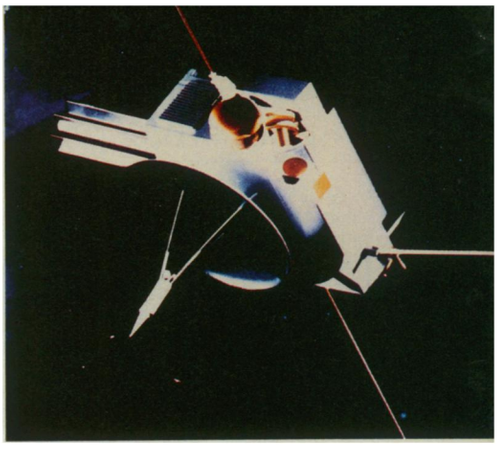
Space 1990

Launching a new decade of exploration

By JONATHAN EBERHART



NASA enters a new era of scientific exploration with a year of missions that span the agency's capabilities. Some projects use the shuttle as a delivery van and even as a multipurpose laboratory. Others use one-shot, unmanned rockets known as expendable launch vehicles (ELVs). And several feats will not involve new launchings at all, being instead the work of craft already in space.

One such venture comes first on NASA's 1990 science calendar. When the Galileo spacecraft — launched last Oct. 18 on a circuitous route to reach Jupiter in 1995 — flies around Venus on Feb. 9, it will take pictures of the planet's clouds, measure charged particles in the interplanetary magnetic field and monitor the activity of the sun in what has already proved a record-setting solar cycle.

But apart from demonstrating whether Galileo still works, the Venus flyby will give 1990 a frustratingly taciturn beginning. Instead of opening the year with a data-rich radio "downlink" of new Venus measurements, Galileo will have to keep its discoveries to itself for more than eight months. Scientists must wait until the craft gets close enough to Earth to transmit the results using the less efficient of its two antennas, since the other will remain furled until later in the mission to protect it from the heat of the sun (SN: 9/30/89, p.218).

Galileo's work for 1990 will not end with its Venus data-dump, however. On Dec. 8, it will pass even closer to Earth and its moon, photographing both of them by visible, ultraviolet and infrared light. Among the craft's tools is the most sophisticated camera NASA has yet sent off for planetary observations.

Beyond February's Venus encounter awaits a diverse series of space endeavors:

• Scheduled for a March 26 launch by the shuttle is what the space agency hopes will prove its hit of the year: the long-awaited Hubble Space Telescope. Astronauts should release the satellite from Discovery's cargo bay on March 27, for a run hoped to last 15 years or more (SN: 1/6/90, p.8). NASA officials describe the $2 billion device as the most expensive single scientific instrument ever built, although other projects, such as the Superconducting Super Collider, may capture that title in coming years.

• On April 26, NASA plans to orbit another telescopic payload, but this time the instruments will stay fixed in the shuttle's cargo bay. Called Astro, it is designed to work as part of the European Space Agency's crew-carrying Spacelab module. This means it will operate only for the 10 days or less that the shuttle can remain in space. Plans call for a second Astro mission in 1992.

Astro will carry three ultraviolet telescopes aimed by a single pointing system. Together, the telescopes will study extreme ultraviolet sources, such as quasars and galaxies, while making wide-angle observations of various objects whose emissions represent a wide band of ultraviolet wavelengths. Project officials expect the ultraviolet trio to conduct as many as 200 to 300 independent observations during each of its two missions.

The first Astro flight will also carry an X-ray telescope originally planned for a mission called the Shuttle High-Energy Astrophysics Laboratory, which fell victim to a launch shortage created by the 1986 loss of the shuttle Challenger. NASA eliminated the laboratory as a separate program but retained the telescope by assigning it to the Astro flight. The instrument measures the amount of energy of each X-ray wavelength detected. The resulting spectrum enables astronomers to determine the composition, temperature and degree of ionization of each X-ray source.

• Scheduled for launch no sooner than May, the Roentgen Satellite, or ROSAT, was originally designed to be carried aboard the shuttle. But when post-Challenger flight delays left NASA short of available shuttle space, project scientists redesigned the satellite so that it could ride a Delta 2 rocket into orbit. Rather than travel into "deep space," this X-ray observatory will orbit Earth while scanning emissions from our galaxy and beyond.

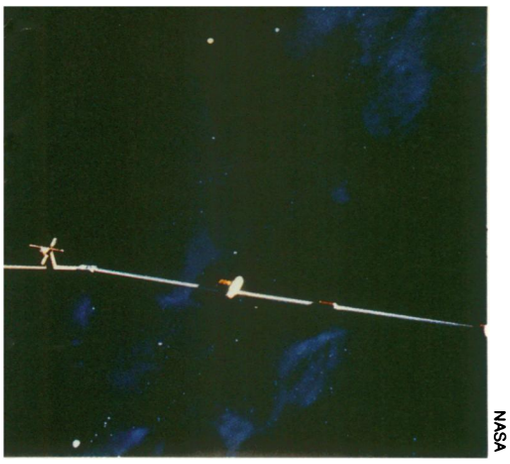
The mission has an international flavor: West Germany built the satellite and its main telescope, while the United Kingdom contributed a wide-field camera to photograph large areas of space. NASA itself provided a high-resolution imaging system and will handle the satellite's launch.

