state & society

President requests more support for R&D at NSF and NASA

Citing a decline in recent years in the quality of scientific equipment and in the number of top-ranked laboratories in the US, President Jimmy Carter last November promised that his Administration would provide expanded funds for scientific research and development. In his FY 1979 budget request to Congress, the President has called for a 6.1% increase in the conduct of R&D (from \$26.3 to \$27.9 billion) and a 10.9% increase in basic research (from \$3.3 to \$3.6 billion) among all agencies of the Federal government. According to Frank Press, the Director of the Office of Science and Technology Policy and the President's Science and Technology Adviser, the basic research increase in real dollars is nearly 5%.

Colleges and universities are budgeted to receive \$3.6 billion for R&D from over a dozen different Federal agencies.

Defense-related R&D is up by 8.4% or \$1.1 billion, to \$13.8 billion, and includes a 14% increase in basic-research funding. On the other hand, civilian-related R&D (which does not include space-related activity) is up by only 2.4%, or \$225 million, to \$10.7 billion, reflecting decisions to cut back on development and demonstration programs where potential user demand appears to be low.

In FY 1979 DOE has allocated \$294 million for high-energy physics, \$91 million for nuclear physics, \$334 million for magnetic-confinement fusion and \$126 million for inertial-confinement fusion.

BARDON

In addition, \$30 million has been allocated for nuclear sciences and \$94 million for materials sciences.

NSF's budget for R&D will increase 10% or \$75 million, to \$829 million, including \$755 million for basic research.

NASA expects to increase its support for basic research to \$520 million, an 11.1% increase over FY 1978. Overall R&D obligations for the agency are expected to rise by \$316 million in FY 1979 to a total of \$4.2 billion while facilities construction will decrease by \$9 million.

For NSF an increase of 10% has been requested for support of basic research, up to \$755 million. (See table 1.) At the press briefing for NSF's budget, James A. Krumhansl, who heads the Mathematical and Physical Sciences and Engineering Directorate, stated that the physics program will provide increased funding for instrumentation and will emphasize the greater utilization of facilities. Marcel Bardon, the new director of the physics division, told us that instrument support in various areas of physics will be increased by \$3.4 million. The amount of \$2.2 million will be allocated for instrumentation for users of the Positron–Electron Project (PEP) at Stanford University. In addition, \$9.5 million is budgeted for further work in converting Cornell University's Wilson Synchrotron to an 8 GeV × 8 GeV electron–positron colliding-beam facility and \$1.1 million for development of a superconducting cyclotron for heavy-ion physics at Michigan State University; both facilities (costing respectively \$21 million and \$3 million over three years) are expected to go into operation during FY 1979, according to Bardon. He also told us that \$1.0 million in the forthcoming budget has been allocated for a new Institute of Theoretical Physics. No location has yet been chosen for this Institute.

In the materials-research division, according to the acting director, Howard Etzel, \$800 000–900 000 has been budgeted for modernization of research in-

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Lindenbaum sees economic gains from high-energy physics

"One of the biggest problems facing the high-energy physics community is to convey to the decision-makers and the average American the practical values as well as the intellectual triumphs resulting from increased support of high-energy physics," according to Sam Lindenbaum, a physicist from Brookhaven and CCNY, who recently spent 15 months in Washington as Deputy for Scientific Affairs, High Energy Physics Program, Division of Physical Research, ERDA. He returned to Brookhaven shortly before ERDA became a part of DOE. He recently discussed with us his views on the current status of US high-energy physics research.

Although intellectual curiosity is the major motivation for undertaking high-energy physics research, Lindenbaum argued that support for this field does produce significant economic benefits for the US: "I personally believe that we have entered an era of a mature industrial society where the basic production of standard products is no longer something in which we hold an advantage, and in fact we are at a competitive disadvantage with other countries in many such cases.

