DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
SCIENCE
(Tabular dollars in thousands, Narrative in whole dollars)

HIGH ENERGY PHYSICS

PROGRAM MISSION

The High Energy Physics (HEP) program is a major component of the Department's fundamental research mission. It 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 GOAL of the High Energy Physics program is to:

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

The OBJECTIVES related to this goal are:

1. 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.

2. 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, the Stanford Linear Accelerator Center, and the Alternating Gradient Synchrotron complex at the Brookhaven National Laboratory.

3. 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 completion of the Fermilab Main Injector project, the initial operation of the B-factory at SLAC and the initiation of a new experimental facility at Fermilab called Neutrinos at the Main Injector (NuMI).

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

4. TO CONTINUE TO PROVIDE THE PROGRAM'S TECHNOLOGICAL BASE - Support long-range accelerator and detector R&D in order to develop the advanced concepts and technologies which are critical to the long-range viability of high energy physics research.

5. TO CONTINUE TO PURSUE INTERNATIONAL COLLABORATION ON LARGE HIGH ENERGY PHYSICS PROJECTS - Continue to champion U.S. participation in the Large Hadron Collider (LHC) program at CERN. Recommend and defend funding for U.S. participation on the LHC project as recommended by the High Energy Physics Advisory Panel's (HEPAP) "Subpanel on the Vision for the Future of High Energy Physics".

SCIENTIFIC FACILITIES UTILIZATION:

The High Energy Physics request includes $433,520,000 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 all three of the Department's major high energy physics facilities: the Tevatron at Fermilab, the B-factory at SLAC, and the Alternating Gradient Synchrotron at BNL until its transfer to the Nuclear Physics program in FY 1999 for use as part of the RHIC facility .

PERFORMANCE MEASURES:

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

1. Quality of scientific results and plans as indicated by expert advisory committees, recognition by the scientific community, and awards received by DOE-supported HEP 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.

2. 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.

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

3. 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.

4. Progress on the Fermilab Main Injector and the Neutrinos at the Main Injector projects 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.

5. At least 80 percent of the research programs will be reviewed by appropriate peers.

6. The major upgrade of scientific facilities will be managed to keep them on schedule and within cost.

7. HEP will begin operating the B-factory at SLAC, the Main Injector for the Tevatron at Fermilab, and will deliver on the 1999 US/DOE commitments to the international Large Hadron Collider project.

SIGNIFICANT ACCOMPLISHMENTS AND PROGRAM SHIFTS:

1. Measurement, by teams of university and laboratory scientists working at Fermilab, of the mass and production properties of the top quark. 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.

2. The world's most precise measurement, 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.

3. 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.

4. 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.

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

5. Operation, for the first time ever, of a high energy particle beam transfer line using permanent magnets, thus saving the power and cooling needed for conventional magnets. This was done at Fermilab as part of the Main Injector project.

6. A test of a superconducting accelerator-style magnet fabricated at LBNL achieved a new world record field strength of 13.5 teslas (previous record 11 teslas.)

7. The 1996/1997 fixed target run at Fermilab was highly successful. The accelerator and the experiments performed well, and the researchers have a large amount of data which is in the process of being analyzed.

8. The final data collection with the Fermilab external fixed-target program at 800 GeV will be completed in FY 1999, and the prime focus of the Fermilab program will turn to research with Tevatron collider with higher luminosity of the new Main Injector.

9. The final data collection with the Stanford Large Detector will be completed during FY 1998 and the prime focus of the SLAC program will turn to research with the B-factory.

10. 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 will be nearly complete and commissioning will be about to start.

11. 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.

12. The B-factory Project at SLAC will be completed and is within the planned cost and schedule profiles. At the end of FY 1998, the project will be complete and commissioning will be underway. The physics research program, using the BaBar detector will begin during FY 1999.

13. The experiment at BNL designed to study the magnetic properties of the muon was brought into operation with the initial performance of the apparatus exceeding the design goals.

14. The Alternating Gradient Synchrotron at BNL will be transferred to the Nuclear Physics program for use as the injector for the RHIC facility. This will occur during the 3rd quarter of FY 1999.

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

15. Waste Management activities at Fermilab and SLAC were included as a new (beginning in FY 1998) responsibility transferred from the Environmental Management (EM) program. The Department has initiated a pilot program intended to evaluate opportunities to reduce the volume of newly generated waste and its associated management and disposal costs resulting from Departmental mission activities. Beginning in FY 1998, the Department will implement the Pilot Waste Management Re-Engineering Program at a limited number of sites, at which the responsibility for the newly generated waste management programs will be transferred from the Office of Environmental Management to the generating program. Throughout the implementation of the pilot, the regulatory accountability will remain with the program that currently holds the regulatory permits. In addition, the Office of Environmental Management will be responsible for any unavoidable funding shortfalls due to underestimates for FY 1998 waste generation.

    The Department expects that this re-engineered waste management structure will result in increased awareness on the waste generating organizations' part, thereby creating a financial incentive to minimize waste generation. Waste generating programs will be able to clearly track the true cost of their waste generation, as well as incorporate the associated costs within the formulation of the outyear budgets. To the extent that the programs minimize waste generation, the savings will be available to support increased mission activity. The impacts of this pilot arrangement will be carefully evaluated throughout FY 1998. The Pilot Waste Management Re-Engineering Program was initiated in response to several recommendations received from several Departmental stakeholders, including the National Academy of Sciences and the Environmental Management Advisory Board.

16. 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.

