U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

HEARING CHARTER

NSF Major Multi-User Research Facilities Management: Ensuring Fiscal Responsibility and Accountability

Wednesday, April 18, 2012
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

1. Purpose

On Wednesday, April 18, 2012, the Committee on Science, Space, and Technology Subcommittee on Research and Science Education will hold a hearing to examine the planning, management, operations, and stewardship of major multi-user research facilities funded through the National Science Foundation.

2. Witnesses

Dr. Ethan J. Schreier, President, Associated Universities, Inc.

Dr. William S. Smith, **Jr.**, President, Association of Universities for Research in Astronomy

Dr. David Divins, Vice President and Director, Ocean Drilling Programs, Consortium for Ocean Leadership, Inc.

Dr. Gregory S. Boebinger, Director, National High Magnetic Field Laboratory and Professor of Physics, Florida State University and University of Florida

Dr. Sol Michael Gruner, Director, Cornell High Energy Synchrotron Source and The John L. Wetherill Professor of Physics, Cornell University

3. Overview

- Providing support for major multi-user research equipment and facilities is a component of support for basic research.

- According to the most recent National Science Foundation (NSF) Strategic Plan for 2011 through 2016, "A major element in the ability to expand S&E knowledge in general, as well as transform the frontiers, is having tools that enable new capabilities for measurement, observation, manipulation, and experimentation." [1]

[1] *NSF Strategic Plan FY2011-2016*, p. 9.

- The Fiscal Year 2013 NSF budget request includes $1119.47 million for major multi-user research facilities, including $923.30 million from the Research and Related Activities account for operations and maintenance of existing facilities, federally funded research and development centers, operations and maintenance of facilities under construction, and planning and concept development.[2]

- The operations and maintenance of existing facilities, funded by NSF, is reviewed annually. Every five years facilities are considered for renewal or recompetition. In 2008, the National Science Board endorsed the principle that "all expiring awards are to be recompeted, because rarely will it be in the best interest of U.S. science and engineering research and education not to do so."[3]

- The National Science Foundation supports three of the thirty-nine Federally Funded Research and Development Centers (FFRDC). FFRDCs "provide the sponsoring federal agencies with capabilities to meet special long-term R&D needs that cannot be met as effectively by existing in-house or by contractor resources."[4]

4. Background

A component of support for basic research is providing researchers, students, and teachers access to powerful, cutting-edge equipment and facilities. This research infrastructure has a major impact on broad segments of scientific and engineering disciplines. Large and up-to-date research equipment and facilities enhance the fundamental processes of basic research. These equipment and facilities may consist of multi-user facilities, large-scale computational infrastructures, or networked instrumentation and equipment. Telescopes, particle accelerators, gravitational wave observatories, and research vessels are only a handful of examples of major research infrastructure projects.

Major Multi-User Research Facilities and the National Science Foundation

As the primary federal agency supporting basic scientific research, the National Science Foundation (NSF) funds a variety of large research projects, from multi-user research facilities to tools for research and education and distributed instrumentation networks. This funding provides state-of-the-art tools for research and education, distributed instrumentation networks and arrays, accelerators, telescopes, research vessels, aircraft, and earthquake simulators. In addition, support for internet-based and distributed user facilities is increasing as a result of rapid advances in computer, information, and communication technologies. Funding support for these major projects is coordinated with other agencies, organizations, and international partners to ensure projects are integrated and complementary. Infrastructure construction is funded out of the Major Research Equipment and Facilities (MREFC) account at NSF. Planning, and operations and maintenance of multiuser facilities are funded through NSF's Research and

[2] NSF FY13 Budget Request – Facilities, p. 1.
[3] The National Science Board, Committee on Programs and Plans, NSB-08-12, http://www.nsf.gov/nsb/publications/2008/nsb0812_comp_recomp.pdf
[4] NCSES InfoBrief, March 2012, NSF 12-315, p. 1.

