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(NASA-TM-85497) STS-9: ORBITAL WORKSHOP SPACELAB TO FLY ON NINTH SHUTTLE MISSION (NASA) 8 p HC A02/MF A01 CSCL 22A

NASA Facts

National Aeronautics and Space Administration

John F. Kennedy Space Center
Kennedy Space Center, Florida 32899
AC 305 867-2468

KSC Release No. 231-83
October 1983

STS-9

Orbital Workshop Spacelab to fly on Ninth Shuttle Mission

Kennedy Space Center, Fla. — When the Shuttle Orbiter Columbia blasts off the launching pad at Kennedy Space Center this fall on the ninth flight of NASA's Space Transportation System, it will be carrying in its cavernous cargo hold a versatile orbiting workshop called Spacelab.

Built by the European Space Agency, Spacelab converts the Shuttle spaceship into an orbiting research laboratory for both astronauts and a new breed of spaceborne scientists.

Spacelab 1 will demonstrate new instruments and methods for conducting experiments that are difficult or impossible to perform in ground-based laboratories, rockets or orbiting satellites. And many of the instruments will be the largest, most powerful, or most sensitive of their kind ever to be placed in orbit. This mission is expected to produce a high yield of new knowledge and to establish a pool of resources for reuse on future missions.

Aboard Columbia for its sixth trip into space will be a six-man crew: the largest crew ever carried in a U.S. spacecraft. John Young, a veteran of five space missions, will command the STS-9 mission to become NASA's most prominent astronaut and the first astronaut to command two Shuttle missions. Joining Young are NASA Astronauts Brewster Shaw, pilot, and Robert Parker and Owen Garriott, mission specialists.

Two members of the crew, Byron Lichtenberg, an American, and Ulf Merbold, a European, will become the first non-astronaut scientists to ever go into space. Merbold's flight will be the first of a European in a U.S. spacecraft. Never before have scientists who are not trained astronauts worked in space, actively conducting research in collaboration with investigators on the ground. In the shirtsleeve environment of the well-equipped laboratory module, these "payload specialists" will enjoy many of the comforts of a ground-based research center.

Launch of STS-9 is scheduled for no earlier than October 28 from Complex 39's Pad A. The launch opportunity on that day extends for 13 minutes: from 12:30 p.m. EDT until 12:43 EDT. Columbia will be launched into a circular 250 km (155 s. mile) orbit with an inclination to the equator of 57 degrees.

The principal cargo for STS-9 is Spacelab 1 and its associated experiments. Beginning about five hours after launch until Spacelab closeout at 200 hours five minutes mission elapsed time, activities on the mission will be devoted to Spacelab payload activities.

On flight day 1, Spacelab experiments will be activated. Flight day 2 includes the verification flight testing (VFT) cold test and additional Spacelab experiments. Flight day 3 and 4 include additional hot and cold tests. Days 5 through 8 are dedicated to Spacelab experiments. On flight day 9, the Spacelab experiments will be deactivated and the orbiter will go into a passive thermal control attitude for a number of hours in preparation for landing.

Approximately 72 separate investigations will be carried out during a mission which will last for almost nine days. For the first time, Shuttle crewmembers will work around the clock. The STS-9 crew is divided into two teams of three crewmembers each.

The red team consists of Commander Young; Mission Specialist 1, Parker; and Payload Specialist 1, Merbold. The blue team includes Pilot Shaw; Mission Specialist 2, Garriott; and Payload Specialist 2, Lichtenberg.

Columbia is scheduled to end its 214 hour, 39 minute flight with a landing at approximately 10:09 a.m. EST on November 6 at Edwards Air Force Base, California.