    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 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 are outstanding; they 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 (cancelled in 1993), it has strong potential for

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

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 completed negotiations 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 have been approved by CERN and by 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 tentatively 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% 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 Energy Research 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.

PROGRAM MISSION - HIGH ENERGY PHYSICS (Cont'd)

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 and helping to design the planned physics capabilities of the LHC accelerator and detectors.

Fabrication of LHC subsystems and components by U.S. participants will begin 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 will be provided in FY 1998 and $65,000,000 in FY 1999 to support continuation of these R&D and design efforts, and the initiation of fabrication of those subsystems and components which will be specified in the agreements with CERN. The $329,000,000 required to complete DOE funding of the project will be requested in FY 1999 as an advance appropriation.

Funding of Contractor Security Clearances

In FY 1999, the Department will divide the responsibility for obtaining and maintaining security clearances. The Office of Security Affairs, which has been responsible for funding all Federal and contractor employee clearances, will pay only for clearances of Federal employees, both at headquarters and the field. Program organizations will be responsible for contractor clearances, using program funds. This change in policy will enable 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 Energy Research is budgeting $373,000 for estimated contractor clearances in FY 1999 within this decision unit.

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

U.S. LHC ACCELERATOR AND DETECTOR FUNDING
(Dollars in thousands)

	US Contribution	FY 1996*	FY 1997*	FY 1998*	FY 1999*	FY 2000	FY 2001
Accelerator	$200,000**	$ 2,000	$ 6,670	$ 15,600	$ 29,000	$ 31,200	$ 31,200
Detector	$250,000	$ 4,000	$ 8,330	$ 19,400	$ 36,000	$ 38,800	$ 38,800
Total DOE	$450,000	$ 6,000	$ 15,000	$ 35,000	$ 65,000	$ 70,000	$ 70,000
NSF***	$ 81,000				$ 22,150	$ 15,900	$ 16,370

	FY 2002	FY 2003	FY 2004
Accelerator	$ 31,200	$ 29,000	$ 24,100
Detector	$ 38,800	$ 36,000	$ 29,900
Total DOE	$ 70,000	$ 65,000	$ 54,000
NSF***	$ 16,860	$ 9,720	

This estimated annual funding profile is based on the needs of the LHC project and is consistent with flat out year funding for the HEP 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.

* 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 will be used for: fabrication of machine and detector hardware, supporting R&D, prototype development of subsystems, and purchases by CERN from U.S. vendors.

** 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.

*** The NSF funding has been approved by the National Science Board.

HIGH ENERGY PHYSICS

PROGRAM FUNDING PROFILE

(Dollars in thousands)

Subprogram	FY 1997 Current Appropriation	FY 1998 Original Appropriation	FY 1998 Adjustments	FY 1998 Current Appropriation
Research and Technology.....	$ 207,364	$ 210,240	-$342 a/	$ 209,898
Facility Operations	350,806	418,945	0	418,945
Subtotal.....	558,170	629,185	-342 a/	628,843
Construction.....	100,000	50,850	0	50,850
Subtotal, High Energy Physics.....	658,170	680,035	-342 a/	679,693
Adjustment.....	-1,051 b/	-1,766 c/	0	-1,766 c/
Adjustment.....	0	-342 a/	342 a/	0
TOTAL, HEP.....	$657,119 d/	$677,927	$0	$677,927

a/ Share of Science general reduction for contractor training.

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

c/ Share of Science general reduction for use of prior year balances assigned to this program. The total general reduction is ap at the appropriation level.

d/ Excludes $12,410,000 which was transferred to the SBIR program and $745,000 which was transferred to the STTR progra

Public Law Authorization:

Public Law 95-91, "Department of Energy Organization Act"

	FY 1999 Request
$	213,365
	456,635
	670,000
	21,000
	691,000
	0
	0
	$691,000

general

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HIGH ENERGY PHYSICS
(Dollars in thousands)

PROGRAM FUNDING BY SITE

Field Offices/Sites	FY 1997 Current Appropriation	FY 1998 Original Appropriation	FY 1998 Adjustments	FY 1998 Current Appropriation	FY 1999 Request
Albuquerque Operations Office					
Los Alamos National Laboratory	$880	$890	$0	$890	$894
Chicago Operations Office					
Argonne National Laboratory	8,861	9,058	0	9,058	8,475
Brookhaven National Laboratory	75,860	77,801	0	77,801	56,395
Fermi National Accelerator Laborat	263,211	274,972	0	274,972	256,070
Oakland Operations Office					
Lawrence Berkeley National Labor	27,192	23,794	0	23,794	22,820
Lawrence Livermore National Labc	683	380	0	380	380
Stanford Linear Accelerator Center	165,892	149,638	0	149,638	147,035
Oak Ridge Operations Office					
Thomas Jefferson National Accelerator Facility	15	0	0	0	0
Oak Ridge National Laboratory	379	272	0	272	240
Richland Operations Office					
Pacific Northwest Laboratory	10	10	0	10	10

Field Offices/Sites	FY 1997 Current Appropriation	FY 1998 Original Appropriation	FY 1998 Adjustments	FY 1998 Current Appropriation	FY 1999 Request
All Other Sites a/	115,187	143,220	-342 b/	142,878	198,681
Subtotal	658,170	680,035	-342 b/	679,693	691,000
Adjustment	-1,051 c/	-1,766 d/	0	-1,766	0
Adjustment	0	-342 b/	342 b/	0	0
TOTAL	$657,119 e/	$677,927	$0	$677,927	$691,000

a/ Funding provided to universities, industry, other federal agencies and other miscellaneous contractors.
b/ Share of Science general reduction for contractor training.
c/ Share of General Science and Research general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.
d/ 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.
e/ Excludes $12,410,000 which was transferred to the SBIR program and $745,000 which was transferred to the STTR program.