Related Activities (RRA) account. The NSF Fiscal Year 2013 (FY13) budget request for the major multi-user research facilities is $1119.47 million.[5]

Major Multi-User Research Facilities Funding[6]

(dollars in millions)

	FY11 Actual	FY12 Estimate	FY13 Request	Change Over FY12 Estimate	
				Amount	Percent
Total, Research and Related Activities	**913.54**	**909.70**	**923/30**	**13.6**	**1.5**
Operations and Maintenance (O&M) of Existing Facilities	*673.63*	*655.37*	*647.35*	*-8.02*	*-1.2*
Federally Funded R&D Centers	*195.25*	*195.85*	*191.71*	*-4.14*	*-2.1*
O&M of Facilities under Construction	*17.49*	*44.73*	*72.49*	*27.76*	*62.1*
R&RA Planning and Concept Devcelopment	*27.17*	*13.75*	*11.75*	*-2.00*	*-14.5*
Major Research Equipment and Facilities Construction	**125.37**	**197.06**	**196.17**	**-0.86**	**-0.5**
Total, Major Multi-User Research Facilities	**1038.91**	**1106.76**	**1119.47**	**12.71**	**1.1**

The MREFC account was formally established in 1995, as an NSF-wide budgetary account to promote effective planning and management in the Foundation's support for large investments in major research equipment and facilities. The MREFC account supports the acquisition, construction, and commissioning of major research facilities and equipment. "The MREFC account was created to separate the construction funding for a large facility – which can rise and fall dramatically over the course of a few years – from the more continuous funding of facility operations and individual-investigator research."[7]

Since the creation of the MREFC account, NSF has funded 17 projects. In the FY13 budget request, NSF is requesting funding for four facilities: Advanced Laser Interferometer Gravitational-Wave Observatory (AdvLIGO); Advanced Technology Solar Telescope (ATST); National Ecological Observatory Network (NEON); and Ocean Observatories Initiative (OOI). Two other facilities, Atacama Large Millimeter Array (ALMA) and IceCube Neutrino Observatory (IceCube) are transitioning from the MREFC account to the appropriate research directorates for operations and maintenance. At this time, there are no new proposed facilities. The FY13 budget request for the MREFC account is $196.17 million.

Pre-construction planning and concept and development for MREFC projects are funded from the RRA account. This funding supports activities including design, cost estimates, and other actions that prepare potential projects for oversight review, agency decisions milestones, and potential implementation. The FY13 budget request for planning and development is $11.75 million.[8]

The continued operations and maintenance (O&M) of major multi-user research facilities is also funded through the RRA account. NSF Directorate support for O&M is essential for major

[5] NSF FY13 Budget Request – Facilities, p. 1.
[6] NSF FY13 Budget Request – Facilities, p. 1.
[7] The National Academy of Sciences, *Setting Priorities for Large Research Facility Projects Supported fy the National Science Foundation*, p. 8.
[8] NSF FY13 Budget Request – Facilities, p. 66.

multi-user research facilities. Currently, the Engineering, Geosciences, and Mathematical and Physical Sciences Directorates, as well as the Office of Polar Programs, support existing facilities, see below. The FY13 budget request for O&M is $647.35 million.

Major Multi-User Research Facilities Funding Request[9]

(dollars in millions)

