High Energy Physics

Program Mission

The High Energy Physics (HEP) program of the Department of Energy (DOE) has the lead responsibility for Federal support of high energy physics research and supports fundamental research activities under the mandate provided in Public Law 95-91 which established the Department. The High Energy Physics program is a key element in the Science and Technology component of the DOE Strategic Plan, supporting several of the strategies which make up that component. This program is also one of the identified elements in the Secretary's Performance Agreement with the President, and is an integral part of the Department's fundamental research mission. The program is directed at understanding the nature of matter and energy at the most fundamental level, and the basic forces which govern all processes in nature. Fundamental research provides the necessary foundation that ultimately enables the Nation to progress in its science and technology capabilities, to advance its industrial competitiveness, and to discover new and innovative approaches to our energy future.

The high quality of the research in this program is continuously evaluated through the use of merit based peer review and scientific advisory committees.

Program Goal

Provide new insights into the nature of energy and matter to better understand the natural world.

Program Objectives

- *To continue to support high quality research* — Support high quality university and laboratory based high energy physics research, both theoretical and experimental. Experimental research is primarily performed by university scientists using particle accelerators located at major laboratories in the U.S. and abroad.
- *To effectively operate the department's high energy physics accelerator facilities* — Provide optimal and cost effective operation for research of the Fermi National Accelerator Laboratory, and the Stanford Linear Accelerator Center. The Alternating Gradient Synchrotron complex at the Brookhaven National Laboratory will be transferred to the Nuclear Physics (NP) program during FY 1999.
- *To continue to provide world class research facilities* — Plan for and build new, state-of-the-art research facilities that allow researchers to advance the forefront of the science of high energy physics. Support essential improvements and upgrades at the major accelerator laboratories. Manage the commissioning of the Fermilab Main Injector project, the initial operation of the B-factory at SLAC and the continuation of the new experimental facility at Fermilab called Neutrinos at the Main Injector (NuMI).

- *To continue to provide the program's technological base* — Support long-range accelerator and detector R&D required to provide the advanced concepts and technologies which are critical to the long-range viability of high energy physics research.
- *To continue to pursue international collaboration on large high energy physics projects* — Work to put into place the management and control systems needed to successfully carry out the planned and agreed to collaboration with CERN on the Large Hadron Collider (LHC) project. Work to explore and pursue other opportunities for effective and beneficial international collaborative activities.

Scientific Facilities Utilization

The High Energy Physics request includes $439,814,000 to maintain support of the Department's scientific user facilities. This investment will provide significant research time for thousands of scientists in universities, and other Federal laboratories. It will also leverage both Federally and privately sponsored research, consistent with the Administration's strategy for enhancing the U.S. National science investment. The proposed funding will support operations at the Department's two major high energy physics facilities: the Tevatron at Fermilab, and the B-factory at the Stanford Linear Accelerator Center (SLAC), and on an incremental basis will provide support for limited operation of the Alternate Gradient Synchrotron (AGS) at the Brookhaven National Laboratory (BNL), which is primarily being operated as part of the Nuclear Physics (NP) funded Relativistic Heavy Ion Collider (RHIC) complex.

Performance Measures

Performance measures related to basic science activities are primarily qualitative rather than quantitative. The scientific excellence of the High Energy Physics program is continually reevaluated through the peer review process. Some specific performance measures are:

- Quality of scientific results and plans as indicated by expert advisory committees, recognition by the scientific community, and awards received by DOE-supported High Energy Physics researchers. The results of these reviews and other quality measures will be used to determine programmatic directions aimed at maintaining the world leadership position of the U.S. high energy physics program.
- Sustained achievement in advancing knowledge, as measured by the quality of the research based on results published in refereed scientific journals, and by the degree of invited participation at national and international conferences and workshops.
- Operation of research facilities in a manner that meets user requirements, as indicated by achieving performance specifications while protecting the safety of the workers and the environment, and by the level of endorsement by user organizations; operating facilities that are used for research at the forefront of science; and operating facilities reliably and according to planned schedules.
- Progress on the Neutrinos at the Main Injector project as measured by accomplishment of scheduled milestones; progress on achieving luminosity and operational efficiency for the B-factory at SLAC as measured by comparison with stated project goals.
- Progress on achieving luminosity and operational efficiency for the Tevatron at Fermilab in its new mode of operation with the recently completed Main Injector.

- The upgrade of scientific facilities will be managed to keep them on schedule and within cost.
- High Energy Physics will begin operating the B-factory at SLAC, the Main Injector for the Tevatron at Fermilab, and will deliver on the FY 2000 U.S./DOE commitments to the international Large Hadron Collider project.
- Review at least 80 percent of the research projects by appropriate peers and selected through a merit-based competitive process.
- Continue collaborative efforts with NASA on space science.

Significant Accomplishments and Program Shifts

- Completion of a long range planning study of the High Energy Physics program was accomplished by a Subpanel of the High Energy Physics Advisory Panel (HEPAP), (Gilman report). Their report is entitled “Planning for the Future of U.S. High-Energy Physics.” The Subpanel’s recommendations were considered carefully in preparing this budget.

Research and Technology

- Measurement, by teams of university and laboratory scientists working at Fermilab, of the mass and production properties of the top quark was accomplished. This is the last, and by far the heaviest, of the fundamental building blocks of matter (quarks) whose existence was predicted by the Standard Model of elementary particles. The mass of the top quark is now measured more accurately than any of the other quarks.
- The world’s most precise measurement was made, by a team of university and laboratory scientists working at Fermilab, of the mass of the W boson. This result is considerably more precise than the best measurement from LEP.
- The world’s highest precision single measurement was made by a group of university and laboratory scientists working at SLAC, of the weak mixing angle, a fundamental parameter of the Standard Model.
- The observation was made, by the CDF collaboration working at Fermilab, of the B meson containing a charmed quark. This discovery completes the theoretically predicted family of B mesons.
- The observation was made for the first time ever by the kTeV collaboration of the predicted decay of the kaon into a pair of pions and an electron-positron pair.
- A major advance in theoretical physics was achieved when it was shown and verified that all of the known “string” theories are equivalent. This greatly reduces the number of possible theories which describe all of the known forces including gravity.
- A test of a superconducting accelerator-style magnet fabricated at Lawrence Berkeley National Laboratory (LBNL) achieved a new world record field strength of 13.5 teslas (previous record 11 teslas.) This is a significant accomplishment in the effort to advance technology for future accelerators.
- At the g-2 experiment at BNL, designed to study the magnetic properties of the muon and to develop a more precise measurement of the anomalous magnetic moment, initial data collection has been

completed. Once data collection has been completed, the analysis of these data should become available over the next three years. The experimenters are confident that they will achieve the world's best measurement of the anomalous magnetic moment of the muon. If the final result agrees with the standard model, it will place significant new limits on physics beyond the standard model.

Facility Operations

- The final data collection with the Fermilab 800 GeV fixed-target program will be completed in FY 2000, and the prime focus of the Fermilab program will turn to research using the Tevatron collider with the higher luminosity of the new Main Injector.
- The Alternating Gradient Synchrotron at BNL will be transferred to the Nuclear Physics program for operation as the injector for the RHIC facility during the 3rd quarter of FY 1999. Beginning in FY 2000, use of the AGS for High Energy Physics experiments will be on an incremental cost basis.
- The European Center for Nuclear Research (CERN) in Geneva, Switzerland has initiated the Large Hadron Collider (LHC) project. This will consist of a 7 on 7 TeV proton-proton colliding beams facility to be constructed in the existing Large Electron-Positron Collider (LEP) machine tunnel (LEP will be removed). The LHC will have an energy 7 times that of the Tevatron at Fermilab. Thus the LHC will open up substantial new frontiers for scientific discovery.

  The Project is proceeding well. All the civil engineering contracts have been awarded and work is underway and proceeding on schedule. Work is underway for the ATLAS detector hall, for the CMS detector hall, for a beam transfer line tunnel on the Swiss side, and for a second beam transfer line tunnel together with enlargements of the main tunnel on the French side. In addition, CERN has completed approximately 700 million Swiss francs worth of contracting for the collider, which is a significant portion of the total project budget. This includes orders placed with three companies, German, Italian and French, for two full-length collider dipole magnets from each, with an option for a third.

  Participation by the U.S. in the LHC program is extremely important to U.S. High Energy Physics program goals. The LHC will become the foremost high energy physics research facility in the world around the middle of the next decade. With the LHC at the next energy frontier, American scientific research on that frontier depends on participation in LHC. The High Energy Physics Advisory Panel (HEPAP) Subpanel on Vision for the Future of High-Energy Physics (Drell) strongly endorsed participation in the LHC, and this endorsement has been restated by HEPAP on several occasions.

  The physics goals of the LHC include a search for the origin of mass as represented by the "Higgs" particle, exploration in detail of the structure and interactions of the top quark, and the search for totally unanticipated new phenomena. Although LHC will have a lower energy than the Superconducting Super Collider (canceled in 1993), it has strong potential for answering the question of the origin of mass. The LHC energies are sufficient to test theoretical arguments for a totally new type of matter. In addition, history shows that major increases in the particle energy nearly always yield unexpected discoveries.

  DOE and NSF have entered into an agreement with CERN about contributions to the LHC accelerator and detectors as part of the U.S. participation in the LHC program to provide access for U.S. scientists to the next decade's premier high energy physics facility. The resulting agreements were approved by CERN, the DOE and the NSF and were signed in December of 1997.

Participation in the LHC project (accelerator and detectors) at CERN will primarily take the form of the U.S. accepting responsibility for designing and fabricating particular subsystems of the accelerator and of the two large detectors. Thus, much of the funding will go to U.S. laboratories, university groups, and industry for fabrication of subsystems and components which will become part of the LHC accelerator or detectors. A portion of the funds will be used to pay for purchases by CERN of material needed for construction of the accelerator. As a result of the negotiations, CERN has agreed to make these purchases from U.S. vendors.

The agreement provides for a U.S. DOE contribution of $450,000,000 to the LHC accelerator and detectors over the period FY 1996 through FY 2004 (with approximately $81,000,000 being provided by the NSF). The DOE contribution is broken down as follows: detectors $250,000,000; accelerator $200,000,000 (including $90,000,000 for direct purchases by CERN from U.S. vendors and $110,000,000 for fabrication of components by U.S. laboratories).