"The areas in which we really shine are the exotic technology areas—just those areas that are spun off from frontier research such as that done in high-energy physics. For example, the heart of the modern digital computer, the scale-of-two counter, was invented in nuclear research, the high-energy physics of the late 1930's and the early 1940's. The first modern digital computer was originally developed in connection with the Manhattan Project. The accelerators—the tools of the trade that one uses in high-energy physics—have demanded new exotic technologies that in many cases were developed originally for those accelerators. Other examples include high-vacuum technology of the modern type and the high-voltage equipment industry. The accelerators themselves have been used for medical applications, industrial radiography and for fusion energy experiments."

Another serious problem facing the high-energy physics community in the

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of light on these subjects. Although it is difficult to foretell what the results of these advances will be, one must remember the dramatic impacts on our daily lives resulting from Maxwell's unification of electric and magnetic phenomena and Einstein's unification of matter and energy.

"I also felt that the government administrators both directly concerned with the program and the various decision-making bodies above them can be reached by logical arguments as to why support of high-energy physics is in the national interest both intellectually and practically."

Lindenbaum observed that the Washington environment is entirely different from the one that is found in active research. He advised that government experience can be very valuable if an individual is "well impedance-matched" to the Washington environment. According to Lindenbaum, "it takes an individual with a broad enough viewpoint so that he can communicate with the people involved on a level that they consider understandable and do it in a way that they can relate to." —CBW

NSF and NASA budgets

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strumentation at the 15 NSF-supported Materials Research Laboratories. Funds to continue the construction of synchrotron-radiation facilities at the University of Wisconsin and Stanford University have been requested. Wisconsin's Aladdin storage ring, expected to cost \$3 million over a three-year period, will produce radiation from 1 eV to 2.5 keV and with a wiggler will reach 10 keV; it will become even more intense in those spectral regions that overlap Wisconsin's 240-MeV Tantalus I storage ring. Some 30 to 40 ports are planned. The three-year, \$6.7-million expansion of the Stanford Synchrotron Radiation project at SPEAR will add by 1980 seven new beam lines serving 14 monochromators. The construction of a multipole transverse wiggler operating at 18 kG will yield a flux up to about 10 keV. In FY 1978 \$4 million was allocated for construction components at Wisconsin and Stanford and \$1.5 million for operating expenses for existing facilities at these locations; the breakdown for FY 1979 is not yet available. Etzel also said that construction is slated to begin during the forthcoming fiscal year on a second-generation 30-tesla hybrid magnet at the Bitter National Magnet Laboratory.

William E. Howard III, director of NSF's astronomical-sciences division, told us that the \$78-million Very Large Array radiotelescope project near Socorro, New Mexico has been allocated \$12.2 million for further construction and is now expected to be completed in FY 1980. At present, 10 of the 27 antennas are operating. When the Array goes into full operation in FY 1981, it will have a resolution of 0.6 seconds of arc at an observing wavelength of 6 cm and 2.1 seconds of arc at the 21-cm wavelength of neutral hydrogen.

NSF's new Applied Science and Research Applications Directorate (the successor to the RANN program) is budgeted at \$73.9 million, which includes a \$6.9-million deferral from FY 1978 and a \$9.1-million increase in new obligational authority. Jack T. Sanderson, who heads ASRA, told us that earthquake research is slated for an increase of \$8.3 million up to \$26.4 million in FY 1979 and that the program for applied physics, mathematics, biological sciences and engineering (within the division of applied research) is budgeted at \$10.4 million, an increase of \$1.0 million over FY 1978.

NASA. As it did last year, R&D accounts for about 75% of NASA's total budget authority request of \$4.372 billion. The Space Shuttle has been allocated \$1.439 billion, space sciences (which includes physics and astronomy, lunar and planetary exploration and life sciences) allocated \$513.2 million and space and terrestrial applications allocated \$283.4 million. (See table 2.)