	FY11 Actual	FY12 Estimate	FY13 Request	Change Over FY12 Estimate	
				Amount	Percent
Operations and Maintenance of Existing Facilities	**673.63**	**655.37**	**647.35**	**-8.02**	**-1.2**
Engineering					
National Nanotechnology Infrastructure Network (NNIN)	*16.36*	*15.86*	*15.36*	*-0.50*	*-3.2*
Network for Earthquake Engineering Simulation	*20.10*	*20.50*	*20.50*	*0*	*0*
Geosciences					
Academic Research Fleet [A]	*81.67*	*76.75*	*72.00*	*-4.75*	*-6.2*
EarthScope: USArray, SAFOD, POB	*26.02*	*25.05*	*26.17*	*1.12*	*4.5*
Incorporated Research Institutions for Seismology	*12.37*	*12.36*	*11.25*	*-1.11*	*-9.0*
Integrated Ocean Drilling Program	*53.35*	*44.40*	*38.90*	*-5.50*	*-12.4*
Mathematical and Physical Sciences					
Arecibo Observatory (formerly NAIC)[B]	*9.26*	*8.70*	*8.20*	*-0.50*	*-5.7*
Cornell High Energy Synchrotron Source (CHESS)/ Cornell Electron Storage Ring (CESR)	*14.12*	*19.67*	*20.00*	*0.33*	*1.7*
Gemini Observatory	*19.50*	*22.07*	*18.15*	*-3.92*	*-17.8*
IceCube	*6.90*	*6.90*	*6.90*	*0*	*0*
Large Hadron Collider	*18.00*	*18.00*	*18.00*	*0*	*0*
Laser Interferometer Gravitational Wave Observatory	*30.30*	*30.40*	*30.50*	*0.10*	*0.3*
National High Magnetic Field Laboratory	*32.68*	*25.80*	*31.75*	*5.95*	*23.1*
National Solar Observatory	*9.10*	*9.10*	*8.00*	*-1.10*	*-12.1*
National Superconducting Cyclotron Laboratory	*21.50*	*21.50*	*21.50*	*0*	*0*
Other Facilities[C]	*4.86*	*2.52*	*2.66*	*0.14*	*5.6*
Polar Programs					
Polar Facilities and Logistics[D]	*297.54*	*295.79*	*297.51*	*1.72*	*0.6*
Federally Funded Research and Development Centers[E]	**195.25**	**195.85**	**191.71**	**-4.14**	**-2.1**
National Center for Atmospheric Research (NCAR)	*98.10*	*98.60*	*92.29*	*-6.31*	*-6.4*
National Optical Astronomy Observatory (NOAO)	*29.50*	*25.50*	*25.50*	*0*	*0*
National Radio Astronomy Observatory (NRAO)[F]	*67.65*	*71.75*	*73.92*	*2.17*	*3.0*
Operations and Maintenance of Facilities under Construction	*17.49*	*44.73*	*72.49*	*27.76*	*62.1*
Advanced Technology Solar Telescope (ATST)	*2.00*	*2.00*	*2.00*	*0*	*0*
National Ecological Observatory Network (NEON)		*15.93*	*30.39*	*14.46*	*90.8*
Ocean Observatories Initiative (OOI)	*15.49*	*26.80*	*40.10*	*13.30*	*49.6*
RRA Planning and Concept Development	**27.17**	**13.75**	**11.75**	**-2.00**	**-14.5**
Pre-construction Planning[G]	*17.50*	*6.75*	*8.75*	*2.00*	*29.6*
Concept and Development for MREFC projects	*9.67*	*7.00*	*3.00*	*-4.00*	*-57.1*
Major Research Equipment and Facilities Construction	**125.37**	**197.06**	**196.10**	**-0.89**	**-0.5**
Total, Major Multi-User Research Facilities	**1038.91**	**1106.76**	**1119.47**	**12.71**	**1.1**

[9] NSF FY13 Budget Request – Facilities, p. 2.

Totals may not add due to rounding.
[A] An additional $2.0 million in FY12 and $1.0 million in FY13 for Regional Class Research Vessels is included in pre-construction planning.
[B] The National Astronomy and Ionosphere Center (NAIC) was decertified as an FFRDC in FY 2011 and renamed Arecibo Observatory.
[C] Other Facilities includes support for other physics and materials research facilities.
[D] In FY 2011, Polar Facilities and Logistics excludes a one-time appropriation transfer of $54.0 million to U.S. Coast Guard per P.L. 112-10.
[E] Federally Funded R&D Centers does not include support for the Science and Technology Policy Institute, which is an FFRDC but not a multi-user research facility
[F] Operations and Maintenance of ALMA are included in NRAO.
[G] Pre-construction planning includes R&RA funding for potential next-generation major multi-user facilities.

Major multi-user facilities work through contracts or cooperative agreements between NSF and principal investigators (PI) responsible for the facility. These agreements identify the governance and structure for the facilities, specify the roles and responsibilities of the PI, and require regular reviews and audits. The majority of the NSF funded multi-user facilities have transitioned to five-year cooperative agreements. Every five years, the NSF program officer responsible for the facility makes a recommendation to the National Science Board (NSB) as to the renewal, recompetition, or termination of support for the facility.

