experiment using mustard plants will study how this affects development and fundamental biological growth. An experiment with black-bodied beetles will measure how space flight factors change circadian rhythms.

Fundamental biology will also characterize the radiation of the Mir environment and determining how it may impact station-based science.

Environmental Radiation Measurements

Exposure of crew, equipment, and experiments to the ambient space radiation environment in low Earth orbit poses one of the most significant problems to long term space habitation. As part of the collaborative NASA/Mir Science program, a series of measurements is being compiled of the ionizing radiation levels aboard Mir. During the mission, radiation will be measured in six separate locations throughout the Mir using a variety of passive radiation detectors. This experiment will continue on later missions, where measurements will be used to map the ionizing radiation environment of Mir. These measurements will yield detailed information on spacecraft shielding in the 51.6-degree-orbit of the Mir. Comparisons will be made with predictions from space environment and radiation transport models.

Greenhouse-Integrated Plant Experiments

The microgravity environment of the Mir space station provides researchers an outstanding opportunity to study the effects of gravity on plants, specifically mustard plants. The greenhouse experiment determines the effects of space flight on plant growth, reproduction, metabolism, and production. By studying the chemical, biochemical, and structural changes in plant tissues, researchers hope to understand how processes such as photosynthesis, respiration, transpiration, stomatal conductance, and water use are affected by the space station environment. This study is an important area of research, due to the fact that plants could eventually be a major contributor to life support systems for space flight. Plants produce oxygen and food, while eliminating carbon dioxide and excess humidity from the environment. These functions are vital for sustaining life in a closed environment such as the Mir or the International Space Station.

Mustard is planted and grown in the "Svet," a Russian/Slovakian developed plant growth facility, where photosynthesis, transpiration, and the physiological state of the plants are monitored. The plants are observed daily, and photographs and video images are taken. Samples are also collected at certain developmental stages, fixed or dried, and returned to Earth for analysis.

Human Life Sciences Project

The task of safely keeping men and women in space for long durations, whether they are doing research in Earth orbit or exploring other planets in our solar system, requires continued improvement in our understanding of the effects of spacefight factors on the ways humans live and work. The Human Life Sciences (HLS) project has a set of investigations planned for the Mir 24/NASA 5 mission to determine how the body adapts to weightlessness and other space flight factors, including the psychological aspects of a confined environment and how they readapt to Earth's gravitational forces. The results of these investigations will guide the development of ways to minimize any negative effects so that crewmembers can remain healthy and efficient during long flights, as well as after their return to Earth.

Protein Crystal Growth

Protein Crystal Growth (PCG) experiments will be conducted in three facilities - the Gaseous Nitrogen Dewar (GND) facility, the Diffusion-Controlled Crystallization Apparatus for Microgravity (DCAM) facility and the Second-Generation Vapor Diffusion Apparatus (VDA-2) facility.

Diffusion-Controlled Crystallization Apparatus for Microgravity

The Diffusion-Controlled Crystallization Apparatus for Microgravity (DCAM) is designed to grow protein crystals at slow, controlled rates in the microgravity environment of space. The crew of Space Shuttle Atlantis will retrieve protein samples which have been growing in the DCAM on the Russian Mir space station since January 1997, and replace them with new samples. Protein crystals are used in basic biological research, pharmacology and drug development. EarthÕs gravity affects the purity and structural integrity of crystals. The low-gravity environment in space allows for the growth of larger, purer crystals of greater structural integrity. Analyses of some protein crystals grown in space have revealed more about a proteinÕs molecular structure than crystals grown on Earth. DCAM -- a little larger than a 35 mm film can -- has produced promising crystals in a long stay abroad the Mir space station.

Crew members will remove 162 ÒgrowingÓ samples and replace them with 162 new samples. The DCAM passively controls the crystallization.

The new samples will remain aboard Mir until September 1997, when they will be transported back to Earth on the STS-86 Shuttle flight.

Dr. Daniel Carter, New Century Pharmaceuticals Inc., Huntsville, Ala. Is the principal investigator for the DCAM facility.

Gaseous Nitrogen Dewar

Frozen protein samples will be transported to the Russian Mir space station in a Gaseous Nitrogen Dewar (GND) on STS-84, and the existing protein crystals on board Mir from the STS-81 mission will be returned to Earth for laboratory analysis.

This investigation is expected to contribute to the understanding of why proteins grow differently in the microgravity environment of space.

The GND is a vacuum jacketed container with an absorbent inner liner saturated with liquid nitrogen. The approximately 19 individual protein samples will remain frozen for approximately two weeks, until the liquid nitrogen has completely boiled off. This provides ample time to transport and transfer the Dewar to the Mir station. After the liquid nitrogen is completely discharged, the samples will thaw to ambient temperature and protein crystals will crystallize and grow over the four-month duration of the mission.

