THE LIGO LABORATORY CHARTER

April 1999

LIGO-M970023-B-M

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Contents

Overview

The Laser Interferometer Gravitational-Wave Observatory (LIGO) is aimed at opening the field of gravitational-wave astrophysics through the direct detection of gravitational waves. LIGO detectors will use laser interferometry to measure the distortions of the space between free masses induced by passing gravitational waves. The design, construction, and operation of LIGO

is being carried out by scientists, engineers, and staff at the California Institute of Technology (Caltech) and the Massachusetts Institute of Technology (MIT). Caltech has prime responsibility for the project under the terms of a Cooperative Agreement [1] with the National Science Foundation (NSF). LIGO is a national facility for gravitational-wave research, providing opportunities for the broader scientific community to participate in detector development, observations and data analysis. LIGO welcomes the participation of outside scientists at any of these levels. LIGO has been constructed in a phased approach beginning with one three-interferometer detector system and evolving to improved detector configurations to enable more sensitive gravitational-wave observation systems.

The LIGO construction project has been described in the LIGO Proposal [2] submitted to NSF in December 1989, and the Technical Supplement [3] submitted to NSF in May 1993. The construction phase covers the design and construction of the LIGO facilities and the initial interferometers. The initial operating phase supports the installation, and commissioning as well as the initial operation of this gravitational-wave detector system. It also includes a concurrent research program to develop improved detectors and data analysis algorithms. Upon completion of the construction phase of LIGO, the LIGO Project will operate as the LIGO Laboratory and be managed following this LIGO Laboratory Charter.

Objectives

Scientific Objectives

The scientific objectives of LIGO include research in the fundamental physics of gravitation as well as in astronomy and astrophysics. Possible advances in gravitational physics include:

- tests of General Relativity in the strong field and high velocity limit;
- direct measurement of the polarization and propagation speed of gravitational waves;
- direct observation of the dynamics of black holes.

Possible observations in astronomy and astrophysics which may not be measurable by other methods include:

- the final moments of the coalescence of extragalactic binary neutron star systems, which are the most reliably predicted sources and serve as the design benchmark for the sensitivity and spectral coverage of LIGO;
- the coalescence of black-hole/black-hole and black-hole/neutron-star binary systems;
- the inner dynamics of stellar collapse; the internal and surface dynamics of a neutron star;
- the dynamics of the primordial universe at the earliest stages of cosmic evolution;

- an inventory of the gravitational-wave sources distributed throughout the universe.

It is highly likely, as has been the experience in opening other branches of observational astrophysics, that LIGO will expose new classes of sources. The LIGO facilities are designed to accommodate a succession of detection systems with enhanced sensitivity and adjustable spectral response to retain flexibility in the exploratory phase of the science and to optimize the scientific returns once gravitational waves have been detected.

Technical Objectives

The initial operational phase of LIGO includes the minimum facilities necessary for successful detection of gravitational waves: a continuously operating triple coincidence detector comprising three broadband interferometers, operated at two widely separated sites. Initial interferometers are based on reasonable extrapolations from experience with prior gravitational-wave detector prototypes, ancillary experiments and modeling. Specifications for the initial interferometers are given in Table 1. The projected rms strain sensitivity of $\sim 10^{-21}$ in a spectral region near a few hundred hertz is based on a detailed noise budget which gives the characteristic frequency dependence of interferometer noise. The spectral noise density and the noise budget are shown in Figure 1 and Figure 2, respectively. This projected sensitivity is an improvement of several orders of magnitude over the best contemporary detectors, and according to theoretical estimates, may allow detection of predictable sources at a rate of several per year. The nominal frequency band will cover the range of a few hertz to several kilohertz.