HIGH ENERGY PHYSICS

RESEARCH AND TECHNOLOGY

(Tabular dollars in thousands, narrative in whole dollars)

I. **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 and the technology R&D which is the core of the program. The Facility Operations subprogram, described later, provides the large facilities - accelerators, detectors, etc. - needed for the research program.

The Physics Research activity 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 8 DOE laboratories.

The High Energy Technology activity 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 activity 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 HEP 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 activity supports work primarily at the DOE labs, but also at universities, other federal labs, and in industry.

In FY 1997, the Research and Technology subprogram included funding for a major portion of the LHC related R&D effort; the other portion was provided as capital equipment in the Facility Operations subprogram. Beginning in FY 1998, when fabrication by U.S. groups of LHC hardware components began, all of the LHC project funding is budgeted as a separate activity in the Facility Operations subprogram. This provides improved visibility of LHC component funding and will facilitate DOE management by

consolidating all funding in a single subprogram.

II. Funding Schedule:

Program Activity	FY 1997	FY 1998	FY 1999	$ Change	% Change
Physics Research	$ 139,483	$ 142,136	$ 146,855	$+4,719	+ 3.3%
High Energy Technology	67,881	64,309	61,677	-2,632	- 4.1%
SBIR/STTR	0	3,453	4,833	+1,380	+40.0%
Total	$207,364	$209,898	$213,365	$+3,467	+ 1.7%

III. Performance Summary- Accomplishments:

	FY 1997	FY 1998	FY 1999
Physics Research			
Fermilab—Provides support primarily for Fermilab research physicists working on CDF, D-Zero, and several fixed target experiments, on the CMS detector for LHC, on particle astrophysics experiments, and on theoretical analyses. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	$9,698	$ 9,991	$ 9,680
SLAC—Provides support primarily for SLAC research physicists working on the B-factory, on the SLD at SLC, on the Beijing Electron Synchrotron detector at the accelerator in Beijing, China, on fixed target experiments at SLAC, and on theoretical analyses. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	11,028	11,778	11,840
BNL—Provides support primarily for BNL research physicists working on the high priority Rare k-decay experiments at the AGS at BNL, on the D-Zero detector at Fermilab, on the experiment to make a precision measurement of the muon's magnetic	7,584	7,642	7,720

properties, on the Atlas detector for LHC, on other AGS experiments, and on theoretical analyses. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

III. Performance Summary- Accomplishments:	**FY 1997**	**FY 1998**	**FY 1999**
LBNL—Provides support primarily for LBNL research physicists working on the CDF and D-Zero detectors at Fermilab, on the BaBar detector for the B-factory at SLAC, on the Atlas detector for the LHC, on the SLD at the SLC at SLAC, on an underground experiment to search for cosmic dark matter, and on theoretical analyses. Also provides for the Particle Data Group which serves as a clearing house and archivist for data on elementary particles.	10,055	10,275	10,535
ANL—Provides support primarily for ANL research physicists working on the CDF detector at Fermilab, on the ZEUS detector at DESY, on the Atlas detector for LHC, on the underground Soudan-2 detector, on the MINOS detector for the planned NuMI project at Fermilab, and on theoretical analyses.	5,564	5,475	5,605
Universities and Other Laboratories—Provides support for research physicists at over 100 U.S. universities working at all of the U.S. and at several foreign accelerator laboratories, on a number of non-accelerator experiments, and performing theoretical analyses. Provides support for similar research scientists at LANL, LLNL, and ORNL.	95,554	96,975	101,475
Total Physics Research	$139,483	$142,136	$146,855
High Energy Technology			
Fermilab—Provides funding for technology R&D in support of the commissioning of the Fermilab Main Injector, for technology R&D aimed at improving the performance	$13,811	$16,106	$13,415

and reliability of the Fermilab accelerator complex and the detectors used in Fermilab research program, for R&D to develop the muon collider concept, for technology R&D related to

	FY 1997	FY 1998	FY 1999
III. Performance Summary- Accomplishments:			
future machines, and for advanced technology R&D of general benefit to the HEP program. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.			
SLAC—Provides funding primarily for technology R&D support of the commissioning of the B-factory and the BaBar detectors, for technology R&D aimed at improving the performance and reliability of the SLC and the other parts of the SLAC accelerator complex. Also provides for advanced technology R&D of general benefit to the HEP program. In FY 1999, R&D and pre-conceptual design for the Next Linear Collider will continue. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	12,589	14,250	16,900
BNL—Provides funding for technology experiments exploring novel accelerator techniques using the Accelerator Test Facility, R&D aimed at developing the muon collider concept, for technology R&D of general benefit to the HEP program, and R&D in support of the AGS and the AGS experimental program. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	6,197	8,320	5,410
LBNL—Provides support for technology R&D in the areas of superconducting magnets for accelerators, high performance RF power systems, plasma lenses using the accelerator R&D beam at the Advanced Light Source, R&D in support of the joint SLAC/LBNL/ LLNL B-factory project, R&D related to large linear colliders, and for	9,474	9,385	9,615

technology R&D of general benefit to the HEP program.