The total cost of the LHC on a basis comparable to that used for U.S. projects is estimated at about $6,000,000,000. Thus the U.S. contribution represents less than 10 percent of the total. (The LHC cost estimates prepared by CERN, in general, do not include the cost of permanent laboratory staff and other laboratory resources used to construct the project.) Neither the proposed U.S. DOE $450,000,000 contribution nor the estimated total cost of $6,000,000,000 include support for the European and U.S. research physicists working on the LHC program.

The agreement negotiated with CERN provides for U.S. involvement in the management of the project through participation in key management committees (CERN Council, CERN Committee of Council, LHC Board, etc.). This will provide an effective base from which to monitor the progress of the project, and will help ensure that U.S. scientists have full access to the physics opportunities available at the LHC. The Office of Science has conducted a cost and schedule review of the entire LHC project and similar reviews of the several proposed U.S. funded components of the LHC. All of these reviews concluded the costs are properly estimated and that the schedule is feasible.

In addition to the proposed U.S. DOE $450,000,000 contribution and $81,000,000 NSF contribution to the LHC accelerator and detector hardware fabrication, U.S. participation in the LHC will involve a significant portion of the U.S. High Energy Physics community in the research program at the LHC. This physicist involvement has already begun. Over 500 U.S. scientists have joined the U.S.-ATLAS detector collaboration, the U.S.-CMS detector collaboration, or the U.S.-LHC accelerator consortium, and are hard at work helping to design the initial physics research program to be carried out at the LHC helping to specify the planned physics capabilities of the LHC accelerator and detectors, and helping to design and fabricate accelerator and detector components and subsystems.

Fabrication of LHC subsystems and components by U.S. participants began in FY 1998. Funding was provided in FY 1996 ($6,000,000) and FY 1997 ($15,000,000) for preliminary R&D, design and engineering work on the subsystems and components being proposed for inclusion in the agreement with CERN. This funding was essential in order to provide the cost and technical bases for the proposed U.S. responsibilities in LHC, and to be ready for rapid start to satisfy the anticipated timetable for the project. Funding in the amount of $35,000,000 was provided in FY 1998, $65,000,000 will be provided in FY 1999, and $70,000,000 in FY 2000 to support continuation of these R&D and design efforts, and the continuation of fabrication of those subsystems and components specified in the agreements with CERN.

The planned U.S. funding for the LHC project is summarized below.

U.S. LHC Accelerator and Detector Funding

(dollars in thousands)

Fiscal Year	Department of Energy			National Science Foundation[a]
	Accelerator	Detector	Total	
1996 [b]	2,000	4,000	6,000	0
1997 [b]	6,670	8,330	15,000	0
1998 [b]	14,000	21,000	35,000	0
1999	29,740	35,260	65,000	22,150
2000	31,200	38,800	70,000	15,900
2001	32,060	37,940	70,000	16,370
2002	31,200	38,800	70,000	16,860
2003	29,000	36,000	65,000	9,720
2004	24,130	29,870	54,000	0
Total	200,000 [c]	250,000	450,000	81,000

This estimated annual funding profile is based on the needs of the LHC project and is consistent with flat out year funding for the High Energy Physics program. The profile is subject to change as additional planning detail is derived. The total of $450,000,000 from DOE for the project is firm.

Construction

- The Fermilab Main Injector Project is proceeding well and is within the planned cost and schedule profiles. All relevant milestones have been met. At the end of FY 1998, the construction phase of the project was nearly complete and commissioning was underway.
- The C-Zero Experimental Hall project at Fermilab will provide a new underground experimental area at the C-Zero location on the Tevatron ring. When completed in FY 1999, this will provide space for a new program of fixed target and modest sized collider experiments now being planned at Fermilab.
- The B-factory Project at SLAC will be completed within the planned cost and schedule profiles. At the end of FY 1998, the project was essentially complete and commissioning was underway. The physics research program, using the BaBar detector will begin during FY 1999.
- The Wilson Hall Safety Improvements Project is proceeding well. An economical, safe and effective method for repairing the structural beams has been developed and detailed planning and contracting is underway.

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[a] The NSF funding has been approved by the National Science Board.

[b] The FY 1996 and FY 1997 funding was for R&D, design and engineering work in support of the proposed U.S. participation in LHC. Beginning in FY 1998 funding was used for: fabrication of machine and detector hardware, supporting R&D, prototype development, and purchases by CERN from U.S. vendors.

[c] Includes $110,000,000 for LHC supporting R&D and accelerator components to be fabricated by U.S. laboratories and $90,000,000 for purchases by CERN from U.S. vendors.

Funding of Contractor Security Clearances

In FY 1999, the Department divided the responsibility for obtaining and maintaining security clearances. The Office of Security Affairs, which was responsible for funding all Federal and contractor employee clearances, now pays only for clearances of Federal employees, both at headquarters and the field. Program organizations are now responsible for contractor clearances, using program funds. This change in policy enables program managers to make the decisions as to how many and what level clearances are necessary for effective program execution. In this way, it is hoped that any backlog of essential clearances which are impeding program success can be cleared up by those managers most directly involved. The Office of Science is budgeting $373,000 and $270,000 for estimated contractor security clearances in FY 1999 and FY 2000, respectively, within this decision unit.

Funding Profile

(dollars in thousands)

	FY 1998 Current Appropriation	FY 1999 Original Appropriation	FY 1999 Adjustments	FY 1999 Current Appropriation	FY 2000 Request
High Energy Physics					
Research and Technology	209,128	215,865	-974	214,891	227,190
Facility Operations	408,612	459,635	0	459,635	441,200
Subtotal, High Energy Physics	617,740	675,500	-974	674,526	668,390
Construction	50,850	21,000	0	21,000	28,700
Subtotal, High Energy Physics	668,590	696,500	-974	695,526	697,090
Use of Prior Year Balances	-1,851 [a]	-1,610 [a]	0	-1,610 [a]	0
General Reduction	0	-974	+974	0	0
Total, High Energy Physics	666,739 [b]	693,916	0	693,916	697,090

Public Law Authorization:

Public Law 95-91, “Department of Energy Organization Act”

[a] Share of Science general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.

[b] Excludes $12,833,000 which has been transferred to the SBIR program and $770,000 which has been transferred to the STTR program.

Funding by Site

	(dollars in thousands)				
	FY 1998	FY 1999	FY 2000	$ Change	%Change
Albuquerque Operations Office					
Los Alamos National Laboratory	1,090	650	790	+140	+21.5%
Chicago Operations Office					
Ames Laboratory	0	0	219	+219	+100.0%
Argonne National Laboratory	9,512	8,825	9,040	+215	+2.4%
Brookhaven National Laboratory	86,774	62,813	32,769	-30,044	-47.8%
Fermi National Accelerator Laboratory	278,873	283,301	291,788	+8,487	+3.0%
Princeton Plasma Physics Laboratory . .	80	120	534	+414	+345.0%
Total, Chicago Operations Office	375,239	355,059	334,350	-20,709	-5.8%
Oakland Operations Office					
Lawrence Berkeley National Laboratory	26,869	24,492	35,532	+11,040	+45.1%
Lawrence Livermore National Laboratory	1,794	685	680	-5	-0.7%
Stanford Linear Accelerator Center	147,502	145,017	150,231	+5,214	+3.6%
Total, Oakland Operations Office	176,165	170,194	186,443	+16,249	+9.5%
Oak Ridge Operations Office					
Oak Ridge Institute for Science Education	230	100	489	+389	+389.0%
Oak Ridge National Laboratory	772	240	240	0	0.0%
Total, Oak Ridge Operations Office	1,002	340	729	+389	+114.4%
Richland Operations Office					
Pacific Northwest National Laboratory . .	10	10	10	0	0.0%
All Other Sites [a]	115,084	169,273	174,768	+5,495	+3.2%
Subtotal, High Energy Physics	668,590	695,526	697,090	+1,564	+0.2%
Use of prior year balances	-1,851 [b]	-1,610 [b]	0	+1,610 [b]	+100.0%
Total, High Energy Physics	666,739 [c]	693,916	697,090	+3,174	+0.5%

[a] Funding provided to universities, industry, other federal agencies and other miscellaneous contractors.

[b] Share of Science general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.

[c] Excludes $12,833,000 which has been transferred to the SBIR program and $770,000 which has been transferred to the STTR program.

Site Description

Ames Laboratory

Ames Laboratory is a Mulitiprogram Laboratory located on 10 acres in Ames, Iowa. Educational activities supported at the laboratory are directed towards providing opportunities for pre-college teachers that will participate directly in cutting-edge research at DOE science laboratories, and will renew their understanding of scientific investigation.

Argonne National Laboratory

Argonne National Laboratory in Argonne, Illinois, is a Multiprogram Laboratory located on a 1,700 acre site in suburban Chicago. ANL has a satellite site located in Idaho Falls, Idaho. High Energy Physics supports a program of physics research and technology R&D at ANL, using unique capabilities of the laboratory in the areas of accelerator R&D techniques and participation in the CDF and MINOS detector collaborations.

Brookhaven National Laboratory

Brookhaven National Laboratory is a Multiprogram Laboratory located on a 5,200 acre site in Upton, New York. High Energy Physics supports a program of physics research and technology R&D at BNL, using unique capabilities of the laboratory, including the Accelerator Test Facility and the capability for precision experimental measurement. High Energy Physics also makes limited use of the Alternating Gradient Synchrotron which is principally supported by the Nuclear Physics program.

Fermi National Accelerator Laboratory

Fermi National Accelerator Laboratory is a program-dedicated laboratory (High Energy Physics) located on a 6,800 acre site in Batavia, Illinois. Fermilab operates the Tevatron accelerator and colliding beam facility which consists of a four mile ring of superconducting magnets and is capable of accelerating protons and antiprotons to one TeV. Thus the Tevatron is the highest energy particle accelerator in the world, and has a unique capability for research at the energy frontier. Fermilab, together with SLAC, constitute the principal experimental facilities of the DOE High Energy Physics program.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory is a Multiprogram Laboratory located in Berkeley, California. The Lab is on a 200 acre site adjacent to the Berkeley campus of the University of California. High Energy Physics supports a program of physics research and technology R&D at LBNL, using unique capabilities of the laboratory primarily in the areas of participation in the BaBar collaboration, expertise in superconducting magnet R&D, and expertise in design of forefront electronic devices.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory is a Multiprogram Laboratory located on a 821 acre site in Livermore, California. High Energy Physics supports a program of physics research and technology R&D at LLNL, using unique capabilities of the laboratory primarily in the area of advanced accelerator R&D and participation in the B-factory project.

