DOE budget gives physics-related research a 12% raise

President Carter has placed strong emphasis on basic research in his FY 1980 Department of Energy budget. In a total budget down 22%, basic research is receiving a 17% increase from $469 million in 1979 to $551 million in 1980. According to Frank Press, the President's Science and Technology Adviser and Director of the Office of Science and Technology Policy, the 1980 DOE budget emphasizes "longer range R&D in areas where industry is not likely to provide support." These areas include solar energy, nuclear waste disposal, fossil energy, the breeder reactor and fusion. DOE is increasing support for solar-energy technology 24%, the largest increase in the budget.

Physics-related research, excluding fusion research, went up 12%, and fusion research went up 2% in the 1980 budget.

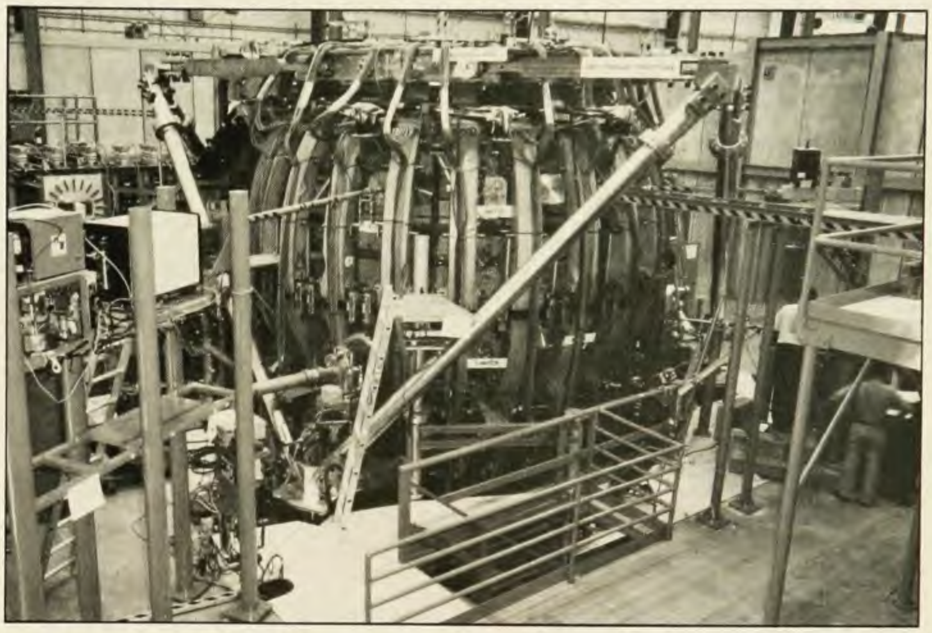
High-energy physics would see a 10% increase in funds under the proposed budget, though the number of construction projects will decline. Next year will be the first year of major construction on the intersecting storage accelerator (Isabelle) at Brookhaven National Laboratory; $45 million is budgeted for this project, and another $6 million will be spent as operating funds for component development. Isabelle is scheduled for completion in FY 1985 at a total construction cost of $275 million.

Construction of the new Positron–Electron Project at SLAC, which will produce 18-GeV electrons colliding with 18-GeV positrons, will be completed by 1980, and the 1980 budget allows $14 million for operation of this facility.

Continued construction of the Energy Saver project at Fermilab is budgeted at $20 million in 1980. Completion of construction and initial experimental use of the Energy Saver is scheduled for FY 1981, and construction of the Energy Doubler project, which would boost the synchrotron's maximum energy from 500 to 1000 GeV, is planned to begin in that year.

The marked decline in the Argonne budget (see Table 1) is due to the closing of the Zero Gradient Synchrotron there.

Nuclear physics. The request for the DOE nuclear-physics program is up 13% in 1980. The Los Alamos Meson Physics Facility will receive $2.4 million for additions to the experimental support facility there. This will make a staging area available for preparation of experiments. Improvements are also planned for the Bates Electron Linear Accelerator at MIT costing $1.8 million. These improvements will increase the beam energy from 400 MeV to approximately 700 MeV.



Doublet III device at General Atomic is essentially a tokamak with a kidney-shaped cross section. At present it operates with a power supply that produces 26 kG and a plasma current of 2.5 MA. In the five-year upgrade expected to be funded by DOE and the Japanese government, the plasma current in the device would double, and power supplies would be added to yield a 40-kG field.