Large Hadron Collider—Provided support for the R&D and planning necessary to provide an informed basis on which to negotiate an agreement with CERN relative to U.S. participation in the LHC Project. In FY 1997 an additional $2,365,000 was budgeted as capital equipment under the Facility Operations subprogram. Beginning in FY 1998, when	12,635	0	0

III. Performance Summary- Accomplishments:	**FY 1997**	**FY 1998**	**FY 1999**
fabrication of LHC subsystems and components will begin, all LHC funds for component fabrication and supporting R&D are budgeted under the Facility Operations subprogram.			
Universities, Other Laboratories, and Other Contractors—Provides support for relevant, high priority technology R&D at universities, other DOE laboratories, and private industry. Areas being studied include improved superconductors; laser, and collective effect accelerator techniques; novel, high powered RF power generators; non-linear dynamics; and theoretical studies.	13,175	16,248	16,337
Total High Energy Technology	$67,881	$64,309	$61,677
SBIR/STTR - Provides funding for the mandated SBIR and STTR programs. Additional funding for the SBIR program is contained in the Facility Operations subprogram. In FY 1997, $1,841,000 and $745,000 were transferred to the SBIR and STTR programs, respectively. The FY 1998 and FY 1999 amounts are the estimated requirement for the continuation of these programs.	0	3,453	4,833
Total Research and Technology	$ 207,364	$ 209,898	$ 213,365

HIGH ENERGY PHYSICS
RESEARCH AND TECHNOLOGY

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

Increase for the support of university and other laboratory based researchers.
+$4,589,000

Decrease at Fermilab reflecting primarily the completion of much of the R&D
-$3,002,000
for the NuMI project.

Increase at SLAC primarily for increased support of linear collider R&D activities. +$2,712,000

Decrease at BNL reflecting the transition of the AGS to becoming the injector for RHIC. -$832,000

Decrease at BNL in High Energy Technology reflecting the end of a unique FY 1998
-$2,000,000
arrangement for support for the Instrumentation Division.

Increase at LBNL to partially offset the impact of inflation. +$490,000

Increase at ANL to partially offset the impact of inflation. +$130,000

Increase in this portion of the SBIR/STTR assessment.
+$1,380,000

Total Funding Change, Research and Technology: +$3,467,000

HIGH ENERGY PHYSICS

FACILITY OPERATIONS

(Tabular dollars in thousands, narrative in whole dollars)

I. <u>Mission Supporting Goals and Objectives</u>: 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, and inventories. General plant projects (GPP) funding will be provided for minor new construction, other capital alterations and additions, and for buildings and utility systems. General purpose equipment (GPE) funding for Brookhaven National Laboratory and landlord GPP funding for Brookhaven 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 HEP research program is also included. As discussed in the preceding program mission statement, funding for a pilot program concerning transfer from EM to ER of waste management responsibility at Fermilab and SLAC is also included beginning in FY 1998.

Beginning in FY 1998, when fabrication of hardware for the LHC project begins, this subprogram includes all of the U.S. DOE funding for LHC machine and detector hardware.

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 HEP 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.

Planned Accelerator Operations
(in weeks)

		FY 1997	FY 1998	FY 1999
Fermilab	Fixed Target	45	a/	26
	Collider		a/	
	Commissioning	__	13	14
	Total	45	13	40
SLAC	SLC	23	16 b/	0
	Fixed Target	10	0	0
	B-factory Commissioning .	0	17	6
	B-factory Operation	0	0	36
	Total	33	33	42
BNL	AGS-HEP c/	12	12	26

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.

b/ Operation of the SLC at SLAC in FY 1998 is constrained by the long shutdown needed for the completion of the B-factory project.

c/ The AGS is also funded and operated by the Nuclear Physics program for operation with heavy ions. In FY 1999 the AGS will transition to the Nuclear Physics program for operation as an injector for RHIC.

HIGH ENERGY PHYSICS
FACILITY OPERATIONS

II. Funding Schedule:

Program Activity	FY 1997	FY 1998	FY 1999	$ Change	% Change
Fermi National Accelerator Laboratory	$ 183,796	$ 192,545	$ 209,755	$+ 17,210	+ 8.9%
Stanford Linear Accelerator Center	94,275	111,460	115,535	+ 4,075	+ 3.7%
Brookhaven National Laboratory	58,210	56,322	43,265	- 13,057	- 23.2%
Universities and Other Laboratories	12,160	8,298	8,302	+ 4	0.0%
Large Hadron Collider	2,365a/	35,000	65,000	+30,000	+85.7%
Waste Management	0b/	4,960	4,980	+ 20	+ 0.4%
SBIR	0	10,360	9,798	- 562	- 5.4%
Total	$350,806	$418,945	$456,635	$+37,690	+ 9.0%

a/ As previously discussed, $12,635,000 in FY 1997 was budgeted for LHC R&D in the High Energy Technology activity within the Research and Technology subprogram.

b/ Waste Management activities in FY 1997 were funded by the Environmental Management Program.

III. Performance Summary- Accomplishments:

	FY 1997	FY 1998	FY 1999
Fermilab—Provides support for operation, maintenance, improvement, and enhancement of the Tevatron accelerator complex, the large detector facilities (CDF and D-Zero), the smaller fixed target experiments, and the on-site computing resources required to design the detectors and analyze the experimental data. Also provides for maintenance of the laboratory physical plant. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	$ 183,796	$ 192,545	$ 209,755

- Tevatron operation
  --FY 1997 - operation in fixed target mode for about 45 weeks.
  --FY 1998 - a 9 month long shutdown required to complete construction and install components of the Main Injector followed by 13

	FY 1997	FY 1998	FY 1999
weeks of Main Injector commissioning and Tevatron startup.			