Los Alamos National Laboratory

Los Alamos National Laboratory is a Multiprogram Laboratory located on a 27,000 acre site in Los Alamos, New Mexico. High Energy Physics supports a program of physics research and technology R&D at LANL, using unique capabilities of the laboratory primarily in the area of theoretical studies, and computational techniques for accelerator design.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education is located on a 150 acre site in Oak Ridge, Tennessee. The High Energy Physics program supports a small effort at ORISE in the area of program planning and review.

Oak Ridge National Laboratory

Oak Ridge National Laboratory is a Multiprogram Laboratory located on a 24,000 acre site in Oak Ridge, Tennessee. The High Energy Physics program supports a small research effort using unique capabilities of ORNL primarily in the area of particle beam shielding calculations.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory is a Multiprogram Laboratory located on 640 acres at the Department's Hanford site in Richland, Washington. The High Energy Physics program supports a small research effort using unique capabilities of PNNL in the area of low background experiments.

Princeton Plasma Physics Laboratory

Princeton Plasma Physics Laboratory is a program-dedicated laboratory (Fusion Energy Sciences) located on 72 acres in Princeton, New Jersey. The High Energy Physics program supports a small research effort using unique capabilities of PPPL in the area of advanced accelerator R&D.

Stanford Linear Accelerator Center

Stanford Linear Accelerator Center is a program-dedicated laboratory (High Energy Physics) located on 426 acres in Menlo Park, California. SLAC operates for High Energy Physics the newly completed B-factory, the SLAC Linear Collider with the Stanford Large Detector, and a program of fixed target experiments. All of these facilities make use of the two mile long linear collider, or linac. SLAC, together with Fermilab, constitute the principal experimental facilities of the DOE High Energy Physics program.

All Other Sites

The High Energy Physics program funds research at 106 colleges/universities located in 38 states. This line also includes funding of research awaiting distribution pending completion of peer review results or program office detailed planning.

Research and Technology

Mission Supporting Goals and Objectives

The High Energy Physics program has two major subprograms. The Research and Technology subprogram provides support for the scientists who perform the research which is the core of the program, and the technology R&D, which is essential to maintain the accelerator and detector facilities at the cutting edge required for a successful research program. The Facility Operations subprogram, described later, provides the large facilities — accelerators, detectors, colliding beams devices — needed for the research program.

The Physics Research category in the Research and Technology subprogram provides support for university and laboratory based research groups conducting experimental and theoretical research in high energy physics. This research probes the nature of matter and energy at the most fundamental level, and the characteristics of the basic forces in nature. Experimental research activities include: planning, design, fabrication and installation of experiments; conduct of experiments; analysis and interpretation of data; and publication of results. Theoretical physics research provides the framework for interpreting and understanding observed phenomena and, through predictions and extrapolations based on current understanding, identifies key questions for future experimental explorations. This subprogram supports research groups at more than 100 major universities and at 9 DOE laboratories.

The High Energy Technology category in the Research and Technology subprogram provides the specialized advanced technology R&D required to sustain and extend the technology base and provide operational support for the highly specialized accelerators, colliding beams facilities, and detector facilities which are essential to the overall high energy physics program goal of carrying out forefront research. The objectives of this category include: 1) carry out R&D in support of existing accelerator and detector facilities aimed at maintaining and improving their performance parameters and cost effectiveness; 2) carry out R&D in support of planned and proposed projects to maximize their performance goals and cost effectiveness; 3) carry out R&D to transfer new concepts and technologies into practical application in the High Energy Physics context; and 4) carry out R&D to search for and develop new concepts and ideas which could lead to significant enhancements of research capabilities or to significant cost savings in the construction and operation of new facilities. This category supports work primarily at the DOE labs, but also at universities, other federal labs, and in industry.

The High Energy Physics program will provide opportunities for pre-college teachers that will participate directly in cutting-edge research at DOE science laboratories, and will renew their understanding of scientific investigation. Where teachers do not possess sufficient background to participate directly in research, DOE will provide mediated research experiences where teachers can work with teams of scientists and science educators to understand the nature of DOE's scientific research. The goal is to provide educators with the tools to sharpen their science and math foundations and apply these tools to their classroom practice. Funds will be provided to pay for teachers' stipends, travel, housing and subsidize laboratory scientists' time for this activity ($2,921,000).

Funding Schedule

	(dollars in thousands)				
	FY 1998	FY 1999	FY 2000	$ Change	% Change
Physics Research	143,592	145,835	159,650	+13,815	+9.5%
High Energy Technology	65,536	69,056	67,540	-1,516	-2.2%
Total, Research and Technology	209,128	214,891	227,190	+12,299	+5.7%

Detailed Program Justification

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Physics Research			
■ **Fermilab:** In FY 2000 the experimental physics research groups at Fermilab will be working on completing and bringing into operation the upgraded CDF and D-Zero facilities, completing a fixed target run, analyzing data from recent experimental data taking runs, and preparing for future experiments including participation in the CMS detector for LHC. The theoretical research group and the theoretical astrophysics group will be working on a variety of theoretical topics.	10,415	8,826	9,240
■ **SLAC:** The experimental physics research groups at SLAC will concentrate their efforts in FY 2000 on the physics analysis and interpretation of the large amounts of data taken with the SLC Large Detector (SLD) detector in prior years, and on early data-taking with the recently commissioned BaBar detector facility and B-factory. Some physics research will also be done in a fixed target experiment studying parity violation, and with the CLEO detector at the Cornell Electron Storage Ring (CESR) facility at Cornell. The theoretical physics group will continue to emphasize topics related to the SLD, BaBar, and Next Linear Collider (NLC) research programs as well as tests of the Standard Model and Quantum ChromoDynamics (QCD).	11,411	12,027	12,441
■ **BNL:** In FY 2000, the BNL experimental physics research groups will be working on experiments at the BNL-AGS involving precision measurements of the muon magnet moment, and rare decays of the K meson; on the Fermilab collider experiment D-Zero probing the high energy frontier; and on the U.S. effort on the Large Hadron Collider ATLAS detector. The Theoretical physics research groups will be working on a number of topics.	7,662	7,690	8,226

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **LBNL:** In FY 2000, LBNL researchers will be analyzing data recently taken at the collider detectors and at fixed target experiments at Fermilab, and will be preparing for studies of B-Bbar decays using the BaBar detector on the B-factory at SLAC. The researchers will also be working on supernova measurements to establish values for cosmological parameters. Recent results indicate the universe may be expanding at an increasing rate. The Particle Data Group at LBNL continues as an international clearinghouse for particle physics information.	10,375	10,498	11,033
■ **ANL:** The experimental high energy physics group will continue collaborating in research on the CDF at Fermilab, and ZEUS at the DESY/HERA facility in Hamburg, Germany. They also will be working on the fabrication of two major new detector facilities: the ATLAS detector for future use at CERN's LHC facility, and the MINOS detector at the Soudan site in Minnesota. The MINOS detector is part of the NuMI project and will use a neutrino beam from Fermilab. The theoretical physics group will continue their research in formal theory, collider phenomenology, and lattice gauge calculations.	5,489	5,465	5,465
■ **Universities and Other Laboratories:** The University Program consists of groups at 100 universities doing experiments (77 universities) and theory (75 universities). These university groups plan, build, execute, analyze and publish results of experiments, train graduate students and post-docs; and provide theoretical concepts, simulations and calculations of physical processes involved in high energy physics. Provides support for research scientists at LANL, LLNL, ORNL, and PNNL. This University and small laboratory (LANL, LLNL, ORNL, PNNL) based research activity is described in more detail below. The recent HEPAP Subpanel (Gilman), recommended that the level of funding for the university based portion of the program be substantially increased over inflation over the next two year period. The funding detailed below includes funding for 3.5 percent over inflation providing more than half of the recommended first year increase. These increases are aimed at improving the research capabilities and operational effectiveness of these (primarily) university based research groups.			

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
▸ **University and other laboratory based Research using Fermilab:** Some 55 DOE-funded universities participate in large international collaborations doing experiments at Fermilab. LLNL is also involved in the MINOS project. These experiments involve the CDF and D-Zero collider detectors, and the KTEV, FOCUS, MINOS, DONUT, and HYPER-CP experiments using external beams of kaons, photons, neutrinos and hyperons. Other experiments are performed in the antiproton accumulator. These universities help to fabricate the detectors, plan and execute the experiments, analyze data and publish the results. The participation has been and is expected to remain about constant, as fixed target 800 GeV experiments diminish and CMS, MINOS, and BTeV related activities increase.	24,905	25,170	26,940
▸ **University and other laboratory based Research using SLAC:** Some 27 DOE–funded universities participate in large international collaborations doing experiments at SLAC. LLNL is also involved in the BaBar detector project. The experiments involve the SLD and BaBar detectors, and other smaller detectors for fixed target experiments. These universities help to build the detectors, plan and carry out experiments, analyze the data and publish the results. The participation has been and is expected to remain about constant, as SLD diminishes, BaBar flourishes, and work on a future large linear collider continues.	9,960	10,360	11,400
▸ **University based Research using BNL:** Some 10 DOE-funded universities participate in collaborative experiments at BNL. These experiments involve fixed targets and kaon or pion beams, colliding beams of protons (RHIC-SPIN) or nuclei (PHOBOS) at RHIC, and external storage rings measuring the muon anomalous magnetic moment to high precision. This participation has decreased significantly due to the phasing out of most of the AGS High Energy Physics program.	3,980	2,960	2,070