First Non-Astronauts To Fly On STS-9

STS-9 will be unique in that it will mark the entry of non-astronaut personnel, called Payload Specialists, into the ranks of space travelers. From the hundreds of scientists who were considered for the position of Payload Specialists for Spacelab 1, two Americans and two Europeans were chosen: Dr. Michael Lampton (University of California, Berkeley); Dr. Byron K. Lichtenberg (Massachusetts Institute of Technology); Dr. Ulf Merbold (Max-Planck Institute, Stuttgart, Federal Republic of Germany); and Dr. Wubbo Ockels (University of Groningen, The Netherlands).

Lichtenberg and Merbold were selected to be the flight payload specialists and will operate the experiments. Lampton and Ockels will provide support from the Payload Operations Control Center on the ground.

John Young, a veteran of five space flights, is commander of STS-9. He has logged 642 hours, 30 minutes in space. Past missions include the Gemini 3 and 10 missions, and the Apollo 10 and 16 flights to the moon. He was commander of the Columbia during the maiden flight of the Space Shuttle, STS-1, in April, 1981.

Pilot Shaw was selected as an astronaut candidate in 1978 and completed a one-year training program making him eligible for assignment to a flight crew. He received bachelor and master of science degrees in engineering mechanics from the University of Wisconsin. A major in the USAF, Shaw received his wings in 1970 and now has more than 3,000 hours flying time in over 30 types of aircraft.

Mission Specialist Parker was selected as a scientist astronaut in 1967. He was a member of the astronaut support crews for the Apollo 15 and 17 missions and served as a program scientist for the Skylab Program Directors Office during the three manned Skylab flights. He received a bachelor of arts degree in astronomy and physics from Amherst College, and a doctorate in astronomy from California Institute of Technology.

Mission Specialist Garriott was the science pilot for the 59 and 1/2 hour Skylab 3 mission conducted in July–September 1973. He logged 1,427 hours and nine minutes in space during that mission, and also spent 13 hours and 43 minutes in three separate EVAs outside the Skylab workshop. Garriott was selected as a scientist astronaut in 1965. He received a bachelor of science degree in electrical engineering from the Univerisity of Oklahoma, and master of science and doctorate in electrical engineering from Stanford University.

Lichtenberg specializes in biomedical engineering. He received a science degree in electrical engineering from Brown University, and did his graduate work at MIT, receiving his masters degree in mechanical engineering and his doctor of science degree in biomedical engineering. Between 1969 and 1973 he served in the U.S. Air Force. He is a fighter pilot in the Massachusetts Air National Guard flying A—10 close air support aircraft.

Merbold's main interests are the study of crystal lattice defects and low-temperature physics. He is a physicist by profession. Merbold received a diploma in physics and a doctorate in science from Stuttgart University. He joined the Max--Planck Gesellschaft at Stuttgart first on scholarship and later as a staff member. Merbold worked as a solid-state physicist on a research team of the Max-Planck Institute for Metal research.

What is Spacelab?

Spacelab is a versatile laboratory for use in space. It is designed to fit in the cargo bay of NASA's Shuttle orbiters and be exposed to space when the doors are opened. Spacelab can be flown in a variety of configurations.

The major Spacelab elements include enclosed pressurized modules in which scientists can work in shirt-sleeve environment, and platforms called pallets w' ch can be placed in the Shuttle's cargo bay behind the module. Up to five pallets can be mounted in the cargo bay for exposing equipment such as telescopes, antennas and sensors directly to space.

The module comes in two segments. The "core segment" houses data processing equipment and utilities for both the pressurized module and pallets when flown together, and has laboratory fixtures such as air cooled experiment racks and a work bench.

The second section called the "experiment segment" provides more pressurized work space and additional experiment racks.

When the habitable module is flown, an access tunnel connects the Spacelab with the orbiter. The hatch between the orbiter's cabin and the Spacelab module is left open during the mission so that the orbiter, the tunnel and the Spacelab module all share the same pressure and cabin air. It also permits easy access for the crew to pass back and forth between the orbiter and the laboratory.