III. Performance Summary- Accomplishments:

--FY 1999 - Operation in fixed target mode for about 26 weeks together with 14 weeks of operation to complete commissioning of the new Main Injector.

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. 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. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.	94,275	111,460	115,535

- SLAC operation
  --FY 1997 - operation of the SLC with SLD for about 23 weeks and operation for fixed target experiments in End Station A for about 10 weeks.
  --FY 1998 - operation of the SLC with the SLD for about 16 weeks followed by a long shutdown to complete the B-factory. B-factory commissioning will require about 17 weeks of linac operation.
  --FY 1999 - operation of the B-factory for about 6 weeks to complete commissioning and for about 36 weeks for initial physics research.

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	58,210	56,322	43,265

	FY 1997	FY 1998	FY 1999
AGS will be transferred to the Nuclear Physics program during FY 1999 for			

III. Performance Summary- Accomplishments:

operation as part of the RHIC project. Also provides for maintenance of the laboratory physical plant. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

- AGS operation
  --FY 1997 - operation of the AGS for HEP for 12 weeks.
  --FY 1998 - operation of the AGS for HEP for about 12 weeks.
  --FY 1999 - operation of the AGS for HEP for about 26 weeks.
  The AGS is also operated by the Nuclear Physics program for heavy ion research.

Universities and other labs - Provides for capital equipment funding at ANL, LBNL, some smaller DOE labs, and for university based researchers. Provides for certain computer networking expenses.	12,160	8,298	8,302
Large Hadron Collider - Beginning in FY 1998 and continuing in FY 1999 funding will be 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 tracking chambers, calorimeters, and data acquisition electronics. Funding in FY 1996 and FY 1997 was for R&D activities and capital equipment in preparation for the U.S. participation in the project. These initial R&D activities were	2,365	35,000	65,000

budgeted, in part, in

	FY 1997	**FY 1998**	**FY 1999**

III. Performance Summary- Accomplishments:

the Research and Technology subprogram ($12,635,000 in FY 1997) presented earlier and, in part, in this subprogram. Education activities for improving science education for students and faculty in America's schools, colleges and universities are also funded in this program.

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

HIGH ENERGY PHYSICS
FACILITY OPERATIONS

The DOE funding for LHC hardware fabrication (which begins in FY 1998) and supporting R&D is displayed below for completeness and clarity.

LHC Accelerator and Detector Funding
(B/A in thousands)

		FY 1997	FY 1998	FY 1999
Facility Operations				
LHC				
accelerator	- Operating Expenses	$ 0	$ 7,800	$14,500
	- Capital Equipment	300	7,800	14,500
detectors	- Operating Expenses	0	12,600	23,400
	- Capital Equipment	2,065	6,800	12,600
Total Facility Operations		$2,365	$35,000	$65,000
Research and Technology a/				
High Energy Technology		$12,635	$ 0	$ 0
Total LHC		$15,000	$35,000	$65,000

a/ These R&D funds are displayed here for comparability purposes only. These FY 1997 funds were budgeted in the Research and Technology subprogram.

III. Performance Summary- Accomplishments:	**FY 1997**	**FY 1998**	**FY 1999**
Waste Management - Provides for a 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.	0	4,960	4,980
SBIR - Additional funding for the SBIR program and all funding for the STTR program is contained in the Research and Technology subprogram. In FY 1997, $10,569,000 was transferred to the SBIR program. The FY 1998 and FY 1999 amounts are the estimated requirement for the continuation of the SBIR program.	0	10,360	9,798
Total Facility Operations	$350,806	$418,945	$456,635

HIGH ENERGY PHYSICS
FACILITY OPERATIONS

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

Increase in operating funds at Fermilab to support an aggressive commissioning schedule for the Fermilab Main Injector and an enhanced operating schedule.	+$12,880,000
Decrease in capital equipment funding for the CDF and D-Zero detector upgrades at Fermilab.	-$11,200,000
Provision in capital equipment funding at Fermilab for the initiation of the NuMI (MINOS) detector.	+$3,000,000
Increase in capital equipment funding at Fermilab primarily for computing hardware needed for analysis of the next round of data.	+$7,530,000
Increase in AIP at Fermilab reflecting restoration after the temporary reduction to fund the C-Zero Hall project.	+$5,000,000
Increase in operating funds at SLAC to support an aggressive commissioning schedule for the B-factory and an enhanced operating schedule.	+$8,235,000
Decrease in capital equipment funding at SLAC for the B-factory detector.	-$17,000,000
Increase in capital equipment funding at SLAC primarily for computing hardware needed for the initial round of B-factory data.	+$9,310,000
Increase in AIP at SLAC reflecting technical needs which are anticipated to arise during commissioning and initial operation of the B-factory.	+$2,740,000
Increase in GPP at SLAC reflecting the priority given to certain infrastructure needs.	+$790,000
Increase in operating funds at BNL to support enhanced operation of the AGS.	+$2,000,000

