state & society

HEPAP subpanel recommends funding for three machines

The 1975 subpanel on new facilities of the High-Energy Physics Advisory Panel has recommended construction of two major new facilities during fiscal year 1977—an electron–positron colliding-beam device at the Stanford Linear Accelerator Center, and a proton–proton colliding-beam device at Brookhaven. In addition, the subpanel recommended development funding for a fixed-target accelerator that will reach 1000 GeV or more, to be built at the Fermi National Accelerator Laboratory (NAL).

The subpanel, headed by Francis E. Low of the Massachusetts Institute of Technology, met at Woods Hole, Massachusetts, during 15–21 June to undertake an updating of the 1974 Weisskopf subpanel report (see PHYSICS TODAY, September 1974, page 77), to make specific recommendations within a long-range context for fiscal year 1977 and to consider these recommendations in the light of various funding levels.

The subpanel recommended that funds be appropriated in fiscal year 1977 for three new high-energy facilities in support of a three-pronged high-energy research effort. They are:

- PEP, an electron–positron colliding-beam facility designed to operate from 5 to 18 GeV in each beam, with a luminosity of 10^{32} cm^{-2} sec^{-1} at 15 GeV, proposed by the Lawrence Berkeley Laboratory and the Stanford Linear Accelerator Center (see PHYSICS TODAY, August 1974, page 20)
- ISABELLE, proposed by Brookhaven National Laboratory, a proton–proton colliding-beam facility designed to operate from 30 to 200 GeV in each beam, with a luminosity of up to 10^{33} cm^{-2} sec^{-1} (see PHYSICS TODAY, August 1974, page 20)
- Energy Doubler/Saver, a superconducting synchrotron with alternative uses as a proton energy doubler or an electrical energy saver, designed to produce proton beams with energies up to 1000 GeV, at a rate of up to 10^{12} protons per second, proposed by NAL (see PHYSICS TODAY, July 1974, page 19).

The 1975 subpanel reaffirmed the 1974 subpanel's recommendation that PEP be authorized in 1976, and that construction of the new facility begin in 1976 if possible. If not, PEP should have highest priority in 1977. The subpanel also recommended authorization for construction of ISABELLE in 1977, and continued research and development funding for NAL's fixed-target accelerator. These recommendations are in agreement with the report of the 1974 subpanel on new facilities, headed by Victor Weisskopf of MIT. The 1975 subpanel endorsed the Weisskopf subpanel's view that "the energy frontier should be pushed forward with positron–electron colliding beams, with proton–proton colliding beams, and with a fixed-target proton accelerator of at least 1000 GeV."

LOW

The subpanel also considered a fourth proposal, an electron–positron colliding-beam facility sponsored by Cornell University, designed to operate from 4 to 8 GeV in each beam, with a luminosity of 10^{32} cm^{-2} sec^{-1} at 8 GeV. It was not recommended for funding because the Low subpanel felt that under their budgetary restraints a second electron–positron colliding-beam facility would not produce a balanced national program, in view of the pressing other needs of that program. In making this choice, the subpanel felt that the higher energy of PEP was critically important.

continued on page 72

Soaring cost of power hits high-energy accelerators

All areas of physics have felt the sting of inflation, but high-energy accelerators have been especially affected by the fastest rising cost of all—electrical energy. The increased cost of energy, together with the rising costs of labor and materials, have resulted in an underutilization of these machines.

The effects of power costs on accelerator operations are difficult to isolate, expecially at a time when all costs are rising faster than funding. The power costs represent a relatively small fraction of the budget at each of the major US accelerators: about 5% at SLAC, 13% at Brookhaven's Alternating Gradient Synchrotron (AGS), more than 15% at Argonne's Zero Gradient Synchrotron (ZGS) and at the Fermi National Accelerator Laboratory (NAL) and about 9% at the Los Alamos Meson Physics Facility (LAMPF). Yet in the last two years the cost of power at each of these installations has increased more than 30%, well above the percentage increase of costs due to other inflationary factors. (See table.)

According to William Herrmannsfeldt of the High-Energy Physics Program at ERDA, a key effect of the rising price of energy is to reduce accelerator utilization by what he called the "leverage factor." Because many items in a budget are basic costs that must be met independent of the amount of time the accelerator is actually in operation, any increases in the budget can go directly to increased running time. For example, Herrmannsfeldt estimated that a million dollars would increase the AGS budget by 4% but would boost its utilization by 12%.

The operating funds for the total high-energy physics program in terms of constant-value dollars have decreased over the past few years primarily because of inflation. Herrmannsfeldt told us that the total power bill for FY75 of $11 million is much less than the erosion in support due to inflation over the past few years. Thus power

Solar energy

continued from page 70

programs for developing solar energy as a commercially viable and environmentally acceptable energy source.

▸ Direct thermal applications, which include solar heating and cooling of buildings and the use of solar heat for agricultural and industrial purposes, are expected to become energy producers before 1985 and to increase significantly between 1985 and 2000.