Renewal and Recompetition of Multi-User Research Facilities

In 2008, the NSB drafted a resolution outlining its support for the regular recompetition of NSF supported multi-user research facilities:

> WHEREAS, the Committee on Programs and Plans has reassessed, at its meeting of February 6-7, 2008, the major principles and key issues in a statement "Competition, Recompetition and Renewal of NSF Awards" (NSB/CPP-08-4) in the context of the various types of NSF awards.
>
> Therefore, be it RESOLVED that the National Science Board (the Board) endorsed strongly the principle that all expiring awards are to be recompeted, because rarely will it be in the best interest of U.S. science and engineering research and education not to do so. Furthermore, the Board endorsed a recompetition policy for major facility awards which is transparent to the research community such that after construction of major facilities is completed, followed by an appropriate time period to bring the facility to sustainable operations, full and open competition of the operations award will be required.
>
> This position was based on the conviction that peer-reviewed competition and recompetition is the process most likely to assure the best use of NSF funds for supporting research and education.
>
> The Board requested that the Director, NSF, take such steps necessary to ensure that all NSF practices embody this principle.[10]

Since that time, NSF has worked to implement the resolution, forming an ad hoc Subcommittee of the Business and Operations Advisory Committee to advise on implementation. In 2010 and

[10] The National Science Board, Committee on Programs and Plans, NSB-08-12, http://www.nsf.gov/nsb/publications/2008/nsb0812_comp_recomp.pdf

2011, the Subcommittee, made up of influential senior researchers in fields served by multi-user facilities, met to produce a report recommending implementation practices. The Subcommittee brought in facility users and directors for input. The NSB will review the report in May of this year.

Federally Funded Research and Development Centers

The category of major multi-user research facilities represents a broad array of facilities and equipment. From university based synchrotrons to the academic research fleet these equipment and facilities vary greatly. Included in this category are federally funded research and development centers (FFRDCs). FFRDCs were established by the federal government during and immediately following World War II.[11]

FFRDCs are privately operated not-for-profit organizations financed exclusively or substantially by federal agencies. To minimize conflicts of interest, FFRDCs cannot compete with for-profit companies for additional government contracts and are not allowed to produce and market commercial products. Each FFRDC is administered, through a contract with the sponsoring federal agency, by a university or university consortium, a nonprofit organization, or an industrial firm. "FFRDCs provide the sponsoring federal agencies with capabilities to meet special long-term R&D needs that cannot be met as effectively by existing in-house or by contractor resources."[12] NSF supports four FFRDCs: the National Center for Atmospheric Research (NCAR), the National Optical Astronomy Observatory (NOAO), and the National Radio Astronomy Observatory (NRAO), and the Science and Technology Policy Institute (STPI)[13].

Associated Universities, Inc. (AUI)[14]

Associated Universities, Inc. (AUI) was established in 1946 by nine universities: Columbia University, Cornell University, Harvard University, the Johns Hopkins University, Massachusetts Institute of Technology, the University of Pennsylvania, Princeton University, the University of Rochester, and Yale University.[15]

AUI operates National Radio Astronomy Observatory (NRAO) and is responsible for oversight and audit of the operation of the FFRDC. AUI appoints the Observatory Director, approves appointments of tenured staff and senior managers; reviews ongoing programs and budget; and oversees long-range planning and proposals for new, major facilities. These actions are reviewed by the NSF, with NSF approval required for major commitments. AUI employs a Visiting Committee of independent experts to review the quality and scope of ongoing and planned

[11] CRS Report for Congress, Department of Homeland Security: Issues Concerning the Establishment of Federally Funded Research and Development Centers (FFRDCs), p. 1-4.
[12] NCSES InfoBrief, March 2012, NSF 12-315, p. 1.
[13] STPI provides analytical support to the Office of Science and Technology Policy but is not a multi-user facility. It is managed by the Institute for Defense Analysis and funded through NSF. FY 12 Appropriations for STPI were $3.04 million.
[14] NSF FY13 Budget Request – Facilities, p. 64.
[15] http://www.aui.edu/about.php?q=history

scientific programs at NRAO. This Committee is composed of distinguished scientists drawn from universities and industrial organizations all over the world.

NRAO provides state-of-the-art radio telescope facilities for scientific users. NRAO conceives, designs, builds, operates, and maintains radio telescopes used by scientists from around the world to study virtually all types of astronomical objects known, from planets and comets in our own Solar System to quasars and galaxies billions of light-years away.

As a FFRDC, NRAO operates major radio telescopes in Green Bank, West Virginia, near Socorro, New Mexico, and at ten telescope array sites spanning the U.S. from the Virgin Islands to Hawaii. Headquartered in Charlottesville, Virginia, NRAO is also the North American implementing organization for the international Atacama Large Millimeter Array (ALMA) project, which in FY 2013 will be in the final stages of construction, funded through the MREFC account.