Table 1: Initial interferometer specifications

Strain Sensitivity [rms, 100 Hz band]	10^{-21}
Displacement Sensitivity [rms, 100 Hz band]	4×10^{-18} m
Fabry-Perot Arm Length	4000 m
Vacuum Level	$< 10^{-6}$ torr
Laser Wavelength	1064 nm
Optical Power at Laser Output	10 W
Optical Power at Interferometer Input	5 W
Power Recycling Factor	30
Input Mirror Properties	Reflectivity = 0.97

End Mirror Properties	Reflectivity 0.9998
Arm Cavity Optical Loss	£ 3%
Light Storage Time in Arms	1 ms
Test Masses	Fused Silica, 11 kg
Mirror Diameter	25 cm
Test Mass Pendulum Period	1 sec
Seismic Isolation System	Passive, 4 stage
Seismic Isolation System Horizontal Attenuation	≅ 10^{-7} (100 Hz)
Maximum Background Pulse Rate	1 per minute

Figure 1: Initial interferometer spectral noise density. The uppermost curve is the rms strain sensitivity of the 40m prototype as of October 28, 1994 displayed for comparative purposes.

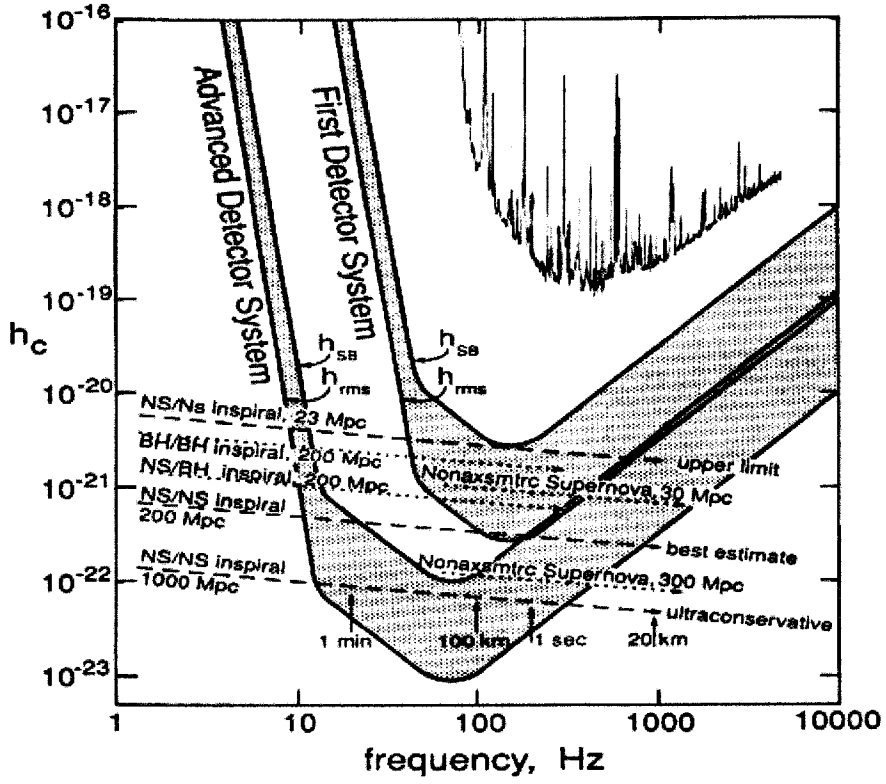
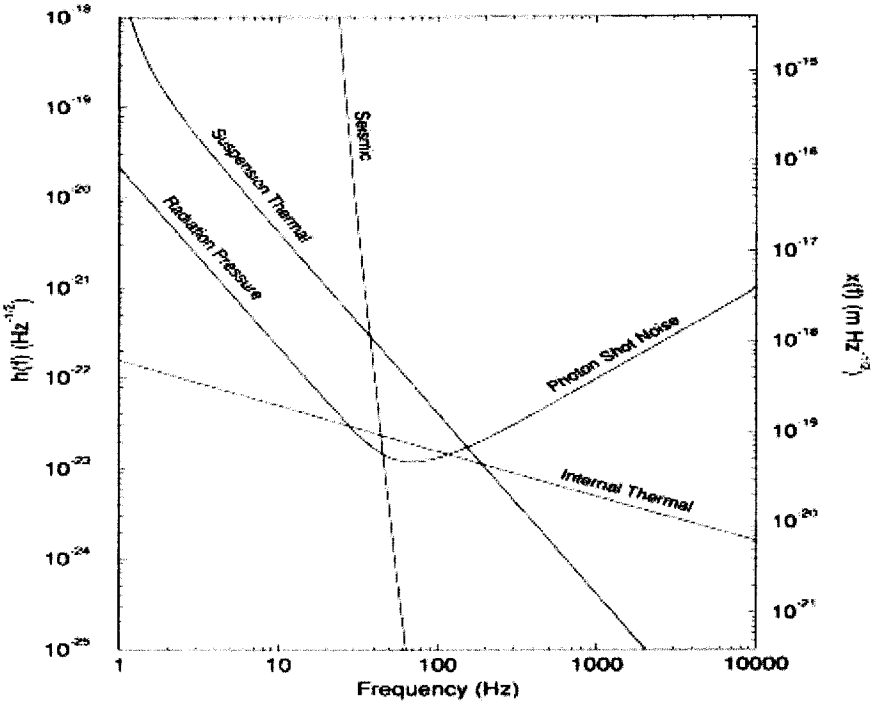