Spacelab is a cooperative venture of the European Space Agency and NASA. Ten European nations are involved: Germany, Belgium, Denmark, Spain, France, United Kingdom, Italy, The Netherlands, Switzerland, and, as an observer state, Austria. ESA is responsible for funding, developing and building Spacelab. ESA's prime contractor is ERNO at Bremen, Germany, but industrial firms in all 10 countries involved take part in the project. Some 50 industrial firms funnel parts to Bremen for assembly and integration. NASA is responsible for the launch and operational use of Spacelab.

Spacelab 1 Objectives

ESA and NASA are jointly sponsoring the Spacelab 1 mission and contributing investigations for the flight. Scientists from 11 European nations, Canada, Japan and the U.S. are providing instruments and experimental procedures for the 72 different investigations that will be carried out in five research areas, or disciplines, during Spacelab 1.

The overall goal of the first mission is to verify Spacelab performance through a variety of scientific experiments. The investigations will exercise the hardware, flight and ground systems, and the flight crew to demonstrate their capabilities for advanced research in space.

The configuration of the laboratory that will fly in Columbia's cargo bay on STS-9 consists of a "core module" and an "experiment module" assembled together to form a "long Module," and a single pallet. The long module is 23 feet (7 meters) long and 13.1 feet (4 meters) in diameter.

The single U-shaped pallet is 13.1 feet (4 meters) wide and 10 feet (3 meters) long.

The tunnel that connects the orbiter with the Spacelab is 18.8 feet (5.8 meters) long.

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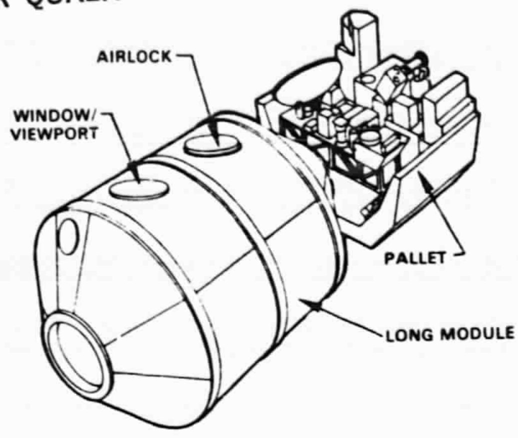
SPACELAB 1 NASA INVESTIGATIONS

DISPLINE	EXPERIMENT	TITLE	PI/NAME/ORGANIZATION
Atmospheric Physics	1NS001	Imaging Spectrometric Observatory	M. Torr (U of Michigan)
Plasma Physics	1NS002 1NS003	Space Experiments with Particle Accelerators Atmospheric Emission Photometric Imaging (AEPI)	T. Obayashi (U of Tokyo) S. Mende (LMSC)
Solar Physics	1NA008	Active Cavity Radiometer Solar Irradiance Monitor	R. Willson (JPL)
Astronomy	1NS005	Far UV Observations Using Faust Instrument	S. Bowyer (UCB)
Life Sciences	1NS006 1NS007 1NS100 1NS101 1NS102 1NS103 1NS104 1NS105	Radiation Environment Mapping Characterization of Persisting Circadian Rhythms Life Science Minilab: Nutation of Helianthus annus Vestibular Experiments Space Flight Influence on Erythrokinetics in Man Vestibulo-Spinal Reflex Mechanisms Effects on Prolonged Weightlessness	E. Benton (U of San Francisco) F. Sulzman (Harvard) A. Brown (U of Penn.) L. Young (MIT) C. Leach (JSC) M. Reschke (JSC) E. Voss (U of Illinois)
Technology	1NT011	Tribology Experiments in Zero-Gravity	C. Pan (Shaker Research) R. Gause and A. Whitaker (MSFC)



SPACELAB 1

Spacelab 1 will also make use of two specially-designed "portholes." A high quality window-viewport assembly will be carried in the ceiling of the forward section of the habitable module. A scientific airlock has been installed in the overhead area of the rear segment for use in exposing small instruments to the space environment outside.

Spacelab 1 Investigations

Spacelab 1 is a multi-disciplinary mission: that is, investigations will be performed in five different fields of scientific research.