▸ Solar electrical systems, which convert solar radiation to electricity, could permit the production of essentially inexhaustible electric power and are thus accorded high priority for long-term development, along with nuclear fusion and the breeder reactor. These systems have the capability of producing electricity which may be supplied to an electric utility grid or used directly. Four subprograms have been set up to utilize a variety of potential electrical sources. Wind energy conversion units are modular systems that may be mass produced in a large number of sizes. The wind-energy investigation will emphasize technical problems in large-scale experimental units (100-kW and MW scale) and systems composed of clusters of MW-scale units. The solar photovoltaic subprogram plans one- to four-megawatt demonstration plants to be in operation by the mid-1980's. Because of the high cost of this type of energy conversion, R&D emphasis will be placed on reducing systems cost by the use of automation and the lowering of materials cost. In the solar thermal electric conversion subprogram, research will be done on the central receiver and distributed collector systems used in the production of thermal and electrical energy. The research should provide information necessary for the construction of total energy systems in the 200 kW–5 MW electric range and 5–50 MW thermal range by the mid-1980's. The ocean thermal energy conversional subprogram includes research and development on components, corrosion and befouling problems and studies in environmental impacts. Critical component tests, in particular on heat exchangers and deep water pipes, may require test facilities before 1980.

▸ Fuels from so-called "biomass" is a project that involves the production of useful fuels such as methane, methanol and hydrogen from organic materials. These fuels are expected to make a major contribution to the nation's energy supply by the year 2020.

Development of the three solar-energy technologies will be supported by the Solar Energy Research Institute, a federal agency established under the Solar Energy Research, Development and Demonstration Act. ERDA will coordinate federal efforts with state and local agencies to boost widespread use of developing solar technologies.

Copies of the report are available from ERDA Technical Information Center, PO Box 62, Oak Ridge, Tennessee 37830.

HEPAP subpanel

continued from page 69

The above recommendations were understood to be contingent upon appropriations equal to the constraints given the Weisskopf subpanel ($245 million per year for operations and equipment, $50 million per year for construction in FY 1976 dollars.) The subpanel was charged with modifying their recommendations under the following funding levels, also expressed in FY 1976 dollars:

Level B: About midway between the constraints given to the Weisskopf subpanel (Level A) and those of Level C defined below ($250 million per year total)

Level C: FY 1976 total funding plus $20 million per year for construction ($190 million annually for operations and equipment, $20 million for construction)

Level D: A level that the subpanel would recommend as closer to optimum for the needs and promise of the field. (Due to time limitations, the subpanel did not attempt to put a dollar figure on this level.)

If funding were appropriated at Level B, the subpanel indicated that $50 million of the $250 million total would be allocated for construction of new facilities, and PEP and ISABELLE would proceed at the same schedule as at Level A. This would necessitate cutting back on the operations budget in order to finance the new construction, thus limiting ongoing programs. Subpanel chairman Low emphasized the vital importance of the new facilities to the growth of the US high-energy physics program. He stressed that the framework for all the recommendations of the subpanel was the hope that the physics program could move forward with colliding electrons, colliding protons, and very high energy fixed-target accelerators. Cutting back on operations and equipment in the present would be a necessary evil in order to safeguard the future of the high-energy program.

At Level C, only PEP would be authorized for construction in 1977. PEP would be given priority over ISABELLE for three reasons, according to Low: the proposal has been tested and the facility has been ready for construction for a year, interest in its research potential is extremely high and its price is moderate ($58 million for construction of PEP, compared with ISABELLE's $160 million). Low described Level C funding as "almost a disaster level" and noted that such a funding level would be a severe setback to the high-energy physics program. At Level C only research and development work could continue for ISABELLE and the Energy Doubler/Saver for the next several years.

The President's budget for the 1976 fiscal year contains appropriations for the high-energy physics program in amounts below Level C, Low pointed out, but some funds for construction of PEP may be included in the 1976 budget. The House of Representatives has appropriated $2.9 million for construction of PEP in FY 1976. PEP has been authorized by the Senate, but appropriations are still being discussed in committee. According to Low, appropriations below Level C would endanger the high-energy physics program to such an extent that "the program could not tolerate such a budget for long."

The subpanel also considered Level D, the optimum budget for the short- and long-range goals of the high-energy physics program. The subpanel noted that the US program has produced a number of fundamental discoveries, including last year's discovery of the J particle. This, the subpanel members felt, was ample justification for a budget that would include all the recommendations of Level A plus the construction of the Cornell facility in 1977. In addition, operating budgets would be increased beyond Level A, and research and development funding would be appropriated for a multi-TeV fixed-target accelerator or a multi-TeV proton–proton colliding-beam facility in or about 1980. —PD

in brief

Undergraduate Education in Science: A Rationale for Program Structure, an overview of NSF activities in this area, is available on request from Central Processing Section, NSF, Washington, D.C. 20550.

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