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
▸ **University based Research using the Cornell Electron Storage Rings:** Some 11 university High Energy Physics groups with DOE funding participate in the electron-positron colliding beam experiments at Cornell's CESR facility utilizing the collaboratively built CLEO detector. They help to plan, build, execute, analyze and publish the experiments. This participation has been decreasing, as some groups move to BaBar at SLAC.	4,980	4,440	4,145
▸ **University and other laboratory based Research not using accelerators:** Some 28 DOE-funded universities are involved in High Energy Physics experiments not utilizing accelerators. LANL, LLNL and PNNL are also involved in non-accelerator experiments. These experiments, which are primarily in the areas of astrophysics and cosmology, include MACRO (Italy), Super-Kamiokande (Japan), SNO (Canada), CHOOZ (France), SOUDAN (Minnesota), CDMS (Stanford), GRANITE (Mt. Hopkins, Arizona), Palo Verde (Arizona) and AMS (Space Station). They help build the detectors, plan, execute, analyze and publish the results. This participation has increased and is expected to increase further due to the newly emerging interest and opportunities in astrophysics and cosmology, such as GLAST, AUGER and CDMS (Soudan). The funding includes an increase of $1,800,000 for the fabrication of underground detectors such as those listed above. The allocation of these funds will be decided on the basis of a peer review process which is presently underway.	12,950	15,300	18,115
▸ **University and other laboratory Theoretical Studies:** Some 75 universities with DOE funding participate in research in theoretical high energy physics. Theoretical studies at LANL are also included here. This effort is expected to remain about constant. They provide theoretical ideas, concepts, calculations and simulations of physical processes in high energy physics.	18,920	19,250	20,720

	FY 1998	FY 1999	FY 2000
	(dollars in thousands)		
▸ **University based Research using Foreign Labs:** Universities funded by the DOE are doing experiments with international collaborations using facilities at foreign accelerator labs. Some 45 universities are conducting experiments at CERN (Switzerland), 11 at DESY (Germany), 10 at KEK (Japan), 1 at IHEP (Russia), 1 at BINP (Russia), and 2 at Beijing (China). They help to fabricate the detectors and experimental apparatus, plan and execute the experiments, analyze the data and publish the results. The participation has increased and is expected to increase further with the participation in the ATLAS and CMS detectors at CERN's LHC. The funding includes an increase of $1,000,000 to address technical infrastructure needs, such as technical staff and computers, related to research operations at foreign laboratories.	20,925	22,700	26,930
▸ **Other University and other laboratory based Research activities:** A new focussed program in Detector R&D, recommended by the HEPAP Subpanel, was started modestly in FY 1999, will be continued and expanded slightly ($1,000,000). The Outstanding Junior Investigator program, which is intended to identify and provide support for highly promising investigators at an early stage in their careers, will continue at a level of about $400,000 in new awards per year. A new educational program, Quark-Net, aimed at involving high school students and teachers in high energy physics research, will be started in FY 1999 and will continue at $250,000. The accelerator and beamline shielding studies carried out at ORNL are included here. Funding of conferences, studies, and workshops is also included here. The funding includes an increase of $500,000 to increase the capability of the computer network link to CERN and an increase of $750,000 for anticipated but unknown needs or opportunities which is not yet allocated.	1,620	1,149	2,925
Total, Universities and Other Laboratories	98,240	101,329	113,245
Total, Physics Research	143,592	145,835	159,650

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
High Energy Technology			
■ **Fermilab:**			
▸ **Accelerator R&D:** Activities in FY 2000 include design of an improved proton source; design of an electron cooling system to improve antiproton beam quality: construction of a large-scale experiment to test the concept of ionization cooling, which is critical for any future muon collider; R&D on superconducting magnets and other components for future 100 TeV proton colliders; and tests of accelerating electrons with plasma wake-fields driven by intense electron beams. Muon collider R&D, with a high priority in the National High Energy Physics program, will increase in FY 2000. The proposed funding provides an approximately constant level of effort, except for the increase to permit the critical muon collider experiment to proceed.	9,221	7,670	8,670
▸ **Experimental Facilities R&D:** Activities in FY 2000 include: R&D on the feasibility of reducing the cell size in the CDF detector wire chamber to accommodate the higher track density that will result from increasing the Tevatron collider event rate; developing scintillating fibers for the D–Zero detector that are capable of withstanding the increased radiation level resulting from the increased collision rates; R&D on radiation-hard materials such as diamond and silicon carbide to replace silicon micro strip detectors at high collision rates; R&D on specialized electronics for high event rates in numerous, high-density data channels; and developing parallel computing configurations, high speed networks, and high-capacity data storage systems for high data rates. The proposed funding provides a slightly decreasing level of effort.	8,700	6,670	6,670
Total, Fermilab	17,921	14,340	15,340

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **SLAC:**			
▸ **Accelerator R&D:** Activities in FY 2000 include R&D to explore new concepts in accelerator physics in support of design of future linear colliders. The R&D on the design for a linear collider to operate with TeV scale center of mass energy will be reduced to $12,000,000 in FY 2000. Relevant areas are high powered radio frequency systems, accelerator structures, controls and instrumentation, and advanced beam optics. This R&D and design activity is being done in the context of an international collaboration. R&D in support of the B-factory, commissioned in FY 1999, will continue at a significant level to ensure a strong luminosity performance in the initial data run for physics research. The R&D programs in generic collider R&D will continue, and the program in advanced accelerator physics looking at the use of lasers, plasmas, and ultra high frequency radio frequency systems, will be given slightly increased priority.	14,651	16,500	11,900
▸ **Experimental Facilities R&D:** In FY 2000, the focus will be on instrumentation for physics studies in the center of mass collision energy range of 50 GeV to 5,000 GeV. This will include work to support and improve performance of BaBar, the newly operating B-factory detector, and an expanded program of R&D, consistent with the recommendations of the HEPAP Subpanel, on developing preliminary designs for a detector to operate with a new electron-positron linear collider operating at the TeV center of mass energy scale.	1,545	2,500	2,900
Total, SLAC	16,196	19,000	14,800

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **BNL:**			
▸ **Accelerator R&D:** Activities in FY 2000 will include, R&D on new methods of particle acceleration such as laser acceleration and Free Electron Laser (FEL) accelerators, primarily using the excellent capabilities of the BNL Accelerator Test Facility. R&D on the muon collider concept will be expanded and will include design work on key system components including the high field solenoid and the dipole magnets. In the BNL superconductor test facility the characterization of new high critical temperature superconductors as well as their special requirements for magnet fabrication should be better understood. With the transfer of the AGS to the Nuclear Physics program during FY 1999, Accelerator R&D in support of the AGS is being brought to an orderly close.	5,570	5,045	5,155
▸ **Experimental Facilities R&D:** In FY 2000, semiconductor drift photo diodes for detection of photons of energies as low as 50 eV will be designed and produced. Development of radiation hardened monolithic electronics for a number of experiments will continue. Development of lead-wolfrate crystals with improved light output will continue. Testing of the modules that constitute the ATLAS barrel calorimeters will begin.	3,065	1,075	1,075
Total, BNL	8,635	6,120	6,230
■ **LBNL:**			
▸ **Accelerator R&D:** LBNL is a major contributor to accelerator and superconducting magnet R&D for advanced accelerator concepts, including the muon collider and the next linear collider. Development of these concepts is needed to advance the energy and luminosity frontiers to better understand the structure of matter. LBNL has a major role in designing, building, and testing the Low Energy Ring at the B-factory. In FY 1999, the B-factory will be fully commissioned. In FY 2000, preparations for muon cooling experiments, needed to confirm the practicality of a muon collider, will begin at Fermilab, using components developed at LBNL. The high-gradient, all-optical, laser-plasma wakefield accelerator at LBNL will begin accelerating electron bunches.	6,935	6,905	7,565

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
▸ **Experimental Facilities R&D:** LBNL leads in providing custom state-of-the-art electronics, such as silicon vertex detectors, integrated circuit (IC) systems, and other components for high-energy particle detectors such as BaBar at the B-factory and the upgrades to CDF and D–Zero for the next, higher luminosity, runs at Fermilab. LBNL is also involved in developing computer programs for experimental data taking and analysis. In FY 2000, work will continue on large format CCDs and high-resolution imaging systems, plus the production and testing of IC systems.	2,620	2,670	2,670
Total, LBNL	9,555	9,575	10,235
■ **ANL:**			
▸ **ANL Accelerator R&D:** R&D will continue on the acceleration of electrons using structures with plasmas or structures made of dielectric materials called wakefield accelerators. Using this new technique, accelerating gradients at one-third of conventional levels have been reached. Thus there is optimism that the much higher gradient predicted by theory can be achieved. Planning will be underway for an upgraded experimental facility which could generate much higher gradients. In addition, work will be undertaken on muon collider R&D as recommended by the HEPAP Subpanel.	1,135	1,130	1,305
▸ **Experimental Facilities R&D:** In FY 2000 work will be underway on the MINOS detector, the ATLAS detector for the LHC, and a possible upgrade of the ZEUS detector at DESY.	900	920	920
Total, ANL	2,035	2,050	2,225

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **Universities, Other Laboratories, and Other Contractors:**			
▸ **University Program:** The funding will provide for a program of high priority technology R&D relevant to the development of particle accelerators. The R&D is aimed at breakthrough technologies; superconductors for high-field magnets; laser and collective-effect accelerator techniques; novel, high-power radio frequency generators; theoretical studies in particle beam physics, including the non-linear dynamics of particle beams; and at lowering the cost and improving the performance of future experiments and facilities. This element also includes the portion of the increased funding for R&D on future facility concepts as summarized in the table below which has not yet been allocated. Discussions and peer reviews are underway to design an optimum overall program and to identify and fund key activities. In FY 1998 $770,000 was transferred to the STTR program. Additional funding for the SBIR program is contained in the Facility Operations subprogram.	11,194	17,971	18,710
Total, High Energy Technology	65,536	69,056	67,540
Total, Research and Technology, ...	209,128	214,891	227,190

Explanation of Funding Changes from FY 1999 to FY 2000

	FY 2000 vs. FY 1999 ($000)
■ **Physics Research**	
▸ An increase in the base funding for the university program as recommended by the HEPAP.	+6,475
▸ An increase in the funding for the fabrication of non accelerator experiments as recommended by the HEPAP.	+1,800
▸ An increase to initiate an expanded program of detector R&D as recommended by the HEPAP.	+600
▸ An increase to provide for additional R&D to address the computing and networking needs of the new generation of detectors.	+1,500
▸ Initiation of an education program at National Laboratories.	+2,921