Dr. Alexander McPherson, University of California, Riverside is the principal investigator for the GND facility.

Second-Generation Vapor Diffusion Apparatus (VDA-2)

The experiment will grow high-quality crystals of various proteins using the vapor diffusion method. In addition, the experiment is expected to foster protein crystal growth research. Investigators associated with this study are from several international universities and research institutes.

Production of high-quality crystals is critically important in drug design. Results of studies of enzyme crystal structures are used to design new drugs to treat chronic conditions and diseases.

The Vapor Diffusion Apparatus -- which has flown previously on 22 missions -- uses the ground-based ñhanging dropî method of growing protein crystals. The apparatus includes four trays -- each containing 20 experiment chambers. The 80 chambers contain approximately 15 different proteins in a variety of mixtures.

Before launch, protein and precipitant solutions are loaded into two barrels of triple-barreled syringes, with the third barrel used for mixing. Each syringe protrudes into an experiment chamber surrounded by a reservoir.

The four VDA-2 trays are installed in a Commercial Refrigerator/Incubator Module (CRIM) and are maintained at 72 degrees Farenheit. At approximately 12 hours into the mission, the experiment is activated. The protein and precipitant solutions are mixed to form a droplet. Water diffuses from the hanging droplet through the vapor space into the more concentrated reservoir solution. As the protein droplet becomes more concentrated, protein crystals grow. Temperatures in the CRIM -- monitored and recorded during the flight -- are changed gradually over several days to cause the protein solution to form protein crystals. The change in CRIM temperature is transferred from the temperature-controlled plate through the cylinder lids to the protein solution. Protein crystal growth continues until about one day before landing, when the experiment is deactivated.

Dr. Larry DeLucas at the Center for Macromolecular Crystallography, University of Alabama at Birmingham is the principal investigator. The project is managed by the Biotechnology Office of the Microgravity Research Program Office at the Marshall Space Flight Center in Huntsville, Ala.

Optical Properties Monitor (OPM)

OPM is the first experiment capable of relaying data from in orbit which will measure the effect of the space environment on optical properties, such as those of mirrors used in telescopes, and structural elements, such as the coatings used on space hardware. OPM instruments will measure various optical properties of the, overall showing to what extent the samples deteriorate over the course of the experiment.

American astronaut Jerry Linenger and Mir 23 Commander Vasily Tsibliev performed a spacewalk on April 29 during which they attached the monitor to the outside of the space station. This marked the first experiment deployed jointly by the U.S. and Russia, setting the stage for how the astronauts and cosmonauts will work together on the International Space Station.

During its scheduled nine months on Mir, the experiment will measure the environment's effect on nearly 100 sample materials. The monitor will be the first externally powered experiment in space, using a power-data line to receive power from and transmit information to the Mir. The monitor will collect and store measurements to be transferred weekly to a Mir computer, then to scientists on Earth.

Information gathered will be used to improve designs of optical and structural elements of spacecraft, particularly the International Space Station. It will also be used to plan maintenance schedules for in-orbit satellites, based on measured rates of degradation.

OPM was developed by NASA's Marshall Space Flight Center and AZ Technology of Huntsville, AL. It is scheduled to be retrieved from Mir in February 1998 during the STS-89 mission. The Principal Investigator is Donald Wilkes of AZ Technology in Huntsville, AL.

EUROPEAN SPACE AGENCY (ESA)

Europe is playing a major part in the STS-84 mission - ESA astronaut Jean-Francois Clervoy is onboard as a member of the STS-84 crew along with important ESA science facilities, experiments and technology equipment.

ESA astronaut on board

Astronaut Jean-Francois Clervoy is making his second spaceflight. His first was as a Mission Specialist in November 1994 on STS-66, the Atmospheric Laboratory for Applications and Science-3 (ATLAS-3) mission.

He has a number of crucial tasks on STS-84, including flight engineer during lift-off, rendezvous and docking; payload commander; coordinating the transfer of the four tons of supplies between the two craft; and performing any contingency spacewalks needed.

Clervoy joined the ESA astronaut corps in 1992. Before that, in 1991 and as a French astronaut, he trained in Star City, Russia, on the Mir and Soyuz systems. He is fluent in Russian.

Biorack experiments

The Spacehab houses ESA's Biorack and the MOMO experiment. Biorack - the main science payload on board - is one of Europe's most successful and versatile space facilities. This large multi-purpose unit provides temperature-controlled environments, centrifuges for simulating gravity and a protected workspace for specimen handling, all integrated into a single rack. Now on its sixth flight, it is carrying a total of 10 experiments from France, Germany and the United States.