There are 39 different instruments and experiment facilities.

The scientific payload is equally divided between NASA and ESA experiments in terms of weight, power and volume requirements. Out of the 400 proposals received, NASA and ESA selected 72 investigations that are compatible with each other, the mission objectives, and with the Spacelab hardware and capabilities.

Atmospheric Physics and Earth Observations

There are five major atmospheric physics experiments. Their main purpose is to examine in detail the composition, temperature and motion (dynamics) of atmospheric gases. A related set of instruments will take advantage of Spacelab's flight altitude for global-scale observations of the earth's land and water surfaces.

The telescopes, scanners and cameras on Spacelab 1 will survey environmental conditions with unprecedented ease and accuracy, and with practical applications for monitoring pollution and atmospheric changes.

A large-film metric camera will produce high-resolution photographs for possible use in making better maps, and a microwave remote sensing facility will provide all-weather radar viewing of the earth's surface, regardless of cloud cover.

The expected results of these investigations include greater knowledge of the earth's global environment, which will be well-documented by transmitted data and a return cargo of photographic film.

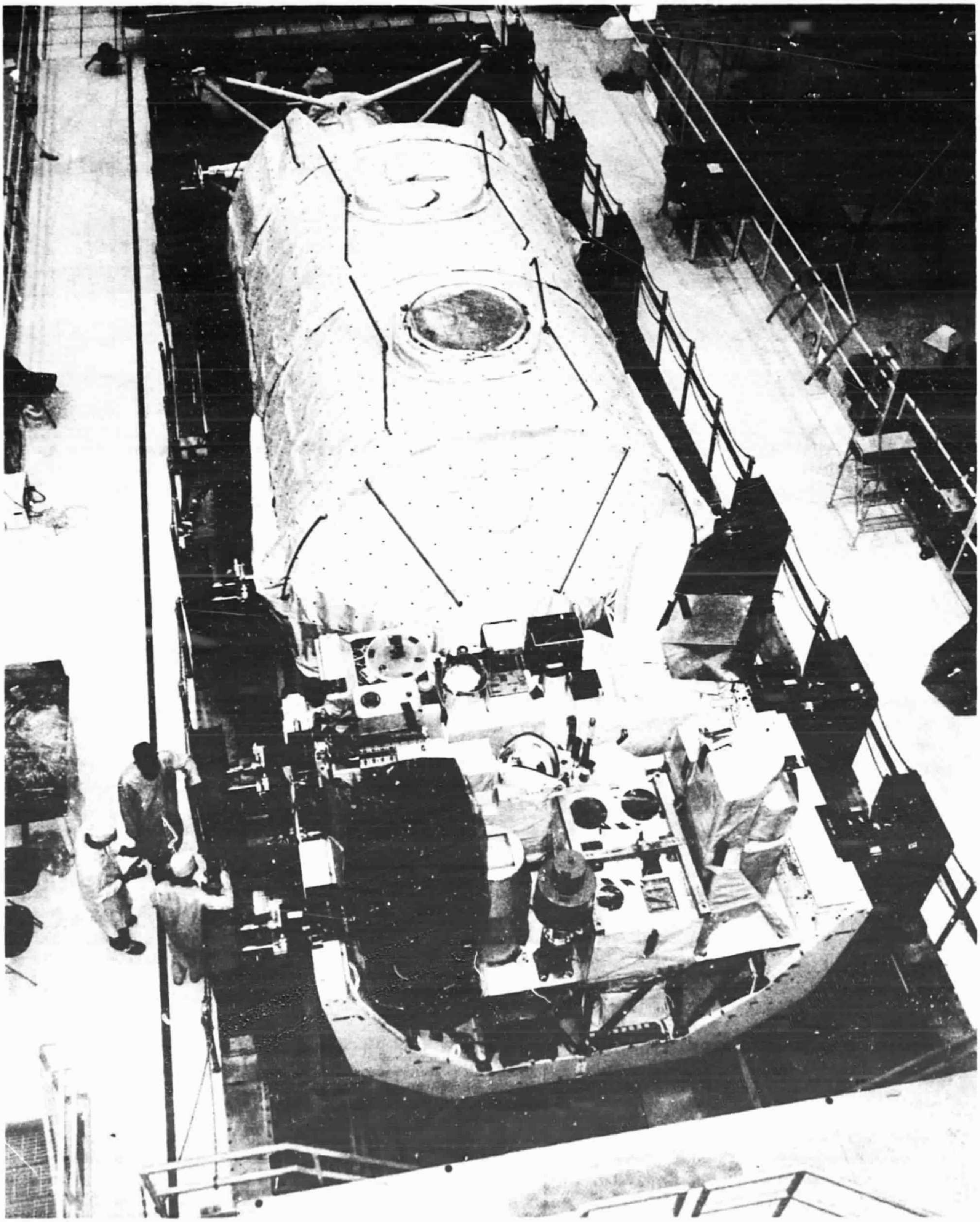
Space Plasma Physics

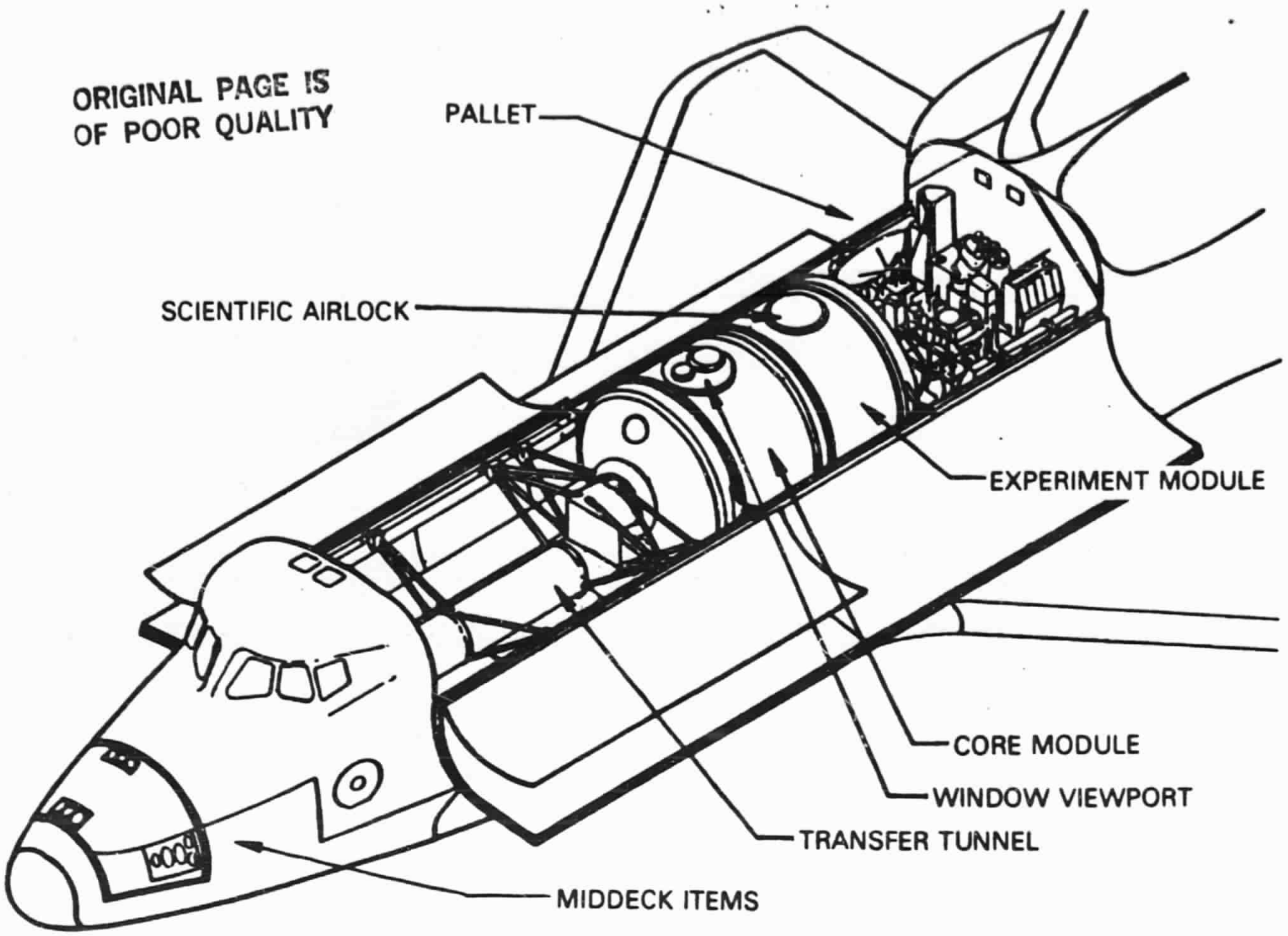
All of the physical relationships between the sun and the earth are not yet fully understood. The Shuttle's orbital altitude is in the ionosphere — the transition zone between the magnetosphere above and the atmosphere below. Thus, Spacelab 1 offers an extraordinary chance to study — from within the plasma envelope surrounding the earth at close range — the charged particles of which it is comprised.