HIGH ENERGY PHYSICS
FACILITY OPERATIONS

Reduction in operating funds reflecting the transition of the AGS to the Nuclear Physics Program in the third quarter of FY 1999.	-$13,960,000
Decrease in capital equipment funding at BNL reflecting the approaching completion of the AGS HEP research program.	-$1,207,000
Increase in General Purpose Equipment at BNL reflecting restoration to the normal level after mutually acceptable one-time reduction in FY 1998.	+$2,020,000
Decrease in AIP funding at BNL reflecting the transition of the AGS to the Nuclear Physics program to serve as the injector for RHIC.	-$940,000
Decrease in GPP at BNL reflecting a one-time increment in FY 1998. -$970,000	
Increase in the funding for the LHC project.	+$30,000,000
Decrease in this portion of the SBIR assessment; the portion in Research and Technology shows an increase of $1,380,000.	-$562,000
Beginning in FY 1999, this program will budget $373,000 for estimated costs of obtaining and maintaining security clearances for contractor employees under the Chicago Operations Office and the Oak Ridge National Laboratory.	+$373,000
Adjustments in a number of other places.	-$349,000
Total Funding Change, Facility Operations:	+$37,690,000

HIGH ENERGY PHYSICS

CONSTRUCTION

I. Mission Supporting Goals and Objectives: This provides for the construction of major new facilities needed to meet the overall objectives of the HEP Program.

II. Funding Schedule:

Program Activity	FY 1997	FY 1998	FY 1999	$ Change	% Change
Construction	$100,000	$50,850	$21,000	-$29,850	-58.7%
Total	$100,000	$50,850	$21,000	-$29,850	-58.7%

III. Performance Summary- Accomplishments:

	FY 1997	FY 1998	FY 1999
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. By the end of FY 1998, the project will be about 98% complete. The accelerator will be commissioned and the project completed during FY 1999.	$52,000	$30,950	$ 0
B-factory Project - This project provides for the construction of a B-factory in the PEP storage ring tunnel at SLAC. The B-factory will be completed in FY 1998 and will begin operation for physics research in FY 1999.	45,000	0	0

III. Performance Summary- Accomplishments:	**FY 1997**	**FY 1998**	**FY 1999**
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 230kv transformers. Procurement of long lead switch gear items will be initiated in FY 1997, and the project will be completed by the end of FY 1998.	3,000	9,400	0
Neutrinos at the Main Injector (NuMI) - The FY 1999 funding will provide for an Architect-Engineer firm to accomplish detailed design of several parts of the project and the initiation of wetlands mitigation and the excavations and furnishing for the beam line and target hall. 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 overall project is NuMI; the large detector in the project is designated as MINOS.	0	5,500	14,300
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.	0	5,000	0

III. Performance Summary- Accomplishments:	**FY 1997**	**FY 1998**	**FY 1999**
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	0	6,700
Total Construction	$100,000	$50,850	$21,000

EXPLANATION OF FUNDING CHANGES FROM FY 1998 TO FY 1999:

The Fermilab Main Injector project will be completed in FY 1998.	-$30,950,000
The SLAC Master Substation Upgrade project will be completed in FY 1998.	-$9,400,000
Continuation of the Fermilab NuMI project.	+$8,800,000
C-Zero Area Experimental Hall project at Fermilab will be completed in FY 1998.	-$5,000,000
Initiation of the Wilson Hall Safety Improvement Project at Fermilab. +$6,700,000	
Total Funding Change, Construction:	-$29,850,000

HIGH ENERGY PHYSICS
CAPITAL OPERATING EXPENSES & CONSTRUCTION SUMMARY
(Dollars in thousands)

	FY 1997	FY 1998	FY 1999	$ Change	% Change
Capital Operating Expenses					
General Plant Projects (total)	$11,760	$13,945	$13,785	$-160	-1.1%
Accelerator Improvement Projects (total)	4,940	2,810	9,610	+6,800	+242.0%
Capital Equipment (total)	56,381	84,141	89,510	+5,369	+6.4%

Construction Project Summary (both Operating and Construction Funded)

Project Number	Project Title	TEC	Previous Approp.	FY 1997 Approp.	FY 1998 Approp.	FY 1999 Request	Unapprop. Balance
92-G-302	Fermilab Main Injector	$229,600	$146,650	$52,000	$30,950	$ 0	$ 0
94-G-304	B-factory	177,000	132,000	45,000	0	0	0
97-G-303	SLAC Master Substation Upgrade	12,400	0	3,000	9,400	0	0
98-G-304	Neutrinos at the Main Injector	75,800	0	0	5,500	14,300	56,000
98-G-305	C-Zero Area Experimental Hall	5,000	0	0	5,000	0	0
99-G-306	Wilson Hall Safety Improvements	15,600	0	0	0	6,700	8,900
Total Construction		--	$278,650	$100,000	$50,850	$21,000	$64,900

CAPITAL OPERATING EXPENSES & CONSTRUCTION SUMMARY-HEP (Cont'd)

Major Items of Equipment (CE $2 Million and Above)	TEC	Previous Approp.	FY 1997 Approp.	FY 1998 Approp.	FY 1999 Request	Acceptance Date
1. g-2 Experiment	$ 17,685	$ 16,893	$ 792	$ 0	$ 0	FY 1997
2. D-Zero Upgrade	55,270	20,562	7,925	14,700	9,200	FY 2000
3. CDF Upgrade	57,940	20,032	7,925	14,700	9,000	FY 2000
4. B-factory detector (BaBar)a/	67,000	22,700	20,300	20,500	3,500	FY 1999
5. Antimatter in Space	3,192	2,125	867	200	0	FY 1997
6. Super-Kamiokande	3,584	2,460	593	531	0	FY 1998
7. Large Hadron Collider - Machine**	96,000	0	0	7,800	14,500	FY 2005
8. Large Hadron Collider - Detectors**	85,000	0	0	6,800	12,600	FY 2005
9. MINOS	45,000	0	0	0	3,000	FY 2002

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.