These federally funded, ground-based observing facilities for radio astronomy are available to any qualified astronomer, regardless of affiliation or nationality, on the basis of scientific peer-reviewed proposals, and annually serve over 1,500 users worldwide. The Observatory allocates telescope time on the basis of merit but provides no financial support. NSF does not provide individual investigator awards targeted specifically for use of NRAO facilities. Many users are supported through NSF or NASA grants to pursue scientific programs that require use of the facilities.

NRAO supplements Division of Astronomical Sciences (AST) support with funding provided by other NSF sources, other federal agencies, and non-federal sources. Management is through a cooperative agreement with AUI. AUI manages the observatory through its own community-based oversight and users' committees. The NRAO director reports to the president of AUI. The current cooperative agreement is in place for the years FY10 through FY15. Preparations are underway for a solicitation for the management and operation of NRAO that will be promulgated in FY13 for a new cooperative agreement to begin October 1, 2015.

Association of Universities for Research in Astronomy (AURA)[16]

Association of Universities for Research in Astronomy (AURA) is a consortium of universities, and educational and other non-profit institutions that operates astronomical observatories. AURA membership includes 37 U.S. Institutions and seven international affiliates.[17] AURA operates several multi-user facilities, including National Optical Astronomy Observatory (NOAO), the Gemini Observatory, and the National Solar Observatory.

NOAO

NOAO was established in 1982 by uniting operations of the Kitt Peak National Observatory (KPNO) in Arizona and the Cerro Tololo Inter-American Observatory (CTIO) in Chile. NOAO is a FFRDC for research in ground-based, nighttime, optical, and infrared (OIR) astronomy. NOAO also is the gateway for the U.S. astronomical community to the International Gemini

[16] NSF FY13 Budget Request – Facilities, p. 20, 45, 61.
[17] http://www.aura-astronomy.org/about.asp

Observatory and to the "System" of federally-funded and non-federally-funded OIR telescopes through the Telescope System Instrumentation Program (TSIP) and the Renewing Small Telescopes for Astronomical Research (ReSTAR) program.

For all NOAO and "System" telescopes, peer-review telescope allocation committees provide merit-based telescope time but no financial support. NOAO manages national community involvement in the development of potential future infrastructure projects and is closely involved in the design, development, and potential construction and operations of the Large Synoptic Survey Telescope (LSST). NOAO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer reviewed observing proposals.

In FY 2011, NOAO received $15.77 million for reimbursed services from partnerships and tenant observatory support, from the Kitt Peak Visitors' Center, grants from other federal agencies, and NSF supplemental funding for LSST and for the Research Experiences for Undergraduates (REU) program.

An NSF AST program director provides continuing oversight, including consultation with an annual NSF program review panel. The program director reviews detailed annual program plans, annual long range plans, quarterly technical and financial reports, and annual reports submitted by NOAO, and attends AURA governance committee meetings.

The NOAO director reports to the president of AURA, who is the principal investigator on the FY10 NSF cooperative agreement. AURA receives management advice from an observatory council composed of members of its scientific and management communities. NOAO employs separate visiting and users committees for the purposes of self-evaluation and prioritization.

In addition to reviews held mid-way through all cooperative agreements, NSF conducts both periodic and ad hoc external reviews of AURA management. A Business Systems Review (BSR) to evaluate the restructuring of NOAO's business services began in FY12. A mid-term management review is scheduled for FY12. A full BSR will be conducted in FY13.

A management review of AURA's performance was carried out in August 2006. In response to the review, the NSB extended the previous cooperative agreement with AURA for eighteen months, through September 30, 2009. A proposal for renewal of the cooperative agreement was received from AURA in December 2007 and underwent review in 2008. The NSB authorized a new cooperative agreement with AURA for the management and operation of NOAO for the period October 1, 2009, through March 31, 2014. A solicitation is being developed and will be promulgated in late 2012 for the management of NOAO under a new cooperative agreement to begin April 1, 2014.

Gemini

The Gemini Observatory (Gemini) consists of two infrared-optimized 8-meter telescopes, one in the northern hemisphere, in Hawaii, and one in the southern hemisphere, in Chile. This siting of the two telescopes assures complete coverage of the sky and complements the observations from space-based observatories.