The cytoskeleton of the lentil root statocyte
Dominique Driss-Ecole, Pierre et Marie Curie University, Paris, France

If fresh food is to be grown on future space stations and long missions it is important to know how microgravity affects plant growth, particularly the development of starch which influences food value. This experiment - flying for the sixth time on Biorack - will use time-lapse photography to build on results from previous studies that have shown plants containing starch-producing amyloplasts behave differently in microgravity. Lentil seedlings will be grown in microgravity for 27 hours and then slightly fixed to allow analysis. Photography will follow the oscillations of the root tips and allow studies to be made of the root structure.

Morphology and physiology of Loxodes after cultivation in space
Ruth Hemmersbach, DLR-Institute of Aerospace Medicine, Cologne, Germany

Several generations of the single-celled organism Loxodes striatus will be grown to study the effect of microgravity on the health, shape, size and number of cells, and amounts of DNA. Complementary ground-based studies will also be carried out. This experiment will contribute to our understanding of bone decalcification under space conditions.

The effect of microgravity on normal vestibulo-ocular reflex development
Eberhard R. Horn, University of Ulm, Germany

To enhance understanding of vestibular/ocular development in all vertebrates, the experiment will compare the growth of four groups of tadpoles and two groups of fish embryos exposed to various periods of microgravity.

Repair of radiation damage under microgravity
Jurgen Kiefer, University of Giessen, Germany

A repair-deficient mutant of the yeast Saccharomyces cerevisiae (which cannot repair radiation damage at certain temperatures) will be irradiated in-flight for several days to determine the ability of cells to repair radiation damage in microgravity. Ground controls and experiments on a 1g centrifuge in space will allow a well-defined assessment of cellular repair capability.

Dosimetric mapping inside Biorack
Gunther Reitz, DLR-Institute of Aerospace Medicine, Cologne, Germany

When cell-damaging ionising radiation passes through spacecraft shielding, it yields secondary products such as neutrons and fragments of nuclear disintegrations. This experiment uses passive and active detectors to improve knowledge of the radiation environment inside a spacecraft.

Lymphocyte and monocyte intra-cellular signal transduction in microgravity
Didier A. Schmitt, Blood Transfusion Centre, Strasbourg, France

This experiment will determine the effect of microgravity on the distribution of the Protein Kinase C enzyme between different parts of white blood cells, which play an important role in the immune system.

Microgravity effects on bone cell gene expression
Millie Hughes-Fulford, University of California, San Francisco, USA

During the flight, bone-forming cell cultures (osteoblasts) will be activated and fixed while exposed to different levels of gravity. Subsequent analysis will look at how microgravity affects bone loss, an important factor for astronauts spending long periods in orbit.

Microgravity and signal transduction pathways in sea urchin sperm
Joseph S. Tash, Univ. of Kansas Medical Center, Kansas, USA

A series of related experiments that will expand previous knowledge on how gravity affects sperm function and motility.

Graviperception in starch-deficient plants
John Z. Kiss, Miami University, Oxford, Ohio, USA

Using starch-deficient mutants, this experiment is expected to clear up the role of starch grains in plants roots by confirming a correlation between gravity-induced root curvature and starch content. In previous studies, the strongest gravity-induced root curvature has been from plants with the highest starch content.

Effect of microgravity on lymphocyte activation: cell-cell interaction and signalling
Clarence F. Sams, Johnson Space Center, Houston, Texas, USA

Weightlessness may interfere with activation of white blood cells and this study will help determine parameters under which microgravity alters this. Understanding the effects of gravity at cellular level will support immunology studies, cancer research and cellular biology.

MOMO experiment

The MOMO experiment (Morphological Transition and Model Substances) will investigate solidification, one of the most fundamental processes in the industrial production of materials.

On Earth, solidification is affected by gravity, causing a buoyancy-driven convective flow in molten material. In space, gravity-driven convection is effectively eliminated, providing the opportunity to look at its effect on interface morphology.

One area of key interest is the surface shape and structure of growing solid material. In this experiment, housed in a Spacehab Self-standing Drawer, the transparent liquid alloy Succinonitril-acetone, whose solidification behaviour is similar to that of metals, will be used to allow in-situ optical observation of crystal growth. Some 1000 images of the solidification process will be recorded for later comparison with similar experiments performed on the ground.

STS-84 CREW BIOGRAPHIES

CHARLES J. PRECOURT (Colonel, USAF)
STS-84 Commander

PERSONAL DATA - Born June 29, 1955, in Waltham, Massachusetts, but considers Hudson, Massachusetts, to be his hometown. Married to the former Lynne Denise Mungle of St. Charles, Missouri. They have three daughters. He enjoys golf and flying light aircraft. He flies a Varieze, an experimental aircraft that he built. His parents, Charles and Helen Precourt, reside in Hudson. Her parents, Loyd and Jerry Mungle, reside in Streetman, Texas.