** The FY 1998 and FY 1999 funding and the TEC in both cases are based on preliminary estimates and will need to be revised in future years as additional detailed planning is completed. Substantial additional LHC funding is being provided as operating expenses. The overall multiyear DOE contribution to LHC fabrication is capped at $450,000,000.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1998 Congressional Budget Request are denoted with a vertical line in left margin.)

SCIENCE
(Tabular dollars in thousands. Narrative material in whole dollars.)

HIGH ENERGY PHYSICS

1.	Title and Location of Project:	Neutrinos at the Main Injector (NuMI) Fermi National Accelerator Laboratory	2a. Project No.: 98-G-304 2b. Construction Funded

SIGNIFICANT CHANGES

- Total Estimated Cost and Total Project Cost have been adjusted since project is proceeding from design only to continuation of design and initiation of construction activities.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1998 Congressional Budget Request are denoted with a vertical line in left margin.)

SCIENCE
(Tabular dollars in thousands. Narrative material in whole dollars.)

HIGH ENERGY PHYSICS

1. Title and Location of Project: Neutrinos at the Main Injector (NuMI)
Fermi National Accelerator Laboratory

2a. Project No.: 98-G-304
2b. Construction Funded

	Preliminary Estimate	Title I Baseline	Current Baseline Estimate
3a. Date A-E Work Initiated, (Title I Design Start Scheduled):	1st Qtr. FY 1998	TBD	TBD
3b. A-E Work (Titles I & II) Duration:	21 months	TBD	TBD
4a. Date physical Construction Starts:	1st Qtr. FY 1999	TBD	TBD
4b. Date Construction Ends:	4th Qtr. FY 2002	TBD	TBD

	Preliminary Estimate a/ b/	Title I Baseline	Current Baseline Estimate
5. Total Estimated Cost (TEC) --	$75,800	TBD	TBD
6. Total Project Cost (TPC) --	$135,300	TBD	TBD

7a. Design Financial Schedule (Federal Funds):

Fiscal Year	Appropriations	Adjustments	Obligations	Costs
1998	$5,500		$5,500	$1,375

a/ The FY 1998 request provided only for architect-engineering and technical design work for the facility construction and technical systems.
b/ The TEC and TPC will be refined during FY 1998 using the funds provided for architect-engineer and technical design work.

1. Title and Location of Project: Neutrinos at the Main Injector (NuMI)
Fermi National Accelerator Laboratory

2a. Project No.: 98-G-304
2b. Construction Funded

7b. Construction Financial Schedule (Federal Funds):

Fiscal Year	Appropriations	Adjustments	Obligations	Costs
1999	14,300		14,300	6,325
2000	28,000		28,000	15,525
2001	18,000		18,000	26,575
2002	10,000		10,000	26,000

8. 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.

1. Title and Location of Project: Neutrinos at the Main Injector (NuMI)
Fermi National Accelerator Laboratory

2a. Project No.: 98-G-304
2b. Construction Funded

9. Details of Cost Estimate*

	Item Cost	Total Cost
a. EDI&A		
1. Conventional construction	$8,163	
2. Technical components	1,200	
		$9,363
b. Construction costs		
1. Conventional construction	37,298	
2. Technical components	6,807	
		44,105
c. Contingencies at approximately 29 percent of above costs		
1. Conventional construction	13,002	
2. Technical components	2,530	
		15,532
d. Project management and indirect costs		
1. Project Management	2,700	
2. Indirect costs	4,100	
		6,800
Total		$75,800

* 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.

1. Title and Location of Project: Neutrinos at the Main Injector (NuMI)
Fermi National Accelerator Laboratory

2a. Project No.: 98-G-304
2b. Construction Funded

10. 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.

11. Schedule of Project Funding and Other Related Funding Requirements

a. Total project costs	Prior Years	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	Total	
1. Total facility costs								
(a) Line item (Section 9) TEC	$0	$1,375	$6,325	$15,525	$26,575	$26,000	$75,800	
Total facility costs	$0	$1,375	$6,325	$15,525	$26,575	$26,000	$75,800	
2. Other project costs								
(a) Capital Equipment	$0	$0	$3,000	$16,500	$20,000	$10,500	$50,000	
(b) R&D costs necessary to complete the project	600	1,400	0	0	0	0	2,000	
(c) Conceptual Design Cost	700	100	0	0	0	0	800	
(d) Decontamination & Decommissioning Costs	0	0	0	0	0	0	0	
(e) NEPA Documentation Costs	0	0	0	0	0	0	0	
(f) Pre-operating costs	0	0	0	0	0	0	0	
(g) Other project-related costs	0	0	2,000	3,000	1,000	700	6,700	
Total other project costs	$1,300	$1,500	$5,000	$19,500	$21,000	$11,200	$59,500	
Total project costs (TPC)	$1,300	$2,875	$11,325	$35,025	$47,575	$37,200	$135,300	d/

b. Related annual costs

1. NuMI facility operating costs	$ 500
2. Incremental utility costs (estimate based on FY 1997 rate structure)	500
Total related annual costs	$1,000
Total operating costs (FY03-07)	$5,000

d/ The Total Project Cost will be refined during the FY 1998 design effort.

1. Title and Location of Project: Neutrinos at the Main Injector (NuMI)
Fermi National Accelerator Laboratory

2a. Project No.: 98-G-304
2b. Construction Funded

12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

a. Total project costs

1. Total facility costs

(a) Construction line item - explained in items 8, 9.

