

1984. This posed a problem for NASA, however, because the 1984 launch will require more power than a 1982 launch would have, and the Interim Upper Stage, the solid-fuel engine that NASA wants to use in Galileo, will not be able to power the entire apparatus to Jupiter in 1984. NASA's answer was to split the Galileo orbiter and probe into two separate launches. Two Interim Upper Stage engines will power the two-part mission, thus adding to the cost of the Galileo Mission. The delays and the redesign of Galileo have cost the Office of Space Science alone about \$200 million.

Planetary scientists are concerned about the future of planetary exploration, and with good reason. The Pioneer mission to orbit Venus and drop a probe into its atmosphere and the Voyager mission to fly by Jupiter and Saturn will have completed their primary objectives by the fall of 1981. Galileo will not reach its destination until 1986. During this five-year hiatus in planetary encounters, planetary scientists will have to rely on the backlog of data from these missions to keep them busy. "I think that is an alarming situation," Eugene Levy, chairman of the committee on planetary and lunar exploration of the National Academy of Sciences space science board, told PHYSICS TODAY. "Just as the scientific challenges and opportunities are burgeoning the nation is shrinking away from an active and vigorous program," he said. Compounding this problem is the fact that planetary missions are becoming inherently more and more expensive as we move out of the early reconnaissance phase of planetary exploration.

The new high-energy astrophysics project in the 1981 budget, the Gamma Ray Observatory, will be launched from the space shuttle in 1985. The 1981 budget request for this effort is \$19 million. The observatory, which is being designed to last for about two years, will improve our estimates of the positions of gamma-ray sources (such as quasars, supernovas, pulsars, radio galaxies and neutron stars) by a factor of 50-100. It will carry five instruments to detect very high-energy gamma rays from pulsars, nuclear gamma rays and gamma-ray bursts.

Applications. Carter cut his original request for space and terrestrial applications by \$26 million to a total of \$369 million, 7.3% higher than the 1980 level. At the same time, however, he asked Congress to appropriate an additional \$30 million for the Landsat D space and ground systems, which are suffering cost overruns. The applications budget continues to emphasize remote sensing, space communications and materials processing in space.

The 1981 budget includes a National

Oceanic Satellite System, a cooperative project between the Department of Defense, NASA and NOAA. NOSS is estimated to cost \$800 million over a 10-year period. In 1981 DOD is expected to provide \$11.5 million for NOSS, and NASA and NOAA will each provide approximately \$6 million. The new monitoring system is to demonstrate the feasibility of providing from polar-orbiting spacecraft, in real time

and under varying weather conditions, continuous observation of the Earth's ocean surface winds, sea state, surface water temperature, wave height, ice and other geophysical measurements.

A major new space applications emphasis is a five-year satellite communications development effort. In 1981, \$29 million will be spent on space communications, 28% more than in 1980.

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DOD basic research: 10% real growth

The Congress is now deliberating a request for the FY 1981 Department of Defense budget that includes \$637 million for research. That figure is \$15 million less than what Carter requested for DOD research in January. Using the official estimate of inflation as it applies to research (of 9% per annum), the current request just allows DOD to claim a 10% real growth for 6.1 (basic) research, keeping Defense Secretary Harold Brown's 1977 pledge.

Most of the \$15 million in cuts from the original budget request have been made in the Navy and Air Force research programs, but nothing in the DOD research budget has had to be cancelled totally as a result of the President's budget amendment. Although DOD has not yet decided exactly which programs will suffer budget reductions, George Gamota, DOD director for research, told us that, "judging from past experience, the newer programs will be scrutinized the hardest in the next few months, in order to protect the continuity of research efforts." As of January, DOD's request for basic research in physics was about \$120 million, an 18% increase over 1980.

DOD expects to continue its very-high-speed integrated circuits development program in 1981 with about \$35 million. The five-year program is expected to cost \$200 million. Contracts

for this program will be awarded to both universities and industries. DOD has also proposed a \$6.1-million ultra-small electronics research program. A generation beyond the very-high-speed integrated circuits, the ultra-small circuits would further reduce the size of the conductor widths to 50-500 Å to achieve still faster circuitry.

Approximately \$35 million is budgeted for particle-beam technology, of which up to \$6 million will be spent on research. The major objective of this program is to demonstrate the feasibility of stable exo- and endo-atmospheric propagation of high-power beams. Ultimately, DOD hopes to be able to apply this technology to weapons uses.

DOD will also devote "a considerable effort" in 1981 to "filling in" the regions of the electromagnetic spectrum for which appropriate sources and detectors are not yet developed. For example, the region of approximately 1 mm wavelength appears to be best for detecting targets and guiding weapons under conditions of poor visibility. But this is a region where the performance of conventional microwave tubes is poor and where conventional lasers are unavailable. DOD is exploring as a source of high-quality radiation a hybrid between the microwave tube and the laser, such as the free-electron laser.

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CERN elects Schopper as director

Herwig Schopper, head of the DESY laboratory at Hamburg, has been named the next director-general of CERN in a unanimous vote of the CERN Committee of Council. The committee is composed of a delegate from each of the twelve CERN member states. Schopper will succeed the two current directors-general, John Adams and Leon Van Hove, whose five-year terms of office expire 1 January 1981.

Schopper has been a professor at Hamburg University and chairman of the Directorate of Directors at DESY since 1973. He received his doctorate in 1951 from the University of Ham-

burg and has held professorships at the Universities of Erlangen, Mainz and Karlsruhe. Schopper was chairman of the scientific council of the nuclear research center in Karlsruhe from 1967 to 1969. In 1970 he was named head of the department of particle physics at CERN and since last year has served as a member of the CERN scientific policy committee.

The Italian delegation to the CERN council had at first disputed Schopper's nomination. Schopper was running against an Italian, Antonino Zichichi, professor of advanced physics at the University of Bologna, founder and di-