Construction of the National Superconducting Cyclotron Laboratory at Michigan State University, originally planned as an NSF activity, is now a DOE budgetary responsibility (PHYSICS TODAY, March, page 127). James Kane, associate director for basic energy sciences and acting associate director for high-energy and nuclear physics, attributed the shift to the success of the DOE in managing large-scale construction projects in the past. The construction is expected to take approximately three and a half years and cost between $25 and $30 million, of which $6 million is requested in 1980. When construction is completed, it is expected that NSF will assume responsibility for supporting its operation.

Materials sciences. Highlights of the materials-sciences budget include:

- Authorization funding of the $24-million National Synchrotron Light Source at Brookhaven is to be completed in 1980, for which $9 million is budgeted.
- A total of $12.6 million will be authorized in two installments to create a new Chemical and Materials Sciences Laboratory at Berkeley. This involves adding to the existing Materials and Molecular Research Division building and purchasing an electron microscope with a point-to-point resolution of 1.7 Å.
- $2.4 million will be used to double the number of research stations at Argonne's Intense Pulsed Neutron Source I. This facility, scheduled for completion in late 1981, is expected to produce 10^{15} neutrons/cm^2-sec. DOE is delaying a decision to build IPNS II until 1983–84. If built, IPNS II is expected to yield 10^{16} neutrons/cm^2-sec. Another possible choice is to rely on the pulsed neutron source at Los Alamos, which can provide comparable pulse rates. Because the LAMPF accelerator provides protons for several programs, a pulsed neutron source presumably would cost less to operate than IPNS II but would allow only a

Table 1. DOE physics-related research

	(estimated budget authorities in millions of dollars)			
	FY 1979		FY 1980	
High-energy physics				
Fermilab	57.9		63.2	
Brookhaven	35.7		38.8	
Argonne	16.3		10.5	
SLAC	37.7		49.0	
General R&D	46.3		52.5	
Total operating budget		193.9		214.0
Total capital equipment		41.2		36.0
Total construction		61.5		76.0
Nuclear physics				
Medium-energy physics	38.4		41.7	
Heavy-ion physics	30.7		33.6	
Nuclear theory	5.7		6.1	
Total operating budget		74.8		81.4
Total capital equipment		7.5		8.2
Total construction		10.4		14.8
Basic energy sciences				
Nuclear sciences				
Nuclear research	10.3		10.9	
Nuclear data measurements	4.4		4.8	
Nuclear data compilation and evaluation	2.1		2.3	
Heavy-element chemistry	3.2		3.6	
Isotope preparation	8.4		9.1	
Total operating budget		28.4		30.7
Total capital equipment		1.3		1.3
Total construction		–		–
Materials sciences				
Solid-state physics	31.7		35.5	
Metallurgy, ceramics and materials chemistry	39.8		45.8	
Total operating budget		71.5		81.3
Total capital equipment		5.9		6.5
Total construction		16.7		11.7
Chemical sciences		54.7		69.3
Engineering, mathematics and geosciences		16.5		25.3
Advanced energy projects		7.5		16.8
Biological energy research		4.0		7.2
Other capital equipment		0.1		0.1
Total program direction		2.9		4.1

Table 2. DOE fusion research

	(estimated budget authorities in millions of dollars)			
	FY 1979		FY 1980	
Magnetically confined fusion				
Confinement systems	88.8		92.6	
Development & Technology	51.4		50.0	
Applied plasma physics	60.6		71.2	
Reactor projects	32.1		39.1	
Total operating budget		232.9		252.9
Total capital equipment		27.2		29.8
Total construction		92.2		78.2
Inertial-confinement fusion				
Advanced drivers	11.7		8.9	
Fusion experiments	85.5		90.3	
Systems studies & weapons applications	6.8		8.6	
Total operating budget		104.0		107.8
Total capital equipment		8.2		8.5
Total construction		31.0		28.5
Total program direction		3.7		4.2

fraction of the experimental time. The DOE will consider all factors in making its decision, including cost, performance, drawbacks, accessibility and involvement of the scientific community in each.