2. Other project costs

(a) Capital equipment - 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) Direct R&D operating costs - 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) Conceptual design costs - includes operating costs for development of conceptual design and scope definition for the NuMI facility.
(d) Decontamination & Decommissioning costs - none required.
(e) NEPA Documentation costs - Costs to develop an Environmental Assessment, including field tests and measurements at the proposed construction location are included in the conceptual design costs
(f) Pre-operating costs - Included in detector and beam prototyping costs
(g) Other project-related costs - Include funding required to complete the construction and outfitting of the Soudan Laboratory for the new far detector by the University of Minnesota.

b. Related annual costs

1. NuMI facility operating costs - including personnel and M&S costs (exclusive of utility costs), for operation, maintenance, and repair of the NuMI facility.
2. Incremental utility costs (estimate based on FY 1997 rate structure) - 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 will begin beyond FY02.

DEPARTMENT OF ENERGY
FY 1999 CONGRESSIONAL BUDGET REQUEST

SCIENCE
(Tabular dollars in thousands. Narrative material in whole dollars.)

HIGH ENERGY PHYSICS

1. Title and Location of Project:	Wilson Hall Safety Improvements Project Fermi National Accelerator Laboratory		2a. Project No.: 99-G-306 2b. Construction Funded

	Preliminary Estimate	Title I Baseline	Current Baseline Estimate
3a. Date A-E Work Initiated, (Title I Design Start Scheduled):	1st Qtr. FY 1999	TBD	TBD
3b. A-E Work (Titles I & II) Duration:	17 months	TBD	TBD
4a. Date physical Construction Starts:	3rd Qtr. FY 1999	TBD	TBD
4b. Date Construction Ends:	3rd Qtr. FY 2002	TBD	TBD

	Preliminary Estimate	Title I Baseline	Current Baseline Estimate
5. Total Estimated Cost (TEC) --	$15,600	TBD	TBD
6. Total Project Cost (TPC) --	$18,800	TBD	TBD

1. Title and Location of Project: Wilson Hall Safety Improvements Project
Fermi National Accelerator Laboratory

2a. Project No.: 99-G-306
2b. Construction Funded

7a. Design Financial Schedule (Federal Funds):

Fiscal Year	Appropriations	Adjustments	Obligations	Costs
N/A				

7b. Construction Financial Schedule (Federal Funds):

Fiscal Year	Appropriations	Adjustments	Obligations	Costs
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

8. 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.

8. Project Description, Justification and Scope (continued)

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 6 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.

1. Title and Location of Project: Wilson Hall Safety Improvements Project
Fermi National Accelerator Laboratory

2a. Project No.: 99-G-306
2b. Construction Funded

8. Project Description, Justification and Scope (Continued)

Building Entrances: The north (main) entrance doors will be replaced with revolving doors. The south entry doors will also be replaced, as well as the window walls adjacent to all of these locations.

Skylight: Water penetration is causing structural deterioration and damage to Wilson Hall. The skylight system requires disassembly, cleaning, replacement of damaged panels and glazing materials, and repair of the internal drainage system. Failure to complete this work may result in safety concerns for the entire system which functions as the roof to the 16 story Atrium.

The building systems portion of this project provides for the repairs, alterations, and improvements of the Wilson Hall domestic water system. The work includes replacement of piping known to be either substantially blocked or substantially deteriorated. The quality of the domestic water supplied to the drinking fountains will be improved by installation of a re-circulating piping loop and filtration system.

9. Details of Cost Estimate

	Item Cost	Total Cost
a. Design and Management Costs		$ 4,010
1. Engineering design and inspection	$1,790	
2. Construction Management Costs	1,820	
3. Project management	400	
b. Construction costs (buildings)		8,670
c. Contingencies at approximately 30 percent of above costs		2,920
d. Total line item cost (Section 11. a. 1. (a))		$15,600

Note: 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

1. Title and Location of Project: Wilson Hall Safety Improvements Project
Fermi National Accelerator Laboratory

2a. Project No.: 99-G-306
2b. Construction Funded

10. Method of Performance

Overall project management, quality assurance, supervision of design and construction efforts and coordination with the US. 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.

11. Schedule of Project Funding and Other Related Funding Requirements

	Previous Years	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	Total
a. Total project costs							
1. Total facility costs							
(a) Line item (Section 9. d.)	$0	$0	$1,690	$6,340	$6,990	$580	$15,600
(b) (Federal and Non-federal)		$0	$0	$1,690	$6,340	$6,990	$580
$15,600							
2. Other project costs							
(a) Design development costs	$530	$270	$ 0	$ 0	$ 0	$ 0	$ 800
(b) Other project-related costs	0	0	560	380	1,000	460	2,400
(c) Total other project costs	$530	$270	$ 560	$ 380	$1,000	$ 460	$3,200
(d) Total project cost	$530	$270	$2,250	$6,720	$7,990	$1,040	$18,800

12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

a. Total project funding
1. Total facility costs
(a) Line item--Narrative not required.
(b) PE&D--None.
(c) Expense-funded equipment--None
(d) Inventories--None.

1. Title and Location of Project: Wilson Hall Safety Improvements Project
Fermi National Accelerator Laboratory

2a. Project No.: 99-G-306

2b. Construction Funded

12. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

2. Other project costs
   (a) R&D necessary to complete construction--None.
   (b) Design development--No narrative required.
   (c) Decontamination and Decommissioning (D&D)--None.
   (d) NEPA Documentation-- A Categorical Exclusion (CX) has been issued for this project, resulting in insignificant cost at this level of detail.
   (e) Other project related costs: 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. Related annual costs - None.