	FY 2000 vs. FY 1999 ($000)
▸ An increase in the funds held for allocation pending completion of planning and peer review activities.	+519
Total, Physics Research	+13,815
■ **High Energy Technology**	
▸ An increase in the funding for muon collider R&D at Fermilab	+1,000
▸ A decrease in the funding for NLC R&D at SLAC.	-5,000
▸ An increase in other Technology R&D at SLAC.	+800
▸ An increase in the funding for muon collider R&D at BNL.	+980
▸ Termination of the program of accelerator R&D at the AGS.	-870
▸ An increase in the funding of muon collider R&D at LBNL.	+660
▸ An increase in the funding for muon collider R&D at ANL.	+175
▸ An increase in the base funding for the advanced accelerator R&D program.	+620
▸ An increase in the funding held for allocation pending completion of planning and peer review activities.	+119
Total, High Energy Technology	-1,516
Total Funding Change, Research and Technology	+12,299

The following table summarizes the above changes for possible future HEP facilities:

	(dollars in millions)		
	FY 1998	FY 1999	FY 2000
Next Linear Collider	10.0	17.0	12.0
Muon-Muon Collider	4.5	5.5	8.2
Very Large Hadron Collider	2.5	3.0	3.0

Facility Operations

Mission Supporting Goals and Objectives

The Facility Operations subprogram includes the provision and operation of the large accelerator and detector facilities which are the essential tools that enable scientists in university and laboratory based research groups to perform experimental research in high energy physics. This subprogram includes funding for the operation and maintenance of the national laboratory research facilities including accelerators, colliders, secondary beam lines, detector facilities for experiments, experimental areas, computing, and computing networking facilities. It includes the costs of detector and accelerator components, personnel, electric power, expendable supplies, replacement parts and subsystems, inventories and, at Fermilab and SLAC, waste management activities. General Plant Projects (GPP) funding is provided for minor new construction, other capital alterations and additions, and for buildings and utility systems. Landlord General Purpose Equipment (GPE), and GPP funding for Lawrence Berkeley National Laboratory, Fermi National Accelerator Laboratory and Stanford Linear Accelerator Center are also included. Accelerator Improvement Projects (AIP) funding support for additions and modifications to accelerator facilities which are supported by the High Energy Physics research program is also included.

The principal objective of the Facility Operations subprogram is to maximize the quantity and quality of data collected for approved experiments being conducted at the High Energy Physics facilities. The ultimate measure for success in the Facility Operations subprogram is whether the research scientists have data of sufficient quantity and quality to do their planned measurements or to discover new phenomena. The quality of the data is dependent on the accelerator and detector capabilities, and on the degree to which those capabilities are achieved during a particular operating period. The quantity of the data relates primarily to the beam intensity, the length of the operating periods, and the operational availability of the accelerator and detector facilities.

Performance Measures

- Progress on achieving luminosity and operational efficiency for the B-factory at SLAC as measured by comparison with stated project goals.
- Progress on achieving luminosity and operational efficiency for the Tevatron at Fermilab in its new mode of operation with the recently completed Main Injector.
- High Energy Physics will begin operating the B-factory at SLAC, the Main Injector for the Tevatron at Fermilab.

Planned Accelerator Operations

(in weeks)

	FY 1998	FY 1999	FY 2000
Fermilab	13	38	29
SLAC	33	42	39
BNL	12	14	8

Funding Schedule

	(dollars in thousands)				
	FY 1998	FY 1999	FY 2000	$ Change	% Change
Fermi National Accelerator Laboratory	191,195	210,145	212,743	+2,598	+1.2%
Stanford Linear Accelerator Center	107,745	111,290	118,290	+7,000	+6.3%
Brookhaven National Laboratory	59,367	42,882	5,347	-37,535	-87.5%
Universities and Other Laboratories	10,345	25,408	29,910	+4,502	+17.7%
Large Hadron Collider	35,000	65,000	70,000	+5,000	+7.7%
Waste Management	4,960	4,910	4,910	0	0.0%
Total, Facility Operations	408,612	459,635	441,200	-18,435	-4.0%

Detailed Program Justification

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Fermilab			
Provides support for operation, maintenance, improvement, and enhancement of the Tevatron accelerator and detector complex. This complex includes the Tevatron, which can operate in a collider mode with protons and anti-protons, or in a fixed target mode with protons only; the new Main Injector which will be completed and commissioned in FY 1999; the Booster; the Linac; and the Anti-proton Source and Accumulator. The Tevatron collider and the 800 GeV fixed target modes are mutually exclusive; however, a fixed target program at 120 GeV using the new Main Injector is possible in parallel with Tevatron collider operation. This complex also includes the two large colliding beams detectors – CDF and D-Zero – and a number of fixed target experiments in the external beams areas.			
■ **Accelerator Operation:** In FY 2000, the upgraded Tevatron complex will be operated for about 6 weeks ending a fixed target run begun in FY 1999. This will be followed by 8 weeks of commissioning of the Main Injector and 15 weeks of operation of the Tevatron in collider mode with the higher luminosity available from the newly completed Main Injector. The funds requested will provide for the operation of the Tevatron, the Main Injector, the Booster, the Linac and the antiproton source as needed. The reduction in capital expenditures resulting from the completion of the CDF and D-Zero detector upgrade projects is partially offset by the planned increase for the MINOS Detector.	116,910	126,535	126,333

	FY 1998	FY 1999	FY 2000
(dollars in thousands)			
■ **Experimental Facility Operations:** In FY 2000, the upgrades of the CDF and the D-Zero detectors will be completed and the upgraded detectors will be brought into operation. In addition, the funding will support the active experiments in the completion of the fixed target run. The funding will also be used to provide the computing resources needed for the analysis of existing data and the planning and design of future experiments.	74,285	83,610	86,410
Total, Fermilab	191,195	210,145	212,743

Tevatron Operation

(in weeks)	FY 1998	FY 1999	FY 2000
Fixed Target	0 [a]	22	6
Collider	0 [a]	0	15
Commissioning	13	16	8
Total, Tevatron Operation	13	38	29

SLAC

Provides for the operation, maintenance, improvement and enhancement of the accelerator and detector complex on the SLAC site. The accelerators include the electron linac and the SLC, and to these is being added the B-factory completed in FY 1999. The detector facilities include the SLD, the End Station A experimental set-ups, and BaBar, the detector which is being constructed for use with the B-factory. Also provides for maintenance of the laboratory physical plant.

[a] Operation of the Tevatron in collider or fixed target mode in FY 1998 is precluded by the long shutdown needed for completion of the Fermilab Main Injector project.

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **Accelerator Operation:** Accelerator operations at SLAC in FY 2000 will concentrate heavily on about 9 months of strong utilization of the newly completed asymmetric B-factory colliding beam storage rings in order to maximize the data collected by the BaBar detector facility. The linac will serve primarily as the injector of positrons and electrons to the B-factory storage rings during this time, although a 5 month parasitic run of a fixed target experiment at the full linac energy is also planned. Includes initial Major Item of Equipment (MIE) funding ($3,000,000) for the fabrication of a portion of the Gamma-ray Large Area Space Telescope (GLAST) project. GLAST, a high sensitivity space based instrument for the study of high energy gamma rays, is planned as a joint DOE-NASA project and has the potential for significant contributions from a number of foreign collaborators. SLAC is the lead laboratory for the DOE portion of the project. Total estimated cost is subject to further negotiations with NASA and potential foreign collaborators.	82,228	79,300	84,500
■ **Experimental Facility Operations:** Experimental facility operations will emphasize running the newly completed BaBar detector facility, which will be the priority research program at SLAC in FY 2000. The End Station A complex will also be operated during the fixed target run.	25,517	31,990	33,790
Total, SLAC	107,745	111,290	118,290

SLAC Operation

	(in weeks)		
	FY 1998	FY 1999	FY 2000
SLC	16	0	0
Fixed Target	0	10	15[a]
B-factory Commissioning	17	16	0
B-factory Operation	0	16	39
Total, SLAC Operation	33	42	39

[a] Fixed Target operation in parallel with B-factory operation.

	FY 1998	FY 1999	FY 2000
	(dollars in thousands)		

BNL

Provides support for the operation, maintenance, improvement, and enhancement of the accelerator and detector complex on the BNL site. The principal facility is the AGS and its complement of experimental set ups. The AGS was transferred to the Nuclear Physics program during the 3rd quarter of FY 1999 to be operated as part of the RHIC facility. In FY 2000, the AGS operation for the HEP program will be on an incremental cost basis.

	FY 1998	FY 1999	FY 2000
■ **Accelerator Operation:** Operation activities covered under this budget category include the incremental cost of running the AGS complex for HEP. Operation for High Energy Physics in FY 2000 will be a eight week run for the muon magnetic moment experiment. Includes, in FY 1998 and FY 1999, but not FY 2000 landlord GPP and GPE funding..	38,332	29,672	3,047
■ **Experimental Facility Operations:** Provides for eight weeks of operation of the muon magnetic moment experiment and general support activities in the experimental areas.	21,035	13,210	2,300
Total, BNL	59,367	42,882	5,347

AGS Operation

	FY 1998	FY 1999	FY 2000
	(in weeks)		
AGS Operation for HEP	12	14	8

Universities and Other Labs

	FY 1998	FY 1999	FY 2000
Provides for capital equipment funding at ANL, LBNL, some smaller DOE labs, and for university based researchers. Provides landlord GPP and GPE for LBNL beginning in FY 2000. Includes $14,735,000 in FY 1999 and $15,015,000 in FY 2000 for the SBIR and STTR programs. Provides for certain computer networking expenses.	10,345	25,408	29,910

Large Hadron Collider

- In FY 1998 and FY 1999, funding was used for: R&D and measurement/testing on superconducting materials, cable, and wire; calculations and R&D on accelerator physics issues regarding the design, instrumentation, and prototypes of the magnets and RF accelerating cavities for the colliding beam intersection regions. Activities on the detectors will include R&D and prototype development of subsystems such as

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
tracking chambers, calorimeters, and data acquisition electronics.			

The LHC work is being performed at various locations including 4 major DOE labs and more than 55 U.S. universities.