Nuclear waste. FY 1980 will see the first formal DOE program directed toward basic research in nuclear waste management, with funding levels close to $8 million. According to Kane, the nuclear waste isolation research—for both commercial and defense-related nuclear wastes—will examine the entire reprocessing–disposal cycle in an attempt to improve the knowledge base "so that those who will eventually select the site and choose the design of waste repositories will have more options open to them." Kane also hopes that the research will eliminate the need for "precautionary over-designing" of such facilities.

Magnetic fusion. Edward Kintner, director of the DOE Office of Fusion Energy, told us that, although his budget for magnetically controlled fusion research increased only 2% in 1980 (a decrease in constant dollars), "we have moved from a construction phase on a number of facilities into an operating phase and we will be able to operate all of the facilities that have just been completed, [even] with this lowered budget." Kintner also told us that his budget had been influenced by the recommendations of the Fusion Review Committee headed by John Foster (PHYSICS TODAY, September 1978, page 85) Probably the most important effect the review group had is that DOE will put increased effort on alternate concepts to the tokamak fusion reactor. The DOE reviewed what it considered to be the three most advanced alternatives—the Elmo Bumpy Torus at Oak Ridge, reversed-field pinch at Los Alamos and the stellarator at the University of Wisconsin—and selected one, the Elmo Bumpy Torus, to stress through increased funding. The DOE budgeted $15 million for both research and development of a proof-of-principle experiment. Reversed-field pinch and stellarator research will be funded essentially at their 1979 levels under the rationale that other countries, especially Japan, England and the Soviet Union, are also putting research money into these approaches. In addition, there are other concepts, Kintner told us, that are "far less developed, but much more interesting in terms of the possibilities if they work." For example, pending the outcome of current reviews, DOE plans to begin funding in 1980 fabrication of the Spheramak (a spherical tokamak) program at Princeton. The first year DOE will spend about $1.75 million on this concept.

Mirror fusion will also be emphasized in the 1980 budget, following the recommendation of the Foster group. An attempt will be made to bring mirror fusion technology up to a level where it can be compared with tokamaks, according to Kintner. In 1980, $63 million will be spent on mirror systems, most of it going to Livermore, where the Mirror Fusion Test Facility is under construction (PHYSICS TODAY, March, page 17).

The deceleration of tokamak research suggested by the Foster group translated into a 3% decrease in funding, from $75.5 million in 1979 to $73.4 million in 1980. The PDX, which recently began operating at Princeton, will receive $12 million in 1980. The Tokamak Fusion Test Reactor, under construction at Princeton, will receive $28 million. MIT's Alcator C, which began operation in 1978, will receive $6 million in funding, and Oak

Ridge's ISX-B will get $9 million.

The 1980 magnetic fusion budget also calls for a hefty 16% increase for applied plasma physics (see Table 2) and continued strong support of technology and systems studies (such as tritium systems and superconducting magnets) that would make it possible to convert the theoretical knowledge we gain about fusion into useful reactors at an early time, Kintner said.

Kintner's 1980 budget also channels approximately $14.5 million for a "first contribution to the increasing relationship between the US and Japan in fusion," he said (PHYSICS TODAY, November, page 93). This money, along with $12.5 million from the Japanese government, will be used to upgrade the Doublet III device at General Atomic, La Jolla, California.

The inertial-confinement fusion budget allows for an overall increase of only 1%. Although detailed breakdowns of this budget are not yet available, this low increase is likely to be met by spending less money on advanced lasers—about $5.1 million in 1980 as opposed to $8.2 million in 1979—according to Larry Killion, associate director of the Office of Inertial Fusion. Some of this advanced laser money is included in the $42.5 million the DOE will provide the Lawrence Livermore Laboratory in 1980 for operating funds.

Other items in the inertial-confinement budget are: heavy-ion fusion, receiving approximately $3.8 million, up $300 000 from last year; construction of the Nova upgrade of the Shiva laser at Livermore, down $5 million from the 1979 level of $20 million, and continuation of construction of the Antares carbon-dioxide laser at Los Alamos, funded at $12 million in 1980 and $10 million in 1979.

The total amount budgeted for Los Alamos is $27.7 million, which includes unspecified amounts for emphasizing target design and carbon-dioxide laser research. Sandia Laboratories, which conducts a program primarily using intense beams of high-energy electrons and light ions as drivers, would receive $12.2 million under the current budget.