EDUCATION - Graduated from Hudson High School, Hudson, Massachusetts, in 1973; received a bachelor of science degree in aeronautical engineering from the United States Air Force Academy in 1977, a master of science degree in engineering management from Golden Gate University in 1988, and a master of arts degree in national security affairs and strategic studies from the United States Naval War College in 1990. While at the United States Air Force Academy, Precourt also attended the French Air Force Academy in 1976 as part of an exchange program.

ORGANIZATIONS - Member of the Association of Space Explorers, the Society of Experimental Test Pilots (SETP), the Soaring Society of America, and the Experimental Aircraft Association.

SPECIAL HONORS - Awarded the Defense Superior Service Medal (2), and the Air Force Meritorious Service Medal (2). Precourt is a distinguished graduate of the United States Air Force Academy and the United States Naval War College. In 1978 he was the Air Training Command Trophy Winner as the outstanding graduate of his pilot training class. In 1989 he was recipient of the David B. Barnes Award as the Outstanding Instructor Pilot at the United States Air ForceTest Pilot School.

EXPERIENCE - Precourt graduated from Undergraduate Pilot Training at Reese Air Force Base, Texas, in 1978. Initially he flew as an instructor pilot in the T-37, and later as a maintenance test pilot in the T-37 and T-38 aircraft. From 1982 through 1984, he flew an operational tour in the F-15 Eagle at Bitburg Air Base in Germany. In 1985 he attended the United States Air Force Test Pilot School at Edwards Air Force Base in California. Upon graduation, Precourt was assigned as a test pilot at Edwards, where he flew the F-15E, F-4, A-7, and A-37 aircraft until mid 1989, when he began studies at the United States Naval War College in Newport, Rhode Island. Upon graduation from the War College, Precourt joined the astronaut program. His flight experience includes over 5,500 hours in over 50 types of civil and military aircraft. He holds commercial pilot, multi-engine instrument, glider and certified flight instructor ratings.

NASA EXPERIENCE - Selected by NASA in January 1990, Precourt became an astronaut in July 1991. His technical assignments to date have included: Manager of ascent, entry, and launch abort issues for the Astronaut Office Operations Development Branch; spacecraft communicator (CAPCOM), providing the voice link from the Mission Control Center during launch and entry for several Space Shuttle missions; Director of Operations for NASA at the Gagarin Cosmonaut Training Center in Star City, Russia, from October 1995 to April 1996, with responsibility for the coordination and implementation of mission operations activities in the Moscow region for the joint U.S./Russian Shuttle/Mir program. A veteran of two space flights, STS-55 in 1993 and STS-71 in 1995, Precourt has logged over 475 hours in space.

Precourt flew his first space mission as a mission specialist aboard Columbia on STS-55, which launched from Kennedy Space Center, Florida, on April 26, 1993. Nearly 90 experiments were conducted during this German-sponsored Spacelab D-2 mission to investigate life sciences, materials sciences, physics, robotics, astronomy and the Earth and its atmosphere. STS-55 also flew the Shuttle Amateur Radio Experiment (SAREX) making contact with students in 14 schools around the world. After 160 orbits of the earth in 240 flight hours, the 10-day mission concluded with a landing on Runway 22 at Edwards Air Force Base, California, on May 6, 1993.

Most recently, (June 27 to July 7, 1995), Precourt was the pilot on the seven-member crew (up) and eight-member crew (down) of Space Shuttle mission STS-71. This was the first Space Shuttle mission to dock with the Russian Space Station Mir, and involved an exchange of crews. The Atlantis Space Shuttle was modified to carry a docking system compatible with the Russian Mir Space Station. It also carried a Spacelab module in the payload bay in which the crew performed various life sciences experiments and data collections. Mission duration was 235 hours, 23 minutes.

CURRENT ASSIGNMENT - Precourt will command STS-84, NASA's sixth Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for May 1997.

EILEEN MARIE COLLINS (Lieutenant Colonel, USAF)
STS-84 Pilot

PERSONAL DATA - Born November 19, 1956, in Elmira, New York. Married to Pat Youngs, originally from San Antonio, Texas. They have one child. She enjoys running, golf, hiking, camping, reading, photography, astronomy. Her parents, James and Rose Marie Collins, reside in Elmira, New York. His parents, Pat and Jackie Youngs, reside in San Antonio.

EDUCATION - Graduated from Elmira Free Academy, Elmira, New York, in 1974; received an associate in science degree in mathematics/science from Corning Community College in 1976; a bachelor of arts degree in mathematics and economics from Syracuse University in 1978; a master of science degree in operations research from Stanford University in 1986; and a master of arts degree in space systems management from Webster University in 1989.

ORGANIZATIONS - Member of the Air Force Association, Order of Daedalians, Women Military Aviators, U.S. Space Foundation, the American Institute of Aeronautics and Astronautics, and the Ninety-Nines.