In the physics and astronomy category, there are two new programs, both involving the Sun. The Solar Polar mission, which will be jointly funded by the European Space Agency, will involve sending two spacecraft into solar orbits that will be inclined about 88° to the ecliptic or solar equatorial plane. (Previous spacecraft have never been inclined more than 15°.) From Earth orbit the Space Shuttle will launch both spacecraft simultaneously within a 10-day launch window in February 1983 along paths that will allow them to rendezvous with Jupiter in May 1984. Observations are expected to begin in September 1986 at a time when the Sun will be in one of its relatively quiet periods. The spacecraft

Table 1. NSF physics-related research

	(estimates in millions of dollars) FY 1978		FY 1979	
MATHEMATICAL AND PHYSICAL SCIENCES AND ENGINEERING DIRECTORATE				
Mathematical sciences		21.5		23.1
Computer research		16.6		18.1
Physics				
Elementary particles	22.7		25.4	
Intermediate energy	9.7		10.7	
Nuclear	12.0		12.8	
Atomic, molecular and plasma	5.9		6.5	
Theoretical	6.2		7.5	
Gravitational	2.3		2.4	
Total physics		58.8		65.3
Chemistry		43.6		47.7
Engineering		45.6		49.6
Materials research				
Solid-state physics	10.2		11.4	
Solid-state chemistry	4.5		5.0	
Quantum solids and liquids	4.9		5.1	
Metallurgy	7.1		7.0	
Ceramics	3.1		3.3	
Polymers	3.5		3.8	
Materials Research Laboratories	17.4		19.0	
National Magnet Laboratory	3.7		4.0	
Synchrotron-radiation facilities	5.5		5.9	
Total materials research		59.9		64.5
Total		246.0		268.3
ASTRONOMICAL, ATMOSPHERIC, EARTH AND OCEAN SCIENCES DIRECTORATE				
Astronomical sciences				
National astronomy centers (except VLA)—operation	27.7		29.3	
Research project support	15.6		16.5	
Very Large Array—construction and operation	13.7		14.6	
Radio-spectrum management	0.1		0.1	
Total astronomical sciences		57.1		60.5
Atmospheric sciences		55.0		59.1
Earth sciences		34.3		38.5
Ocean sciences		58.0		63.3
Arctic research program		5.7		5.9
Total		210.1		227.3

in particular will study how changes within the Sun's convection layer might affect the Earth's climate and will observe the solar corona from a new high-latitude perspective. The mission is expected to cost NASA between $190 and $230 million for development, launch and initial orbital checkout and approximately $40 to $50 million for subsequent operations that will extend over a four-year period. The Europeans will spend about $100 million overall for the spacecraft that they are developing, its instruments, and their part of the operations.

The other new program is the Solar Mesophere Explorer, scheduled to be launched in mid-1981 by a Scout launch vehicle. According to Noel W. Hinners, NASA's Associate Administrator for Space Science, this satellite "is designed very specifically to look at the photochemistry of the mesophere, that region just above the stratosphere, where the important compounds that affect the ozone balance are formed—the nitrogen oxides, the hydrogen oxides and the ozone itself. So it would be looking at the direct influence of the solar ultraviolet flux on the chemistry of that layer." In FY 1979, $5 million will be allocated for development of this satellite.

Several other physics and astronomy projects will continue to receive funding. In FY 1979, according to Charles E. Wash, director of program analysis in NASA's Office of Space Science, preliminary design reviews are expected to be completed on the Optical Telescope Assembly, its Support Systems Module and other scientific instruments to be placed aboard the Space Telescope, and work will begin on the control and data-handling systems for this 1983 mission. The first European-built Spacelab, currently in preparation and scheduled for the first of a number of launches by the Space Shuttle in 1980, will carry approximately 40 US and foreign investigations in support of applications, science and technology objectives. The Jupiter Orbiter–Probe, recently renamed Project Galileo, will receive a sizable increase in funding in FY 1979 as part of normal program development. The second and third High-Energy Astronomy Observatories will be launched during the upcoming fiscal year.