Gemini is an international partnership with the United Kingdom, Canada, Australia, Chile, Argentina, and Brazil. Construction of the telescopes and their instrumentation has involved a large number of industrial entities in several partner and non-partner countries.

Peer-review telescope allocation committees provide merit-based telescope time but no financial support. NSF does not provide awards targeted specifically for use of Gemini. Many U.S. users are supported through separate NSF or NASA grants to pursue scientific programs that require use of Gemini.

NSO

The National Solar Observatory (NSO) operates facilities in New Mexico and Arizona as well as a coordinated worldwide network of six telescopes specifically designed to study solar oscillations. NSO leads the community in design and development of the Advanced Technology Solar Telescope (ATST). NSO makes available to qualified scientists the world's largest collection of optical and infrared solar telescopes and auxiliary instrumentation for observation of the solar photosphere, chromosphere, and corona. NSO also provides routine and detailed, synoptic solar data used by many researchers and other agencies through its online archive and data delivery system. NSO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer-reviewed observing proposals.

NSO partners include the U.S. Air Force Office of Scientific Research, U.S. Air Force Weather Agency, NASA, and industrial entities. Many universities and institutes collaborate with NSO on solar instrumentation development and on the design and development of ATST.

An NSF AST program director provides continuing oversight, including consultation with an annual NSF program review panel. The program director makes use of detailed annual program plans, annual long-range plans, quarterly technical and financial reports, and annual reports submitted by NSO as well as attending AURA Solar Observatory Council meetings.

The NSO director reports to the president of AURA, who is the principal investigator on the FY10 NSF cooperative agreement. AURA receives management advice from its Solar Observatory Council, composed of members of its scientific and management communities. NSO employs visiting and users' committees for the purposes of self-evaluation and prioritization. In addition to reviews held mid-way through all cooperative agreements, NSF conducts both periodic and ad hoc reviews of AURA management, as needed, by external committees. The last extensive review for NSO was in FY08 that led to the award of a new cooperative agreement at the beginning of FY10. Annual reviews are anticipated for both NSO program plans and the ATST project, beginning in spring 2011. A Business Systems Review is scheduled for spring 2012.

A management review of AURA's performance was carried out in August 2006. In response to the favorable review, the NSB extended the current cooperative agreement with AURA for eighteen months, through September 30, 2009. A proposal for renewal of the cooperative agreement was received from AURA in December 2007 and underwent review in 2008. The NSB authorized a new cooperative agreement with AURA for management and operation of NSO for the period October 1, 2009, through March 31, 2014. Since NSO is the home for the

ATST project, which is expected to begin operation in 2018, it is anticipated that the current cooperative agreement will be renewed without competition upon its expiration in 2014.

Consortium for Ocean Leadership, Inc. (COL)[18]

The Consortium for Ocean Leadership, Inc. (COL) is a nonprofit organization that represents 99 public and private ocean research education institutions, aquaria and industry; working to advance research, education and sound ocean policy. COL also manages ocean research and education programs in areas of scientific ocean drilling, ocean observing, ocean exploration, and ocean partnerships.[19]

The Integrated Ocean Drilling Program (IODP), which began in FY04, is an expanded successor program to the Ocean Drilling Program (ODP) and represents an international partnership of the scientists, research institutions, and funding organizations of 25 nations to explore the evolution and structure of Earth as recorded in the ocean basins. The IODP is co-led by NSF and the Ministry of Education, Culture, Sport, Science and Technology (MEXT) of Japan.

IODP platforms provide sediment and rock samples (cores), in-situ monitoring, sampling, and measurement from borehole observatories, shipboard and shorebased descriptive and analytical facilities, downhole geophysical and geochemical measurements (logging), and opportunities to conduct experiments to determine in-situ conditions beneath the sea floor.

Annual operations and maintenance support for IODP includes the costs of operating the *Joides Resolution*, the primary platform of IODP. NSF provides support for U.S. scientists to sail on IODP drilling platforms and to participate in the IODP Science Advisory Structure through an associated grants program.

NSF and MEXT are equal partners in IODP and contribute approximately equal amounts to program operation costs. The European Consortium for Ocean Research Drilling (ECORD), representing 16 European countries and Canada; the People's Republic of China; Korea; India; Australia; and New Zealand have also officially joined IODP and provide financial contributions. IODP partners, including NSF, support IODP integrative activities including science planning, review, data management, drilling science-related engineering development, core and sample archiving, publishing, and international outreach.