SPECIAL HONORS - Awarded the Defense Superior Service Medal, the Air Force Meritorious Service Medal with one oak leaf cluster, the Air Force Commendation Medal with one oak leaf cluster, the Armed Forces Expeditionary Medal for service in Grenada (Operation Urgent Fury, October 1983), and the NASA

Space Flight Medal.

EXPERIENCE - Collins graduated in 1979 from Air Force Undergraduate Pilot Training at Vance AFB, Oklahoma, where she was a T-38 instructor pilot until 1982. From 1983 to 1985, she was a C-141 aircraft commander and instructor pilot at Travis AFB, California. She spent the following year as a student with the Air Force Institute of Technology. From 1986 to 1989, she was assigned to the U.S. Air Force Academy in Colorado, where she was an assistant professor in mathematics and a T-41 instructor pilot. She was selected for the astronaut program while attending the Air Force Test Pilot School at Edwards AFB, California, from which she graduated in 1990.

She has logged over 4,700 hours in 30 different types of aircraft.

Selected by NASA in January 1990, Collins became an astronaut in July 1991. Initially assigned to Orbiter engineering support, she also served on the astronaut support team responsible for Orbiter prelaunch checkout, final launch configuration, crew ingress/egress, and landing/recovery. From April 1995 to October 1996, she worked in Mission Control as a spacecraft communicator (CAPCOM). Currently, she is training for STS-84, the sixth Space Shuttle docking mission with the Russian Space Station Mir. Launch is scheduled for May 1997.

In February 1995, Collins served as pilot on STS-63, the first flight of the new joint Russian-American Space Program. Mission highlights included the rendezvous with the Russian Space Station, Mir, operation of Spacehab, the deployment and retrieval of an astronomy satellite, and a spacewalk. Collins' first mission was accomplished in 129 orbits, traveling over 2.9 million miles in 198 hours, 29 minutes. She was the first woman pilot of a Space Shuttle

C. MICHAELl FOALE (Ph.D.)
STS-84 Mission Specialist

PERSONAL DATA - Born January 6, 1957, in Louth, England, but considers Cambridge, England, to be his hometown. Married to the former Rhonda R. Butler of Louisville, Kentucky. They have two children. He enjoys many outdoor activities, particularly wind surfing. Private flying, soaring, and project scuba diving have been his other major sporting interests. He also enjoys exploring theoretical physics and writing children's software on a personal computer. His parents, Colin and Mary Foale, reside in Cambridge, England. Her parents, Reed & Dorothy Butler, reside in Louisville, Kentucky.

EDUCATION - Graduated from Kings School, Canterbury, in 1975. He attended the University of Cambridge, Queens' College, receiving a bachelor of arts degree in Physics, National Sciences Tripos, with 1st class honors, in 1978. While at Queens' College, he completed his doctorate in Laboratory Astrophysics at Cambridge University in 1982.

ORGANIZATIONS - Member of the Cambridge Philosophical Society, England, and Aircraft Owners & Pilots Association.

EXPERIENCE - While a postgraduate at Cambridge University, Foale participated in the organization and execution of scientific scuba diving projects. With the cooperation of the Greek government, he participated as both a member of one expedition and the leader of another, surveying underwater antiquities in Greece. In the fall of 1981, he dove on the 1543 ocean galleon, "The Mary Rose," as a volunteer diver, learning excavation and survey techniques in very low visibility conditions. Pursuing a career in the U.S. Space Program, Foale moved to Houston, Texas, to work on Space Shuttle navigation problems at McDonnell Douglas Aircraft Corporation. In June 1983, Foale joined NASA Johnson Space Center in the payload operations area of the Mission Operations Directorate. In his capacity as payload officer in the Mission Control Center, he was responsible for payload operations on Space Shuttle missions STS-51G, 51-I, 61-B and 61-C.

NASA EXPERIENCE - Selected as an astronaut candidate by NASA in June 1987, Foale completed a one-year training and evaluation program in August 1988. Before his first flight he flew the Shuttle Avionics Integration Laboratory (SAIL) simulator to provide verification and testing of the Shuttle flight software, and later developed crew rescue and integrated operations for International Space Station Alpha. He has served as Deputy Chief of the Mission Development Branch in the Astronaut Office, and Head of the Astronaut Office Science Support Group. He is presently training at the Cosmonaut Training Center, Star City, Russia, in preparation for a long duration flight on the Russian Space Station Mir. Launch is scheduled on STS-84 in May 1997. A veteran of three space flights, he has logged more than 634 hours in space. He flew as a mission specialist on STS-45 (March 24 to April 2, 1992) the first of the ATLAS series of missions to address the atmosphere and its interaction with the Sun, and again as a mission specialist on STS-56, carrying ATLAS-2, and the SPARTAN retrievable satellite which made observations of the solar corona.