NASA proposes two new space-applications programs. The Earth Radiation Budget System will involve sending visible and infrared radiometers aboard three spacecraft (twice as a "piggyback" to already-scheduled NOAA satellites and a third time as part of an Applications Explorer-type satellite that will be put in a different orbit) that will be launched in 1982 and 1983. According to Ichtiaque Rasool, the new Chief Scientist in NASA's Office of Applications, the satellite system, which will measure both incoming solar radiation and outgoing reflected and emitted radiation on a global basis, will help determine parameters that are important for climate research. This mission, expected to cost a total of $70 to $80 million, is budgeted at $8 million in its first year of funding.

The other new applications program is a Halogen Occultation Experiment which, according to NASA's Administrator Robert A. Frosch, "will really be a series of experiments to look at aspects of the pollution of the upper atmosphere, particularly those halogen pollutants that are connected with the ozone problem." A prototype will be carried aboard two Spacelab flights for five or six days each, and then the experiment will later be flown on an Applications Explorer satellite. This $20- to $26-million mission is slated to receive $6 million in FY 1979.

The Lunar Polar Orbiter (a casualty for the third time) and the Gamma-Ray Observatory did not receive funding, both being considered of lesser priority than the Solar Polar mission. The fate of the Orbiter is unknown, but Wash believes that the Observatory will probably have the highest priority in next year's new programs in the physics and astronomy category.

A rendezvous mission to Comet Halley also was not funded. At the press briefing for NASA's budget, Frosch explained that "the principal reason for not going . . . was the feeling that we could not sensibly be ready to do a good mission . . . . We need a low-thrust, long-duration system. Last year we made a decision between solar sail and ion drive in favor of ion drive . . . , but we don't believe we could have [its development completed] in time to do a Halley mission. We are now thinking in terms of getting that development done and going for a later cometary mission for one of the comets that comes around more often than Halley's." Wash suggests that Encke's Comet, scheduled to arrive at perihelion in 1987, might be such a candidate. —CBW

(The funding of other Federal agencies, including the Department of Energy and the Department of Defense, will be discussed in a subsequent story.)

Table 2. NASA physics and astronomy

	(estimates in millions of dollars) FY 1978		FY 1979	
Physics and astronomy				
High-energy astronomy observatory	18.4		11.4	
Solar Maximum Mission	30.6		16.2	
Space Telescope development	36.0		79.2	
Solar Polar mission development	0		13.0	
Shuttle/Spacelab payload development	28.9		38.3	
Explorer development	23.9		29.8	
Mission operations and data analysis	27.0		32.4	
Research and analysis	33.4		35.9	
Suborbital programs	26.0		29.3	
Total physics and astronomy		224.2		285.5
Lunar and planetary exploration				
Pioneer Venus	18.1		0	
Jupiter Orbiter–Probe	20.7		78.7	
Mission operations and data analysis	84.5		84.4	
Research and analysis	23.9		24.0	
Total lunar and planetary exploration		147.2		187.1

in brief

Prizes for original projects in astronomy and related fields are being offered to high-school students by Boston University's department of astronomy. Additional information is available from Michael Papagiannis, Chairman, Department of Astronomy, 725 Commonwealth Ave., Boston, Mass. 02215.

Copies of NSF 77-313, *Graduate Science Education: Student Support and Postdoctorals, Fall 1975*, are available from the National Science Foundation, Washington, D.C. 20550.

The new president of the Australian Institute of Physics is Terence M. Sabine, head of the school of physics and materials at the New South Wales Institute of Technology.

A scholarship for the study of vacuum science, technique or their applications in any field is being offered by the Welch Foundation through the International Union for Vacuum Science, Technique and Applications. Granted for one year beginning on 1 September 1978, the scholarship consists of between $6000 and $7000. Candidates should have a bachelor's degree, though a doctorate is preferred. Necessary forms and additional information may be obtained from J. H. Singleton, Westinghouse Research and Development Center, 1310 Beulah Road, Pittsburgh, Pa. 15235. The deadline for applications is 1 April 1978. □