DOE will add $2 million in 1980 to complete construction of the second stage of the National Users Laser Facility at the University of Rochester (PHYSICS TODAY, February, page 17). DOE's contract with Rochester covers only construction of the laser, not operation.

Other programs. In addition to solar energy, nonnuclear technology options that will receive increased support in 1980 include production of synthetic liquid and gas fuels from coal, cleaner combustion of coal, extraction of oil and gas from shale, development of geothermal resources and the development of conservation technologies.

DOE's advanced nuclear-fission R&D program will continue to lay the groundwork for the possible future selection of a breeder system, with increased attention paid to improving the fuel efficiency of current generation light-water reactors.

—MEJ

NASA budget has no new programs

NASA's overall $4.725 billion budget for FY 1980—which includes a $158.8 million increase that does not keep pace with inflation—provides funding for no new programs. Space-shuttle development, which reached its peak in funding in FY 1979, will decrease by $262.3 million this year to $1.366 billion. Other allocations include $344.4 million for space and terrestial applications and $419.7 million for aeronautics and space technology.

Although NASA has no new program starts in space science, sizable funding increases are planned for three of its ongoing projects in this area (see Table 3). Detailed design and development of the optical telescope assembly, the support systems module and the science instrumentation of the Space Telescope (scheduled for launch in 1983) will take place this year if the budget is approved, according to Charles E. Wash, director of program analysis in NASA's Office of Space Science. Continued instrument development and initiation of an industry contract for detailed system design of the US-built Solar Polar spacecraft are also anticipated this year; this satellite (together with a companion under development by the European Space Agency) will observe the hitherto unseen north and south poles of the Sun following a February 1983 launch from the Shuttle and a May 1984 fly-by with Jupiter that will enable it to achieve an orbit inclined about 80° to the ecliptic or solar equatorial plane. FY 1980 funding for the "Galileo" Jupiter Orbiter–Probe (to be launched in January 1982) would be used to fabricate and test the orbiter and probe as well as the instruments. All three of these programs are slated to receive increases of about $35 million.

Smaller increases in funding are designated for development of the Shuttle/Spacelab payload and of various Explorer-type satellites. In FY 1980 NASA plans to continue study and development on several "facility-class" instruments for future Spacelab missions, according to Wash. These will include a solar optical telescope, a chemical release module, and a shuttle infrared telescope facility. Wash told us that NASA also plans to continue development of three Explorer satellites for launch in 1981. An Infrared Astronomy Satellite will survey the sky in infrared. A Solar Mesopheric Explorer will measure changes in ozone distribution in the atmosphere between 30 and 80 km above the Earth's surface and relate it to variations in solar radiation. A Dynamics Explorer mission involving two spacecraft (in separate high and low orbits) will investigate the strong interacting processes coupling the hot tenuous convective plasmas of the magnetosphere with the cooler and denser plasmas and gases co-rotating in the Earth's ionosphere, upper atmosphere and plasmasphere.

Funding for the third of the High Energy Astronomy Observatories continues to drop—not surprising in view of its launch in September of this year. This spacecraft will contain a gamma-ray spectrometer and a heavy-nuclei experiment as well as a French–Danish experiment to study the isotopic composition of primary cosmic rays. The Solar Maximum mission, scheduled for launch the following month, will also suffer an unsurprising loss of funding; this mission will investigate solar flares and related

Table 3. NASA physical sciences

(estimates in millions of dollars)	FY 1979		FY 1980	
Physics and astronomy				
High-energy astronomy observatories development	11.1		4.8	
Solar Maximum Mission development	16.2		0.6	
Space Telescope development	79.2		112.7	
International Solar Polar Mission development	13.0		50.0	
Shuttle/Spacelab payload development	34.9		41.3	
Explorer development	29.8		30.4	
Mission operations and data analysis	25.0		36.5	
Research and analysis	44.4		34.3	
Suborbital programs	29.3		26.9	
Total physics and astronomy		282.9		337.5
Planetary exploration				
Galileo Jupiter Orbiter–Probe	78.7		116.1	
Mission operations and data analysis	59.3		59.0	
Research and analysis	44.4		45.1	
Total lunar and planetary exploration		182.4		220.2