Most recently, he served as a mission specialist on STS-63 (February 2-11, 1995), the first rendezvous with the Russian Space Station, Mir. During the flight he made a space walk (extravehicular activity) for 4 hours, 39 minutes, evaluating the effects of extremely cold conditions on his spacesuit, as well as moving the 2800-pound Spartan satellite as part of a mass handling experiment.

CARLOS I. NORIEGA (Major, USMC)
STS-84 Mission Specialist

PERSONAL DATA - Born October 8, 1959, in Lima, Peru. Considers Santa Clara, California, to be his hometown. Married to the former Wendy L. Thatcher. They have five children. He enjoys flying, running, snow skiing, racquetball, and chasing after his small children. His parents, Rodolfo and Nora Noriega, reside in Gilbert, Arizona. Her parents, John and Elizabeth Thatcher, reside in Honolulu, Hawaii.

EDUCATION - Graduated from Wilcox High School, Santa Clara, California, in 1977. Bachelor of science degree in computer science from University of Southern California, 1981. Master of science degree in computer science from the Naval Postgraduate School, 1990. Master of science degree in space systems operations from the Naval Postgraduate School, 1990.

ORGANIZATIONS - American Institute of Aeronautics and Astronautics.

SPECIAL HONORS - Defense Meritorious Service Medal, Air Medal with Combat Distinguishing Device, Air Medal (Strike Flight Award), Navy Achievement Medal.

EXPERIENCE - Noriega was a member of the Navy ROTC unit and received his commission in the United States Marine Corps at the University of Southern California in 1981. Following graduation from flight school, he flew CH-46 Sea Knight helicopters with HMM-165 from 1983 to 1985 at Marine Corps Air Station (MCAS) Kaneohe Bay, Hawaii. Noriega made two 6-month shipboard deployments in the West Pacific/Indian Ocean including operations in support of the Multi-National Peacekeeping Force in Beirut, Lebanon. He completed his tour in Hawaii as the Base Operations Officer for Marine Air Base Squadron 24. In 1986 he was transferred to MCAS Tustin, California, where he served as the aviation safety officer and instructor pilot with HMT-301. In 1988, Noriega was selected to attend the Naval Postgraduate School in Monterey, California, where he earned two master of science degrees. Upon graduation in September 1990, he was assigned to United States Space Command in Colorado Springs, Colorado. In addition to serving as a Space Surveillance Center Commander, he was responsible for the acquisition of several software development projects and was ultimately the command representative for the development and integration of the major space and missile warning computer system upgrades for Cheyenne Mountain Air Force Base. At the time of his selection, he was serving on the staff of the 1st Marine Aircraft Wing in Okinawa, Japan.

He has logged approximately 2,000 flight hours in various fixed wing and rotary wing aircraft.

NASA EXPERIENCE - Selected by NASA in December 1994, Noriega reported to the Johnson Space Center in March 1995, has completed a year of training and evaluation, and is currently qualified for assignment as a mission specialist. He was initially assigned to work technical issues for the Astronaut Office EVA/Robotics Branch while awaiting his first flight assignment.

CURRENT ASSIGNMENT - Noriega will serve as a mission specialist on STS-84, NASA's sixth Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for May 1997.

EDWARD TSANG LU (Ph.D.)
STS-84 Mission Specialist

PERSONAL DATA - Born July 1, 1963, in Springfield, Massachusetts. Considers Honolulu, Hawaii, and Webster, New York, to be his hometowns. Unmarried. He enjoys aerobatic flying, coaching wrestling, piano, tennis, surfing, skiing, travel. His parents, Charlie and Snowlily Lu, reside in Fremont, California.

EDUCATION - Graduated from R.L. Thomas High School, Webster, New York, in 1980. Bachelor of science degree in electrical engineering from Cornell University, 1984. Doctorate in applied physics from Stanford University, 1989.

ORGANIZATIONS - American Astronomical Society, Aircraft Owners and Pilots Association.

SPECIAL HONORS - Cornell University Presidential Scholar, Hughes Aircraft Company Masters Fellow.

EXPERIENCE - Since obtaining his Ph.D., Dr. Lu has been a research physicist working in the fields of solar physics and astrophysics. He was a visiting scientist at the High Altitude Observatory in Boulder, Colorado, from 1989 until 1992, the final year holding a joint appointment with the Joint Institute for Laboratory Astrophysics at the University of Colorado. From 1992 until 1995, he was a postdoctoral fellow at the Institute for Astronomy in Honolulu, Hawaii. Dr. Lu has developed a number of new theoretical advances which have provided for the first time a basic understanding of the underlying physics of solar flares. He has published articles on a wide range of topics including solar flares, cosmology, solar oscillations, statistical mechanics, and plasma physics. He has given over 20 invited lectures at various universities and international conferences. He holds a commercial pilot certificate with instrument and multi-engine ratings.