The Scientific Ocean Drilling Vessel (SODV) project was funded through the MREFC account and supported the contracting, conversion, outfitting, and acceptance trials of a deepsea drilling vessel for long-term use in the IODP. The total NSF cost of the project was $115 million, appropriated through the MREFC account over three years, with FY07 representing the final year of appropriations. The ship owner and operator, Overseas Drilling Limited (ODL), covered an additional $15 million in construction costs in exchange for a higher day-rate charge during operations. This higher day-rate charge will expire at the end of FY13, with reversion to the lower base day-rate for a contractually guaranteed ten years if IODP is renewed.

[18] NSF FY13 Budget Request – Facilities, p. 28.
[19] http://www.oceanleadership.org/about-ocean-leadership/mission/

The Division of Ocean Sciences (OCE) in the Directorate for Geosciences (GEO) manages the SODV and the IODP under the NSF Ocean Drilling Program. NSF's Ocean Drilling Program is located within the Marine Geosciences Section, with several program officers dedicated to its oversight.

NSF and MEXT have signed a Memorandum of Cooperation, which identifies procedures for joint management of a contract to an IODP Central Management Office (CMO). A non-profit corporation of U.S., Japanese, and other international institutions (IODP Management International, Inc.) has been contracted by NSF for the CMO activity. The CMO coordinates and supports scientific planning, drilling platform activity, data and sample distribution, and publication and outreach activities through its management of commingled international science funds, collected and provided by NSF. Drillship providers are responsible for platform operational management and costs. NSF provides a light drillship through a contract with the U.S. systems integration contractor, an alliance formed by COL together with subcontractors at Texas A&M University and Lamont-Doherty Earth Observatory, Columbia University. MEXT manages its drillship through the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), while the British Geological Survey manages ECORD drilling contributions.

Scientific advice and guidance for IODP is provided through the science advisory structure (SAS), recently streamlined and made more efficient in response to independent, contractual management review. Representation in the SAS is proportional to IODP member financial contributions.

Both the CMO and SIC contracts call for management reviews every three years by independent, external panels. Both the SIC and CMO contracts underwent external review in FY10. Performance under both contracts will be reviewed again in FY13. Reviews for each expedition are carried out on a regular basis to evaluate operational and scientific performance, with review of scientific progress in broader thematic areas conducted by an independent panel every several years.

The current IODP program officially ends in 2013, with IODP international agreements and contracts covering activities through FY13. NSF activities regarding a possible IODP renewal, including overall program review, commenced in FY10. IODP scientific community planning efforts for a possible post-FY13 science program commenced in FY09.

National High Magnetic Field Laboratory (NHMFL)[20]

The National High Magnetic Field Laboratory (NHMFL) is operated by Florida State University (FSU), the University of Florida (UF), and Los Alamos National Laboratory (LANL). NHMFL develops and operates high magnetic field facilities that scientists and engineers use for research in core areas of condensed matter and material physics, materials science and engineering, solid state chemistry and various areas of the biological and biochemical sciences, as well as work on energy and the environment.

[20] NSF FY13 Budget Request – Facilities, p. 39.

NHMFL facilities are available to all qualified scientists and engineers through a peer-reviewed proposal process. In 2011, the lab set the world's record for the highest nondestructive pulsed magnetic field reaching 97.4 tesla. The 45 tesla hybrid magnet currently provides the highest steady state magnetic fields in the world. Both magnets enable scientists to get new insights on the electronic structure of novel materials such as graphene, topological insulators, high temperature superconductors and more.

NHMFL collaborates with more than 60 private sector companies, including Cryomagnetics, Pfizer, SuperPower, and Oxford Superconductor Technologies, and national laboratories and FFRDCs, including those supported by the Department of Energy (DOE) such as the Spallation Neutron Source and the Advanced Photon Source at Argonne National Laboratory. International collaboration includes magnet development with the Helmholtz-Zentrum Berlin (HZB) (previously known as the Hahn-Meitner-Institute Berlin), the International Thermonuclear Experimental Reactor (ITER) in France, and national magnet labs in France, the Netherlands, Germany, and China.