LHC Accelerator and Detector Funding Summary

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
Facility Operations			
LHC			
Accelerator Systems			
Operating Expenses	4,315	7,070	600
Capital Equipment	9,685	8,330	19,500
Total, Accelerator Systems	14,000	15,400	20,100
Procurement from Industry	0	14,340	11,100
ATLAS Detector			
Operating Expenses	4,416	8,440	4,900
Capital Equipment	5,634	2,760	10,600
Total, ATLAS Detector	10,050	11,200	15,500
CMS Detector			
Operating Expenses	5,650	14,550	14,110
Capital Equipment	5,300	9,510	9,190
Total, CMS Detector	10,950	24,060	23,300
Total, LHC	35,000	65,000	70,000

	FY 1998	FY 1999	FY 2000
▸ **Accelerator Systems:** In FY 2000, funding will support continuation of the production of interaction region quadrupole magnets, feedboxes, and absorbers; production of RF region dipoles; superconducting cable testing and support; and accelerator physics design studies.	14,000	15,400	20,100
▸ **Procurement from Industry:** Funding will support reimbursement to CERN for purchases from U.S. industry including superconducting wire, cable, and cable insulation materials.	0	14,340	11,100

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
▸ **ATLAS Detector:** In FY 2000, funding will support the production of silicon strips, transition radiation tracker (TRT) modules, barrel cryostat and feedthroughs, front end electronics for the liquid argon calorimeter, the extended barrel tile calorimeter and electronics, the monitored drift tube muon chambers and electronics, and the alignment system for the muon spectrometer. The funding will also provide for advanced prototypes: the readout drivers (RODs) for the silicon and liquid argon systems, the TRT electronics, the electronic system for the liquid argon calorimeter. The R&D will be concluding for the pixel detectors while continuing for the trigger and data acquisition system.	10,050	11,200	15,500
▸ **CMS Detector:** In FY 2000, funding will support work on three of the subsystems in CMS. The endcap muon system will have set up the cathode strip chamber factory in FY 1999, and will be in full production. The hadron calorimeter system will have completed the two preproduction prototypes in FY 1999 and be in full production of copper absorber and the optics. The magnet system will complete the procurement of the majority of the items for the barrel and endcap steel flux return and the coil vacuum tank. The electromagnetic calorimeter subsystem will include procurement of front end transducers and electronics. The trigger/data acquisition and forward pixel subsystems will still be in an engineering phase.	10,950	24,060	23,300
Total, LHC	35,000	65,000	70,000

Waste Management

■ Continues the pilot program concerning packaging, shipment and disposition of hazardous, radioactive or mixed waste generated in the course of normal operations at Fermilab and SLAC. This pilot program is intended to evaluate opportunities to reduce the volume of newly generated waste and its associated management and disposal costs..	4,960	4,910	4,910
Total, Facility Operations	408,612	459,635	441,200

Explanation of Funding Changes from FY 1999 to FY 2000

	FY 2000 vs. FY 1999 ($000)
■ **Fermilab**	
▸ An increase to support full operation of the facility.	+5,600
▸ An increase in GPP.	+999
▸ A decrease in equipment funding reflecting the completion of the CDF and D-Zero detectors offset by increase in the funding for the NuMI/Minos detector.	-4,001
Total, Fermilab	+2,598
■ **Stanford Linear Accelerator Center**	
▸ An increase to support full utilization of the B-factory.	+5,300
▸ An increase in AIP and GPP.	+1,700
Total, Stanford Linear Accelerator Center	+7,000
■ **Brookhaven National Laboratory**	
▸ A decrease reflecting the transfer of the AGS to the NP program.	-28,175
▸ A decrease reflecting the transfer of landlord responsibilities (GPP, GPE) to NP.	-9,360
Total, Brookhaven National Laboratory	-37,535
■ **Universities/Other**	
▸ An increase reflecting primarily the addition of the landlord responsibilities (GPP, GPE) at LBNL to HEP.	+4,502
■ **Large Hadron Collider**	
▸ An increase to follow the agreed profile.	+5,000
Total Funding Change, Facility Operations	-18,435

Construction

Mission Supporting Goals and Objectives

This provides for the construction of major new facilities needed to meet the overall objectives of the High Energy Physics Program.

Funding Schedule

(dollars in thousands)

	FY 1998	FY 1999	FY 2000	$ Change	% Change
Construction	50,850	21,000	28,700	+7,700	+36.7%

Detailed Program Justification

(dollars in thousands)

	FY 1998	FY 1999	FY 2000
■ **Fermilab Main Injector Project:** This project provides for a new accelerator to replace the injector accelerator for the Tevatron complex. The present injector for the Tevatron is the original Fermilab main ring which is less than fully adequate and nearing the end of its useful lifetime. The accelerator will be commissioned and the project completed during FY 1999. .	30,950	0	0
■ **SLAC Master Substation Upgrade:** This project provides for an upgrade and reconfiguration of the main electric power substation on the SLAC site. Obsolete (and hazardous) switch gear will be replaced and load balancing will be implemented thus extending the useful life of the existing main 230 kv transformers. Procurement of long lead switch gear items was initiated in FY 1997, and the project will be completed by the end of FY 1998.	9,400	0	0
■ **Neutrinos at the Main Injector (NuMI):** This project provides for the construction of new facilities at Fermilab and at the Soudan Underground Laboratory in Soudan, Minnesota which are especially designed for the study of the properties of the neutrino and in particular to search for the neutrino oscillations. The FY 2000 funding is for continued detailed design and initiation of construction of conventional facilities and technical components.	5,500	14,300	22,000

	(dollars in thousands)		
	FY 1998	FY 1999	FY 2000
■ **C-Zero Area Experimental Hall:** This project provides for the construction of a new experimental hall at the C-Zero location on the Fermilab Tevatron ring. This will be used to house modest sized collider and fixed target experiments in a new experimental program being planned at Fermilab. This project will be completed in FY 1999.	5,000	0	0
■ **Wilson Hall Safety Improvement Project (Fermilab):** This project provides for urgently needed rehabilitation of the main structural elements of Wilson Hall, and for urgently needed rehabilitation of windows, plumbing, the roof and the exterior of the building.	0	6,700	4,700
■ **SLAC Research Office Building:** This project provides urgently needed office space for the substantial expansion of visiting scientists, or "users", which will occur when the B-factory becomes operational. The visiting user population is projected to increase from 200 visitors per year to 1,100 visitors per year. The new building will provide about 30,000 square feet and will be completed in FY 2001.	0	0	2,000
Total, Construction	50,850	21,000	28,700

Explanation of Funding Changes from FY 1999 to FY 2000

	FY 2000 vs. FY 1999 ($000)
■ Continuation of the Wilson Hall Safety Improvement Project at Fermilab.	-2,000
■ Continuation of the Fermilab NuMI project.	+7,700
■ Initiation of the Research Office Building.	+2,000
Total Funding Change, Construction	+7,700

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 1998	FY 1999	FY 2000 Request	$ Change	% Change
General Plant Projects	13,455	14,841	12,985	-1,856	-12.5%
Accelerator Improvement Projects	5,963	10,186	10,885	+699	+6.9%
Capital Equipment	93,539	76,363	90,315	+13,952	+18.3%
Total, Capital Operating Expense	112,957	101,390	114,185	+12,795	+12.6%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 1998	FY 1999	FY 2000 Request	Unapprop-riated Balance
92-G-302 Fermilab Main Injector	229,600	198,650	30,950	0	0	0
97-G-303 SLAC Master Substation Upgrade	12,400	3,000	9,400	0	0	0
98-G-304 Neutrinos at the Main Injector	76,200	0	5,500	14,300	22,000	34,400
98-G-305 C-Zero Area Experimental Hall	5,000	0	5,000	0	0	0
99-G-306 Wilson Hall Safety Improvements . .	15,600	0	0	6,700	4,700	4,200
00-G-307 SLAC Office Building	7,200	0	0	0	2,000	5,200
Total Construction		201,650	50,850	21,000	28,700	43,800

Major Items of Equipment *(TEC $2 million or greater)*

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp- riations	FY 1998	FY 1999	FY 2000 Request	Accept- ance Date
D-Zero Upgrade	55,270	28,467	14,525	9,555	2,723	FY 2000
CDF Upgrade	54,957	27,957	13,525	9,555	3,920	FY 2000
B-factory detector (BaBar)[a]	68,000	43,000	21,700	3,300	0	FY 1999
Antimatter in Space	3,192	2,992	200	0	0	FY 1998
Super-Kamiokande	3,584	3,053	531	0	0	FY 1998
Large Hadron Collider — Machine [a]	90,615	0	11,485	8,330	19,500	FY 2005
Large Hadron Collider — ATLAS Detector [a]	63,424	0	5,634	2,760	10,600	FY 2005
Large Hadron Collider — CMS Detector [a]	55,950	0	5,300	9,510	9,190	FY 2005
MINOS	45,000	0	0	2,000	5,868	FY 2002
GLAST[b]	N/A	0	0	0	3,000	N/A
Total, Major Items of Equipment		105,469	72,900	45,010	54,801	

[a] The funding for the B-factory detector reflects cost savings of about $20,000,000 resulting from contributions of components and subsystems by non-U.S. collaborating institutions.

[b] Total estimated cost is subject to further negotiations with NASA and potential foreign collaborators.

98-G-304, Neutrinos at the Main Injector (NuMI), Fermi National Accelerator Laboratory, Batavia, Illinois

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Total Estimated Cost and Total Project Cost have been adjusted due to changes in the construction profile.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1998 Budget Request *(A-E and technical design only)*	1Q '98	4Q '98	NA	NA	5,500	6,300
FY 1999 Budget Request *(Preliminary Estimate)*	— " —	3Q '99	1Q '99	4Q '02	75,800	135,300
| FY 2000 Budget Request	3Q '98	2Q '00	3Q '99	2Q '03	76,200	136,100

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design			
| 1998	5,500	5,500	1,140
Construction			
| 1999	14,300	14,300	8,360
| 2000	22,000	22,000	26,300
| 2001	23,000	23,000	27,000
| 2002	11,400	11,400	11,900
| 2003	0	0	1,500

3. Project Description, Justification and Scope

The project provides for the design, engineering and construction of new experimental facilities at Fermi National Accelerator Laboratory in Batavia, Illinois and at the Soudan Underground Laboratory at Soudan, Minnesota. The project is called NuMI which stands for Neutrinos at the Main Injector. The purpose of the project is to provide facilities which will be used by particle physicists to study the properties of neutrinos, which are fundamental elementary particles. In the Standard Model of elementary particle physics there are three types of neutrinos which are postulated to be massless and to date, no direct experimental observation of neutrino mass has been made. However, there are compelling hints from experiments which study neutrinos produced in the sun and in the earth's atmosphere that indicate that if neutrinos were capable of changing their type it could provide a credible explanation for observed neutrino deficits in these experiments.