Figure 2: Initial interferometer noise budget.



Construction Project Objectives

The LIGO Construction Project objective is to build LIGO and to prepare it to operate as a gravitational-wave observatory. The essential characteristics of the facilities accommodating the interferometers are:

- two widely separated sites under common management;
- vacuum systems to accommodate interferometer arm lengths of up to 4 km at each site;
- the ability to operate several interferometric detectors at each site simultaneously and without mutual interference;

- the ability to accommodate interferometers of two different arm lengths, at least at one site;
- a vacuum tube with a clear aperture of approximately 1 meter for the full length of the arms;
- the ability to produce a vacuum of order 10^{-9} torr of hydrogen and 10^{-10} torr of other gases;
- a minimum 20-year lifetime of the facilities; complete support instrumentation.

Construction Project Description

The major LIGO facilities consist of vacuum systems at two widely separated sites - Hanford, Washington and Livingston, Louisiana. The vacuum systems, in the shape of an L with 4 km arms, enclose laser interferometer beams. The beams originate and are detected at the vertex of the L (corner station) and are reflected from the ends of the L (end stations). At the Washington site, additional mirrors are placed at the midpoints (mid stations) of the arms to establish half length interferometers. The system comprising three interferometers, a full length and a half length at Washington and a full length at Louisiana operates in triple coincidence as a single gravitational-wave detector.

The vacuum system consists of two elements: the beam tubes running along the arms of the L and the vacuum chambers and associated tubing at the corner stations, end stations and mid stations (Washington). The vacuum chambers contain the test masses (end points of the interferometer) and their associated seismic isolation systems, the interferometer optics, the optics for beam injection and extraction from the interferometer and the electro-optic and mechanical instrumentation to maintain interferometer alignment and to detect the measured gravitational-wave signal.

The beam tubes are enclosed in a cover for protection and to reduce interferometer noise from scattered light due to wind driven motions of the tubes.

The buildings at both sites are designed to accommodate possible, but not yet proposed to NSF, expansion to a multiple detector phase of LIGO. In addition to the vacuum chambers and pumps, the corner station houses the facility and interferometer control systems, the laser power and cooling systems, the data archiving and facility computer systems, office space for staff and visitors, staging areas, equipment receiving areas and small electronic and mechanical shops. The mid station and end station buildings are smaller, containing only vacuum chambers, pumps, and equipment receiving and staging areas.

Full bandwidth analog strain signals from the interferometers will be digitized and recorded continuously for off-site analysis. Ancillary signals monitoring the state of the instrument, the facility and the environment will be archived continuously. Data will be analyzed for coincident bursts, periodic sources and a stochastic background of gravitational waves.

Mission and Responsibilities

In order to assure the full scientific exploitation of LIGO, following the guidance of the National Science Foundation (NSF):

- we establish a LIGO Laboratory to provide for the operation and coordination of the LIGO program,
- and we separately form a LIGO Scientific Collaboration for the advocacy and execution of the science.

The LIGO Laboratory will:

- operate the scientific facilities at the observatory sites in Hanford, Washington and in Livingston Parish, Louisiana
- assure the scientific vitality of these detector facilities
- provide the capability for acquisition of the data, and for system modeling and data analysis
- operate LIGO research and test facilities at the observatory sites and on the MIT and Caltech campuses
- support engineering design and fabrication of detector upgrades and of new detector systems
- carry out research and development in support of the future LIGO program
- support the LIGO Scientific Collaboration in its exploitation of the scientific capabilities
- review and coordinate new LIGO research initiatives
- support public education and outreach in areas related to LIGO science and technology
- assure a safe and comfortable working environment for LIGO staff and visitors
- support the educational mission of the participating universities

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National Science Foundation Cooperative Agreement

The LIGO Laboratory operates under a Cooperative Agreement between the US National Science Foundation (NSF) and the California Institute of Technology (Caltech). The Agreement defines the obligations of Caltech and MIT in carrying out the mission of the Laboratory.