SPACELAB 1 ESA INVESTIGATIONS

DISCIPLINE	EXPERIMENT NUMBER	TITLE	PI NAME/COUNTRY
Atmospheric Physics	1ES013	Grille Spectrometer	M. Ackerman/Belgium
	1ES014	Waves in the OH Emissive Layer	M. Herse/France
	1ES016	Solar Spectrum from 1900 Ao -4 Micron	G. Thuillier/France
	1ES017	Lyman-Alpha H and D	L. Bertaux/France
Plasma Physics	1ES019A	Low-Energy Electron Flux	
	1ES019B	DC-Magnetic Field Vector Measurement	C. Beghin/France
	1ES020	Phenomena induced by Charged Particle Beams	
Solar Physics	1ES021	Solar Constant Measurement	D. Crommelynk/Belgium
Astronomy	1ES022	Very Wide Field Camera (VWFC)	G. Courtes/France
	1ES023	Spectroscopy in X-Ray Astronomy	D. Andresen/ESA ESTC
	1ES024	Isotopic Stack Experiment	R. Beaujean/Germany
Material Sciences	1ES300	Material Science Double Rack (MSDR)	U. Huth/Germany
	1ES332/333	Organic Crystal Growth	Denmark/France
	1ES338	Crystal Growth of Mecury Iodide	C. Belouet/France
Life Sciences	1ES025	Mass Discrimination During Weightlessness	H. Ross/UK
	1ES026/32	Measurement of Intrathoracic Venous Pressure, Collection of Blood Samples	K. Kirsch/Germany
	1ES027	Advanced Biostack Experiment	H. Bücker/Germany
	1ES028	3-Dimensional Ballistocardiography	A. Scano/Italy
	1ES029	Effect of Radiation	G. Horneck/Germany
	1ES030	Electrophysiological Tape Recorder	H. L. Green/UK
	1ES031	Lymphocyte Proliferation in Weightlessness	A. Cogoli/Switzerland
	1ES201	Effects of Rectilinear Acceleration, Optokinetic, and Caloric Stimuli in Space	R.V. Baumgarten/Germany
Earth Observations	1EA033	Metric Camera	Germany
	1EA034	Microwave Remote Sensing Experiment (MRSE)	Germany

There are five major plasma physics experiments. Both active and passive probing techniques will be used to examine the cause and effect relationships between the earth's magnetosphere and atmosphere. Some active experiments fire beams of charged particles into space and measure the resultant changes in the environment. Some experiments create artificial auroras that help to explain how natural particle beams in the auroras carry energy from the solar wind and the magnetosphere into the earth's atmosphere. Particles injected by active experiments can also be used to trace patterns of magnetic and electric fields, to provide a better picture of the structure of the space environment. Passive experiments using special television cameras, sensors and optical instruments monitor natural processes as well as the effects of the active experiments.