The primary element of the project is a high flux beam of neutrinos in the energy range of 1 to 40 GeV. The technical components required to produce such a beam will be located on the southwest side of the Fermilab site, tangent to the new Main Injector accelerator at the MI-60 extraction region. The beam components will be installed in a tunnel of approximately 1 km in length and 6.5 m diameter. The beam is aimed at two detectors (MINOS) which will be constructed in experimental halls located along the trajectory of the neutrino beam. One such detector will be located on the Fermilab site, while a second will be located in the Soudan Underground Laboratory. Two similar detectors in the same neutrino beam and separated by a large distance are an essential feature of the experimental plan.

The experiments which are being designed to use these facilities will be able to search for neutrino oscillations occurring in an accelerator produced neutrino beam and hence determine if neutrinos do have mass. Fermilab is the only operational high energy physics facility in the U.S. with sufficiently high energy to produce neutrinos which have enough energy to produce tau leptons. This gives Fermilab the unique opportunity to search for neutrino oscillations occurring between the muon and the tau neutrino. Additionally, the NuMI facility is designed to accommodate future enhancements to the physics program that could push the search for neutrino mass well beyond the initial goals established for this project.

4. Details of Cost Estimate [a]

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs	7,150	7,720
Design Management costs (0.0% of TEC)	10	8
Project Management costs (0.0% of TEC)	20	22
Total, Engineering design inspection and administration of construction costs (9.4% of TEC)	7,180	7,750
Construction Phase		
Buildings	8,320	2,880
Special Equipment	10,120	10,270
Other Structures	30,960	38,690
Construction Management (6.0% of TEC)	4,590	540
Project Management (2.8% of TEC)	2,170	1,620
Total, Construction Costs	56,160	54,000
Contingencies		
Design Phase (2.8% of TEC)	2,172	not available
Construction Phase (14.0% of TEC)	10,688	not available
Total, Contingencies (16.8% of TEC)	12,860	14,050
Total, Line Item Cost (TEC)	76,200	75,800

5. Method of Performance

Design of the facilities will be by the operating contractor and subcontractor as appropriate. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bids.

[a] The annual escalation rates assumed for FY 1996 through FY 2002 are 2.5, 2.8, 3.0, 3.1, 3.3, 3.4, and 3.4 percent respectively.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	Outyears	Total
Project Cost						
Facility Cost						
Total, Line item TEC	0	1,140	8,360	26,300	40,400	76,200
Other Project Costs						
Capital equipment [a]	0	0	2,000	5,868	36,357	44,225
R&D necessary to complete construction [b]	450	810	40	0	0	1,300
Conceptual design cost [c]	630	200	0	0	0	830
Other project-related costs [d]	0	1,520	960	7,632	3,433	13,545
Total, Other Project Costs	1,080	2,530	3,000	13,500	39,790	59,900
Total Project Cost (TPC)	1,080	3,670	11,360	39,800	80,190	136,100

[a] Costs to fabricate the near detector at Fermilab and the far detector at Soudan. Includes systems and structures for both near detector and far detector, active detector elements, electronics, data acquisition, and passive detector material.

[b] This provides for project conceptual design activities, for design and development of new components, and for the fabrication and testing of prototypes. R&D on all elements of the project to optimize performance and minimize costs will continue through early stages of the project. Specifically included are development of active detectors and engineering design of the passive detector material. Both small and large scale prototypes will be fabricated and tested using R&D operating funds.

[c] Includes operating costs for development of conceptual design and scope definition for the NuMI facility. Also includes costs for NEPA documentation, to develop an Environmental Assessment, including field tests and measurements at the proposed construction location.

[d] Include funding required to complete the construction and outfitting of the Soudan Laboratory for the new far detector by the University of Minnesota.

7. Related Annual Funding Requirements

(FY 2003 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility operating costs [a]	500	NA
Utility costs (estimate based on FY 1997 rate structure) [b]	500	NA
Total related annual funding	1,000	NA
Total operating costs *(operating from FY 2003 through FY 2007)*	5,000	NA

[a] Including personnel and M&S costs (exclusive of utility costs), for operation, maintenance, and repair of the NuMI facility.

[b] Including incremental power costs for delivering 120 GeV protons to the NuMI facility during Tevatron collider operations, and utility costs for operation of the NuMI facilities, which will begin beyond FY 2002.

99-G-306, Wilson Hall Safety Improvements Project, Fermi National Accelerator Laboratory, Batavia, Illinois

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 1999 Budget Request	1Q '99	2Q '00	3Q '99	3Q '02	15,600	18,800
FY 2000 Budget Request	1Q '99	2Q '00	3Q '99	3Q '02	15,600	18,800

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Construction			
1999	6,700	6,700	1,690
2000	4,700	4,700	6,340
2001	4,200	4,200	6,990
2002	0	0	580

3. Project Description, Justification and Scope

Wilson Hall, constructed in 1972, is the central laboratory facility for the Fermilab site. It is a 17 story reinforced concrete building with a 16 story atrium. The great majority of its area is devoted to office space. In addition, the building contains the cafeteria, the communications center, medical office, some light industrial and shop areas, and an 800 seat auditorium.

The Wilson Hall Safety Improvements Project is a comprehensive project to remediate the deficiencies in this facility. Among the causes for the deficiencies are the age of the building and its systems, safety issues and updating to current code standards, and building components and systems that have reached their useful life expectancy.

The structural deficiencies are currently resulting in the ongoing safety issue of falling concrete debris in occupied areas of the building, and will eventually threaten the integrity of the entire facility. Additional spalling of the concrete could occur on the exterior faces of the building. The current glazing in the sloped window walls is not the code required safety glass. Breakage could result in the falling of sharp edged shards of glass into the atrium area. The quality of the existing drinking water is poor (taste & color) resulting in low usage which allows levels of lead and copper to exceed regulatory requirements.

The building structure portion of this project provides for the rehabilitation of the existing concrete structure at the crossover bays, which connect the two towers that comprise Wilson Hall. The joints between the crossover bays and tower are experiencing significant structural degradation, resulting in the ongoing safety issue of falling debris and the probability of continued deterioration of the joints. Recent computer analysis of the movement of the building structure has indicated that the joints need to be reworked to allow for the seasonal movement caused by temperature changes. This project will implement the solution to the joint erosion problem. It will consist of reconstructing the joints (assuring effective independent movement of each tower). Since a number of areas in the building will have restricted occupancy while the repairs are being made, this project will include the staff relocation required to accommodate the construction as part of Other Project Costs. At the completion of the structural joint repairs, a thorough exterior inspection will be conducted and any necessary repairs completed.

The building envelope portion of this project provides for the weatherproofing of components of the building shell that are currently allowing water penetration, the refurbishment of the existing skylight system, refinishing and partially reglazing the north and south curtain walls, and replacing the exterior entrances, including the entrance plaza:

Entry Plaza: The plaza that covers the "catacomb" area will have clear sealer applied to the sloped portions of the concrete walls enclosing the catacombs. The raised plaza portions will have waterproofing and pavers installed over the existing concrete. The existing paving at the entrance plaza will be removed and a new waterproof membrane and new paving will be installed.

North and South Curtain Wall: The north and south curtain walls of Wilson Hall are comprised of an anodized aluminum framing system that extends the full height of the building. The lower six floors of the system are sloped but do not have the current code required safety glazing. The finish of the aluminum framing is deteriorating and the system is allowing water penetration into the building. Safety glazing will be installed and the system will be repaired to resolve the water penetration.

4. Details of Cost Estimate [a]

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs	920	920
Project Management costs (0.0% of TEC)	100	100
Total, Engineering design inspection and administration of construction costs (6.5% of TEC)	1,020	1,020
Construction Phase		
Buildings	8,850	8,850
Inspection, design and project liaison, testing, checkout and acceptance	870	870
Construction Management (11.7% of TEC)	1,820	1,820
Project Management (2.8% of TEC)	430	430
Total, Construction Costs	11,970	11,970
Contingencies		
Design Phase (1.1% of TEC)	170	170
Construction Phase (15.6% of TEC)	2,440	2,440
Total, Contingencies (16.7% of TEC)	2,610	2,610
Total, Line Item Cost (TEC)	15,600	15,600

5. Method of Performance

Overall project management, quality assurance, supervision of design and construction efforts and coordination with the U.S. Department of Energy for this project will be the responsibility of the Fermi National Accelerator Laboratory, through the Facilities Engineering Services Section (FESS). Design will be accomplished by a combination of FESS staff and consultant A/E fixed price contracts under the direction of the Facilities Engineering Services Section. Construction for project completion will be accomplished by means of one or more competitively bid, fixed price construction subcontracts. Construction Management and overall project management during the construction phase of this project will remain the responsibility of the Facilities Engineering Services Section of the Fermi National Accelerator Laboratory.

[a] The economic escalation rates from FY 1997 dollars for FY 1999 through FY 2001 are 5.3%, 2.9%, and 2.9% respectively from the Department Price Change Index FY 1999 Guidance, General Construction.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	Outyears	Total
Project Cost						
Facility Cost						
Total, Line item TEC	0	0	1,690	6,340	7,570	15,600
Other Project Costs						
Conceptual design cost	530	270	0	0	0	800
Other project-related costs [a]	0	0	560	380	1,460	2,400
Total, Other Project Costs	530	270	560	380	1,460	3,200
Total Project Cost (TPC)	530	270	2,250	6,720	9,030	18,800

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Wilson Hall related annual costs	NA	NA
Incremental utility costs (estimate based on FY 1997 rate structure)	NA	NA
Total related annual funding *(operating from FY 2003 through FY 2007)* [b]	NA	NA

[a] Includes funding for relocation of tenants before and after the construction and rebuilding of their workspaces; refurbishment of existing elevators which will be used for construction purposes, and then restored to public use.