NASA EXPERIENCE - Selected by NASA in December 1994, Dr. Lu reported to the Johnson Space Center in March 1995, has completed a year of training and evaluation, and is qualified for assignment as a mission specialist. He was initially assigned to work technical issues in the Computer Support Branch of the Astronaut Office.

CURRENT ASSIGNMENT - Dr. Lu will serve as a mission specialist on STS-84, NASA's sixth Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for May 1997.

JEAN-FRANCOIS CLERVOY
STS-84 Mission Specialist

PERSONAL DATA - Born November 19, 1958, in Longeville-les-Metz, France, but considers Toulouse, France, to be his hometown. Married to the former Laurence Boulanger. They have two children. He enjoys racquet sports, skill games, canyoning, skiing, and flying activities such as boomerang, frisbee, kites. His father, Jean Clervoy (French Air Force, Ret.), and his mother, Mireille Clervoy, reside in Franconville, France. Her parents, Robert and Juliette Boulanger, reside in Le Perreux-sur-Marne, France.

EDUCATION - Received his baccalaur at from Coll ge Militaire de Saint Cyr l' Ecole in 1976; passed Math. Sup. and Math. Sp . M' at Prytan e Militaire, La Fl che in 1978. Graduated from Ecole Polytechnique, Paris, in 1981; graduated from Ecole Nationale Sup rieure de l' A ronautique et de l' Espace, Toulouse, in 1983; graduated as a Flight Test Engineer from Ecole du Personnel Navigant d' Essais et de R ception, Istres, in 1987.

ORGANIZATIONS - Member, Association of Space Explorers. Honorary member of the French Aeronautics and Astronautics Association.

SPECIAL HONORS - NASA Space Flight Medal. Chevalier de l' Ordre National du M rite. Chevalier de l' Ordre National de la L gion d' Honneur. Komarov Diploma.

EXPERIENCE - Clervoy was seconded from the D l gation G n rale pour L' Armement (DGA) to CNES (French Space Agency) in 1983, where he worked on automatics and attitude control systems for several satellite projects. He was selected in the second group of French astronauts in 1985. Subsequently he participated in an intensive Russian language course.

After graduating as a flight test engineer in 1987, he spent the next five years part-time at the Flight Test Center, Br tigny-sur-Orge, as Chief Test Director of the Parabolic Flight Program, responsible for testing and qualifying the Caravelle aircraft for microgravity, and part-time at the Hermes Crew Office, Toulouse, where he supported the European Manned Space Programs in the fields of extravehicular activity, rendezvous and docking, robotic arm, and man machine interface. In 1991, he trained in Star City, Moscow, on the Soyuz and Mir systems. In 1992, he was selected to join the astronaut corps of the European Space Agency (ESA). He holds military and civilian parachuting licenses, military and civilian diving licenses, and private pilot license. From 1983 to 1987, Clervoy was also a lecturer in signal processing and general mechanics at the Ecole Nationale Sup rieure de l'A ronautique et de l' Espace, Toulouse. Jean-Fran ois holds a commission as Ing nieur en Chef de l' Armement in the DGA.

NASA EXPERIENCE - Clervoy reported to the Johnson Space Center in August 1992. Following one year of training he qualified as a mission specialist for Space Shuttle flights. Clervoy was initially assigned to work robotics issues for the Astronaut Office Mission Development Branch.

After his first space mission he was assigned as flight software verification lead in the Shuttle Avionics Integration Laboratory (SAIL) for the Astronaut Office Mission Support Branch, and was responsible for designing the robotics displays for the Space Station Branch.

Clervoy served as a mission specialist aboard Space Shuttle Atlantis on the STS-66 Atmospheric Laboratory for Applications and Science-3 mission (November 3-14, 1994). ATLAS-3 was part of an ongoing program to determine the Earth's energy balance and atmospheric change over an 11-year solar cycle. Clervoy used the robotic arm to deploy the CRISTA-SPAS atmospheric research satellite 20 hours after lift-off. Clervoy logged 262 hours and 34 minutes in space and 175 orbits of the Earth.

CURRENT ASSIGNMENT - Clervoy will serve as a Payload Commander on STS-84, NASA's sixth scheduled Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for May 1997.

ELENA V. KONDAKOVA
RSA Cosmonaut
STS-84 Mission Specialist

PERSONAL DATA - Born March 30, 1957, in Mitischi, Moscow Region. Married to Ryumin Valerii V., born 1939 in Komsomolskna-Amure, Kharbarovsk Region, Russia. They have one child. Kondakova enjoys the theater, river fishing, reading, traveling. Her parents, Kondakov Vladimir A. and Kondakova (Morozova) Klavdiya S. reside in Kaliningrad, Moscow Region. His parents, Ryumin Viktor N. and Ryumina (Podporina) Alexandra F., are deceased.