Solar Physics and Astronomy

While it protects and sustains life on earth, the atmosphere is a veil that obscures our vision of the sun and stars. Only by using special instruments that can see what the human eye cannot, and by operating them above the atmosphere, can we see the universe clearly. These telescopes, cameras and other detectors can see the sun and stars with greater clarity than normally possible. With them, we can expect to learn much more about the life history of our universe and our sun.

There are two major solar physics experiments designed to measure the sun's output of energy with state-of-the-art precision. These experiments will measure the total energy output of the sun, using three different methods and with the instruments cross-calibrated so that meaningful comparisons can be made. The goal of these investigations is to measure any variations in the solar energy output. This information is important for studies in solar physics, and those dealing with possible effects on the earth's climate.

The four major astronomy experiments will observe faint sources (stars and galaxies) of radiation in the ultraviolet and X-ray wavelengths. Surveys will be performed on large parts of the celestial sphere, with detailed studies on specific objects.

Material Sciences and Technology Development

Spacelab 1 will be outfitted with an integrated set of furnaces and other equipment – the Material Science Facility – that will be shared by investigations from 10 European nations. Most of the scheduled materials science experiments invlove this multiuser facility in pilot studies of crystal growth, fluid physics, chemistry and metallurgy.

Two other experiments will study crystal growth in space. Another experiment requires conducting biological experiments in microgravity. These experiments will demonstrate the capability of Spacelab to serve as a technological development and test facility. The investigations in this group span several disciplines, but have in common the fact that the physical mechanisms invloved are strongly affected on earth by gravity.

Life Sciences

The broad goals of the 17 medical and biological experiments on Spacelab 1 are to gain knowledge of basic life processes and to ensure the health, safety, and capable performance of humans in space. Various biomedical investigations on Spacelab 1 examine the body's responses and adaptations to the stress of prolonged weightlessness. Other experiments in the life sciences discipline use the space environment to study the nature of living organisms

under conditions that cannot be simulated in laboratories on the ground.

Biomedical investigations will evaluate various effects of weightlessness on human physiology and behavior. Blood samples taken from the crew before, during and after flight will be analyzed for changes in red and white blood cell count. Infection-fighting white blood cells will be grown in a culture medium to assess the influence of weightlessness on their activity.

The crew's ability to distinguish between objects of different masses without the sensory cue of weight will be tested. The aim of all these investigations is to understand the mechanisms of tolerance and adaptation.

Another set of experiments will assess the effects of radiation and weightlessness on other organisms. New mapping techniques will be used to measure the level of space radiation that penetrates the walls of Spacelab. Bacteria and other microbes on Spacelab 1 will be examined after the flight to determine the biological hazards of exposure to ambient ultraviolet and cosmic ray radiation.

Observation of sunflower seedlings and fungi growing in Spacelab will yield new information on plant growth patterns normally influenced by gravity and 24-hour circadium rhythms.

Return Payload Weight Dictates Lakebed Landing

Because Columbia will return with significantly more payload weight than on any previous Shuttle Mission, the California lakebed at Edwards Air Force Base has been selected as the primary End-of-Mission site for STS-9.

The ground track for reentry, because of Columbia's 57 degree inclination will look much different than on other flights. Reentry will begin on Columbia's 144th revolution around the earth with the firing of both Orbital Maneuvering System engines over the Indian Ocean.

Columbia will approach the California coastline from the south, following the Baja peninsula, and land on orbit 145 at Edwards Air Force Base at about 8 days, 22 hours and 39 minutes mission elapsed time. Runway 17 has tentatively been selected as the prime EOM runway based on prevailing ground winds.

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