[b] No incremental annual operating costs will result from the completion of this project.

00-G-307, Research Office Building, Stanford Linear Accelerator Center, Stanford, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request	1Q '00	3Q '00	4Q '00	4Q '01	7,200	7,430

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Construction			
2000	2,000	2,000	950
2001	5,200	5,200	6,250

3. Project Description, Justification and Scope

The new Central Office Building project will construct a two-story building with approximately 30,000 gross square feet that will provide permanent, energy efficient office and conference space to meet the needs of the Laboratory. The office building will be located immediately adjacent to and north of the existing SLAC Administrative and Engineering building in the central campus area of the Laboratory. The new government-owned facility described herein will be located on leased land. Features include fixed and flexible office areas, meeting rooms and conference facilities equipped with interior office furnishings. Conventional utilities, such as domestic water, sanitary sewer, HVAC, and electrical power, will be provided by short connections from existing services. Specialized utilities include HVAC control and equipment, telecommunication for video and computers, and the main electrical feed. Construction of this building will allow the demolition of thirteen very old, temporary structures, totaling approximately 20,000 square feet.

This building will provide adequate facilities for the BaBar experimental program. This experimental program is critical to delivering the scientific understanding necessary to the success of the DOE's and the Nation's long-term science objective of maintaining the U.S. high energy physics program at the forefront of basics research.

With the increasing level of activity associated with the BaBar collaboration and SLAC's on-going high energy physics (HEP) experimental program, SLAC's space requirements are projected to exceed the capacity of currently existing office and meeting facilities. The BaBar experiment, which is scheduled to begin operation in FY 1999, expects a large influx of Users who will require adequate office and support space. SLAC expects to host approximately 1,100 HEP Users per year when the BaBar experiment begins full scale operations. The BaBar collaboration itself, consists of over six hundred users from around the world representing over seventy institutions. Office and meeting space is urgently needed to meet the demand created by this mega-collaboration. In the past, SLAC has only had about 200 collaborators/users in residence at any one time. Even at this level, most are housed in less than adequate facilities (the User community has become even more vocal about this in the past year or two). In the BaBar era, SLAC expects substantially more Users to be in residence and, as a national user facility, SLAC needs to be in a position to provide adequate space for them.

SLAC has investigated leasing and conversion alternatives to meet the projected need for office space but none has been judged to be as cost effective or satisfactory as the addition of the new office building. It was determined that there was insufficient off-site office space available nearby for leasing (12,000 square feet with a rental cost of $1,000,000 per year was available). Conversion of existing temporary and permanent facilities is not cost effective because the cost of renovation, necessary seismic and ADA work is roughly equal to the cost of new construction and the resulting space is inferior to new space specifically designed for office use. Additionally, valuable industrial space would be lost.

The use of substandard facilities could meet approximately two-thirds of this projected need but at substantial cost for necessary remedial work. With improved operating and energy efficiencies, it is estimated that the annual operating costs for this 30,000 square foot building will be equal to the current operating costs of the 20,000 square feet of temporary space to be removed.

If the new Central Office Building is not constructed, operating efficiencies and cost savings cannot be achieved, existing temporary structures, which are maintenance intensive and energy inefficient cannot be eliminated, the cost of seismic and ADA retrofitting will not be avoided, and parking will continue to be an operational deficiency in the main Computer Center area. Vehicular and pedestrian safety will not be improved. Commitments made to Stanford University and the SLAC HEP User population will not be met. An estimated $2,000,000 of avoidable costs will be incurred.

Funding is requested to initiate Preliminary and Final Design (Title I and II) of the project, procuring an Architect/Engineering firm to develop and oversee design, procure equipment, and begin construction.

4. Details of Cost Estimate [a]

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (5.8% of total estimated cost (TEC))	419	NA
Design Management costs at 23% of Preliminary and Final Design	98	NA
Project Management costs at 23% of Preliminary and Final Design	98	NA
Total, Design Phase	615	NA
Construction Phase		
Building	4,727	NA
Specialized Utilities	519	NA
Standard Equipment	496	NA
Construction Management at 2% of above	113	NA
Project Management at 1.5% of above	85	NA
Total, Construction Costs	5,940	NA
Contingencies at approximately 10 percent of above costs		
Design Phase (0.8% of TEC)	61	NA
Construction Phase (8.1% of TEC)	584	NA
Total, Contingencies	645	NA
Total, line item costs	7,200	NA

5. Method of Performance

Construction and procurement shall be accomplished by fixed price subcontracts on the basis of competitive bidding. Design and inspection shall be performed by the laboratory and contracted Architect-Engineers.

[a] Escalated to mid-point of construction with a factor of 1.0611. Allocated Indirects included in costs.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	Outyears	Total
Project Cost						
Facility Cost						
Design	0	0	0	615	0	615
Construction	0	0	0	335	6,250	6,585
Total Facility Costs (TEC)	0	0	0	950	6,250	7,200
Other Project Costs						
Conceptual design cost	0	0	30	0	0	30
Other project related costs [a]	0	0	0	0	200	200
Total, Other Project Costs	0	0	30	0	200	230
Total Project Cost (TPC)	0	0	30	950	6,450	7,430

7. Related Annual Funding Requirements

(FY 1998 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility maintenance/repair costs [b]	34	NA
Incremental utility costs [c]	36	NA
Total related annual funding	70	NA
Total Operating costs (operating from FY 2003 through FY 2007)	350	NA

[a] Includes funding for demolition of temporary structures; paving.

[b] Includes costs for janitorial services.

[c] Includes incremental utility costs for electric power and water.

00-G-307, Research Office Building, Stanford Linear Accelerator Center, Stanford, California

(Changes from FY 1999 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2000 Budget Request	1Q '00	3Q '00	4Q '00	4Q '01	7,200	7,430

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Construction			
2000	2,000	2,000	950
2001	5,200	5,200	6,250

3. Project Description, Justification and Scope

The new Central Office Building project will construct a two-story building with approximately 30,000 gross square feet that will provide permanent, energy efficient office and conference space to meet the needs of the Laboratory. The office building will be located immediately adjacent to and north of the existing SLAC Administrative and Engineering building in the central campus area of the Laboratory. The new government-owned facility described herein will be located on leased land. Features include fixed and flexible office areas, meeting rooms and conference facilities equipped with interior office furnishings. Conventional utilities, such as domestic water, sanitary sewer, HVAC, and electrical power, will be provided by short connections from existing services. Specialized utilities include HVAC control and equipment, telecommunication for video and computers, and the main electrical feed. Construction of this building will allow the demolition of thirteen very old, temporary structures, totaling approximately 20,000 square feet.

This building will provide adequate facilities for the BaBar experimental program. This experimental program is critical to delivering the scientific understanding necessary to the success of the DOE's and the Nation's long-term science objective of maintaining the U.S. high energy physics program at the forefront of basics research.

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SLAC has investigated leasing and conversion alternatives to meet the projected need for office space but none has been judged to be as cost effective or satisfactory as the addition of the new office building. It was determined that there was insufficient off-site office space available nearby for leasing (12,000 square feet with a rental cost of $1,000,000 per year was available). Conversion of existing temporary and permanent facilities is not cost effective because the cost of renovation, necessary seismic and ADA work is roughly equal to the cost of new construction and the resulting space is inferior to new space specifically designed for office use. Additionally, valuable industrial space would be lost.

The use of substandard facilities could meet approximately two-thirds of this projected need but at substantial cost for necessary remedial work. With improved operating and energy efficiencies, it is estimated that the annual operating costs for this 30,000 square foot building will be equal to the current operating costs of the 20,000 square feet of temporary space to be removed.

If the new Central Office Building is not constructed, operating efficiencies and cost savings cannot be achieved, existing temporary structures, which are maintenance intensive and energy inefficient cannot be eliminated, the cost of seismic and ADA retrofitting will not be avoided, and parking will continue to be an operational deficiency in the main Computer Center area. Vehicular and pedestrian safety will not be improved. Commitments made to Stanford University and the SLAC HEP User population will not be met. An estimated $2,000,000 of avoidable costs will be incurred.

Funding is requested to initiate Preliminary and Final Design (Title I and II) of the project, procuring an Architect/Engineering firm to develop and oversee design, procure equipment, and begin construction.

4. Details of Cost Estimate [a]

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs (5.8% of total estimated cost (TEC))	419	NA
Design Management costs at 23% of Preliminary and Final Design	98	NA
Project Management costs at 23% of Preliminary and Final Design	98	NA
Total, Design Phase	615	NA
Construction Phase		
Building	4,727	NA
Specialized Utilities	519	NA
Standard Equipment	496	NA
Construction Management at 2% of above	113	NA
Project Management at 1.5% of above	85	NA
Total, Construction Costs	5,940	NA
Contingencies at approximately 10 percent of above costs		
Design Phase (0.8% of TEC)	61	NA
Construction Phase (8.1% of TEC)	584	NA
Total, Contingencies	645	NA
Total, line item costs	7,200	NA

5. Method of Performance

Construction and procurement shall be accomplished by fixed price subcontracts on the basis of competitive bidding. Design and inspection shall be performed by the laboratory and contracted Architect-Engineers.

[a] Escalated to mid-point of construction with a factor of 1.0611. Allocated Indirects included in costs.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 1998	FY 1999	FY 2000	Outyears	Total
Project Cost						
Facility Cost						
Design	0	0	0	615	0	615
Construction	0	0	0	335	6,250	6,585
Total Facility Costs (TEC)	0	0	0	950	6,250	7,200
Other Project Costs						
Conceptual design cost	0	0	30	0	0	30
Other project related costs [a]	0	0	0	0	200	200
Total, Other Project Costs	0	0	30	0	200	230
Total Project Cost (TPC)	0	0	30	950	6,450	7,430

7. Related Annual Funding Requirements

(FY 1998 dollars in thousands)

	Current Estimate	Previous Estimate
Annual facility maintenance/repair costs [b]	34	NA
Incremental utility costs [c]	36	NA
Total related annual funding	70	NA
Total Operating costs (operating from FY 2003 through FY 2007)	350	NA

[a] Includes funding for demolition of temporary structures; paving.

[b] Includes costs for janitorial services.

[c] Includes incremental utility costs for electric power and water.