NHMFL is supported by the Division of Materials Research (DMR) and the Division of Chemistry (CHE) in the Directorate for Mathematical and Physical Sciences (MPS). DMR is the steward supporting the broad mission of the facility, providing 95 percent of the funds. CHE supports the Fourier Transform Ion Cyclotron Resonance Laboratory and provides about 5 percent. Primary responsibility for NSF oversight is with the national facilities program director in DMR, with guidance from an *ad hoc* working group with members from CHE and the Directorate for Biological Sciences.

A consortium of the three institutions (FSU, UF, and LANL) operates NHMFL under a cooperative agreement. FSU, as the signatory of the agreement, has the responsibility for appropriate administrative and financial oversight and for ensuring that operations of the laboratory are of high quality and consistent with the objectives of the cooperative agreement. The principal investigator serves as the NHMFL Director.

NSF conducts annual external reviews, which assess user programs, in-house research, long-term plans to contribute significant research developments both nationally and internationally, and operations, maintenance, and new facility development. Annual reviews also assess the status of education training and outreach, operations and management efficiency, and diversity plans. Recent and upcoming reviews include: Business Systems Review (BSR), final report issued in September 2009; Renewal Review by external panel of site visitors, December 2011; National Research Council study on the future of high field magnetic science, started in FY12.

A comprehensive renewal review was conducted in FY07. On August 8, 2007 the NSB approved a five-year renewal award not to exceed $162 million for FY08-FY12. A five-year renewal proposal for the operation of the NHMFL from FY13 through FY17 was submitted to NSF in summer 2011 and is currently under review, with results expected in summer 2012. NSF has initiated broad-based community input through the National Research Council to plan for the Nation's long-term investment in high magnetic field research.

Cornell High Energy Synchrotron Source/Cornell Electron Storage Ring (CHESS/CESR)[21]

The Cornell High Energy Synchrotron Source (CHESS) is a first generation, high-intensity, high-energy X-ray facility supported by NSF with partial interagency support from the National Institutes of Health (NIH). It uses synchrotron light given off by charged particles, both electrons and positrons, as they circulate at nearly the speed of light around the Cornell Electron Storage Ring (CESR). CHESS provides capabilities for X-ray research in physics, chemistry, biology, materials, and environmental sciences.

Stewardship and oversight of CHESS is provided through the NSF DMR, though the majority of CHESS users come from disciplines outside of materials science. CHESS is also supported by the National Institutes of Health (NIH). CHESS also hosts MacCHESS, a NIH-funded macromolecular crystallography program at Cornell. NSF and NIH provide oversight of CHESS through regular site visits by external reviewers.

Both CESR and CHESS are administered by the Cornell Laboratory of Accelerator-based Sciences and Education (CLASSE), which reports to Cornell's Vice-Provost for Research. CHESS/CESR is operated by Cornell University in accordance with a cooperative agreement with NSF that set goals and objectives for the facility.

Several CHESS/CESR users are from industry, including pharmaceutical corporations (such as Rib-x Pharmaceuticals) and the research arms of Xerox, and General Motors. Some medical institutions also make use of CHESS/CESR (Dana Farber Cancer Institute, Boston Biomedical Research Institute, and Memorial Sloan-Kettering Institute). CHESS/CESR also has collaborations with DOE-supported synchrotron facilities such as the Advanced Photon Source and National Synchrotron Light Source.

CHESS plays a key role as a training ground for X-ray science and accelerator physics with CHESS students and postdoctorates going to staff other X-ray facilities in the U.S. and around the world.

CHESS is a national user facility accessed on the basis of competitive proposal review. The primary function of the CHESS staff is to maintain and operate the facility and to assist users. A policy and advisory board, appointed by the Cornell Vice President for Research, provides advice to the director of CHESS on policies related to the use and development of CHESS facilities and equipment for user experiments. A users committee appointed by the users of CHESS advises the director on matters of facilities operations and priorities for the users. An annual users meeting and several workshops help disseminate results from the facility.

In FY09, NSF completed the review of a proposal for the continued operation of CHESS/CESR in support of X-ray photon science. In December 2009, the NSB authorized NSF to make a four-year award. The cooperative agreement between NSF and Cornell University funds operations until March 2014. Future support will be determined through interagency discussions on the stewardship of CHESS as a national multidisciplinary user facility.

[21] NSF FY13 Budget Request – Facilities, p. 14.