EDUCATION - Graduated from Moscow Bauman High Technical College in 1980.

SPECIAL HONORS - Hero of Russia.

EXPERIENCE - Upon graduation, in 1980, Kondakova started to work in RSC-Energia completing science projects, experiments and research work. Then in 1989 she was selected as a cosmonaut candidate by RSC-Energia Main Design Bureau and sent to Gagarin Cosmonaut Training Center to start the course of general space training. After finishing the course in March, 1990, Kondakova was qualified as "test cosmonaut". From January through June of 1994, she was under training for the 17th main mission and "Euromir-94" flight as a flight engineer of the prime crew. October 4, 1994 through March 9, 1995, she fulfilled her first flight onboard the spacecraft "Soyuz TM-17" and the orbital complex "Mir" as a flight engineer of the 17th main mission. She has spent 169 days in space, including 5 days with NASA Astronaut Norman Thagard. The program included a month long joint flight with German Astronaut Ulf Merbold.

NASA EXPERIENCE - Elena Kondakova will serve as a mission specialist on STS-84, NASA's sixth scheduled Shuttle mission to rendezvous and dock with the Russian Space Station Mir. Launch is scheduled for May 1997.

JERRY M. LINENGER, M.D., (Captain, Medical Corps, USN)
Mir 22 & 23 Flight Engineer-2
STS-84 Mission Specialist

PERSONAL DATA - Born January 16, 1955, and raised in Eastpointe, Michigan. Married to the former Kathryn M. Bartmann of Arlington Heights, Illinois. They have one son. He enjoys competitive triathalons, ocean swim racing, marathons, downhill and cross-country skiing, scuba diving, backpacking, camping. Siblings include Kenneth Linenger, Susan Barry, Karen Brandenburg, and Barbara Vallone, all residing in Michigan. His mother, Frances J. Linenger, resides in Eastpointe, Michigan. His father, Donald W. Linenger, is deceased.

EDUCATION - Graduated from East Detroit High School, Eastpointe, Michigan, in 1973; received a bachelor of science degree in bioscience from the U.S. Naval Academy in 1977; a doctorate in medicine from Wayne State University in 1981; a master of science degree in systems management from University of Southern California in 1988; a master of public health degree in health policy from the University of North Carolina in 1989; a doctor of philosophy degree in epidemiology from the University of North Carolina in 1989.

ORGANIZATIONS - The U.S. Naval Academy, University of Southern California, Wayne State University School of Medicine, and University of North Carolina Alumni Associations; the Association of Naval Aviation; the U. S. Navy Flight Surgeons Association; the Aerospace Medicine Association; the American Medical Association; the American College of Preventive Medicine; the Society of U.S. Navy Preventive Medicine Officers; and the American College of Sports Medicine. Linenger is board certified in preventive medicine.

SPECIAL HONORS - Awarded the Meritorious Unit Commendation; Navy Unit Commendation; National Defense Service Medal; Navy Battle Efficiency Award; Navy Commendation Medal with gold star; and NASA Space Flight Medal. Top graduate, Naval Flight Surgeon Training and Naval Safety Officer's School. Elected to Phi Kappa Phi and Alpha Omega Alpha academic honor societies. Distinguished Alumni Award, Wayne State University School of Medicine.

EXPERIENCE - Linenger graduated from the U.S. Naval Academy and proceeded directly to medical school. After completing surgical internship training at Balboa Naval Hospital, San Diego, California, and aerospace medicine training at the Naval Aerospace Medical Institute, Pensacola, Florida, he served as a naval flight surgeon at Cubi Point, Republic of the Philippines. He was then assigned as medical advisor to the Commander, Naval Air Forces, U.S. Pacific Fleet, San Diego. After completing doctorate-level training in epidemiology, Linenger returned to San Diego as a research principal investigator at the Naval Health Research Center. He concurrently served as a faculty member at the University of California-San Diego School of Medicine in the Division of Sports Medicine.

NASA EXPERIENCE - Linenger joined astronaut selection Group XIV at the Johnson Space Center in August 1992. Linenger flew on STS-64 (September 9-20, 1994) aboard the Space Shuttle Discovery. Mission highlights included: first use of lasers for environmental research; deployment and retrieval of a solar science satellite; robotic processing of semiconductors; use of an RMS-attached boom for jet thruster research; first untethered spacewalk in 10 years to test a self-rescue jetpack. In completing his first mission, Linenger has logged 10 days, 22 hours, 51 minutes in space, completed 177 orbits, and traveled over 4.5 million miles. He trained at the Cosmonaut Training Center in Star City, Russia, in preparation for a 5 month stay in space aboard the Russian Space Station Mir. He launched aboard STS-81 on January 12, 1997 and will return aboard STS-84 in May 1997.