ROSAT's objectives include monitoring X-ray emissions from the coronas of stars of all spectral classes, as well as mapping such emissions from the remnants of supernovas and studying particularly active X-ray sources such as Seyfert galaxies and quasars. In addition, it will look at the shapes of X-ray-emitting clusters of galaxies and carry out detailed mapping of the interstellar medium in the Milky Way. The craft is designed to last at least five years.

• The 17-ton Gamma Ray Observatory (GRO), set for launch with the shuttle on June 4, was designed to operate for at least two years. But along with its four scientific instruments, GRO carries additional propulsion units that can reboost its orbit several times to keep the craft on the job for as long as a decade. Among the scientific instruments is a gamma-ray telescope developed in West Germany.

• Scheduled for launch in June is the Combined Release and Radiation Effects Satellite (CRRES). This joint project of NASA and the U.S. Air Force is, like ROSAT, a shuttle-intended payload redesigned for an unmanned rocket launch. During the mission, the Air Force will conduct tests of high-efficiency solar cells and study how radiation in Earth's magnetic field affects microelectronic devices. NASA's part consists of 24 canisters that will release high-altitude chemical clouds when ejected from the satellite. The clouds will change color as they are ionized by charged particles in the geomagnetic field. Like similar releases conducted in 1984 from one of the three satellites in NASA's Active Magnetospheric Particle Tracer Experiment, the visible clouds should allow scientists to observe changes in the field's shape and motion.

• On Aug. 10, Magellan will arrive at Venus. The first interplanetary spacecraft launched by the United States since 1978, Magellan was sent out from the shuttle last May 4 to orbit the cloud-



NASA

The sun shines on Ulysses.

covered planet (SN: 5/13/89, p.292). Once there, its mission is to map Venus in unprecedented detail, using radar instead of cameras to "see through" the concealing blanket.

• NASA calls Spacelab Life Sciences-1 "the first space laboratory dedicated to life sciences research." Planned for an Aug. 16 launch in the shuttle's cargo bay, the orbiting laboratory will carry a seven-member crew that includes three physicians and a physiologist. They will conduct experiments on each other to learn how the space environment affects a wide range of body systems, including the cardiovascular, cardiopulmonary, renal, endocrine, immune, musculoskeletal and neurovestibular systems.

• Ulysses, the farthest-reaching mission on this year's launch schedule, once went by the more descriptive name of the International Solar Polar Mission. Set for shuttle launch on Oct. 5, this sun explorer will first head out to Jupiter. The detour is another consequence of the Challenger accident, which led NASA to cancel development of an upper-stage rocket powerful enough to conduct the mission with a simple flight toward the sun. Ulysses will instead swing around Jupiter in February 1992 so that the giant planet's massive gravity can tilt the plane of the craft's orbit and redirect Ulysses sunward again at an angle that will carry it over the sun's south pole in August 1994. Then the craft will continue in a huge loop, swinging around and heading back across the solar north pole in June 1995.

The European Space Agency (ESA) provided the spacecraft and five of its nine scientific instruments; NASA contributed the other four instruments and the shuttle launch. As originally envisioned, the mission involved two craft — one each from NASA and ESA — to allow simultaneous observations of both solar poles. But NASA, citing budget pressures, dropped its spacecraft plans for the mission in 1981. The decision triggered strong anti-NASA feelings on the other side of the Atlantic.

• The year's last scheduled scientific space endeavor involves not only NASA and ESA but also the French National Center for Space Studies, the National Research Council of Canada, Japan's National Space Development Agency and the German Aerospace Research Establishment. The program, called the International Microgravity Laboratory (IML) series, will focus on the role of reduced gravity in materials and life sciences, and its planners envision conducting several missions at 17- to 25-month intervals following the Dec. 6 launch of the first one aboard the shuttle.

• Yet another significant scientific accomplishment may take place in space this year, though its date — or even its likelihood — goes unmarked on anyone's calendar. The event hinges on Voyager 1 or 2, or perhaps even Pioneer 10 or 11, detecting a shock wave indicating that the solar wind, moving at supersonic speeds, is bunched up against a similar "wind" coming in from other stars. Scientists do not know where this phenomenon might exist, and their estimates of when a spacecraft could encounter it range from any day now to decades in the future. But wherever that shock wave lies, just outside it will almost surely be the heliopause (SN: 10/7/89, p.231) — the outermost limit of the sun's huge magnetic field and perhaps the most fitting candidate among the many definitions of the true edge of the solar system. □