LIGO Project: Relationship and Order of Precedence

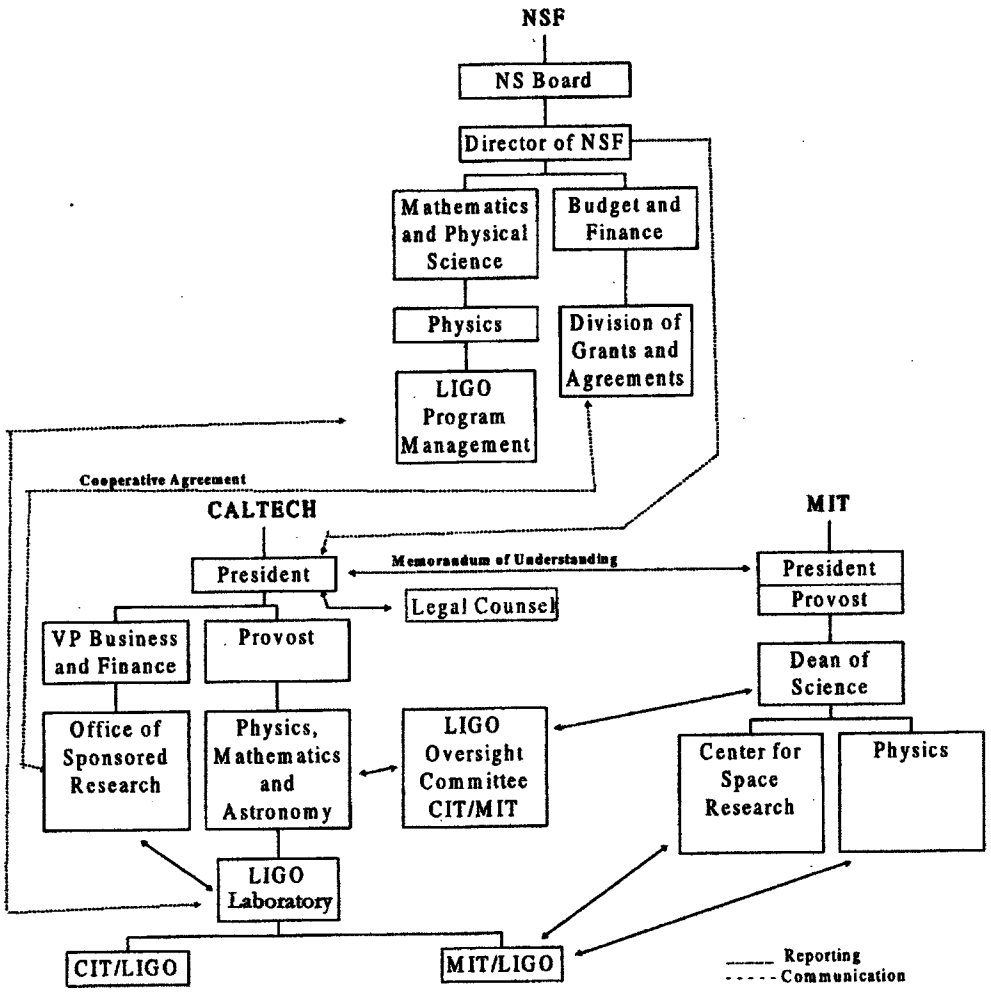
The LIGO Project Management Plan (LIGO M950001) calls for an orderly transition to an operating organization upon completion of LIGO construction. The LIGO Laboratory is the succesor to the LIGO Project. The LIGO Project is organized and executed under the LIGO Project Management Plan. This Charter succeeds the LIGO Project Management Plan following completion of LIGO construction. LIGO construction is defined as the delivery of the facilities and initial interferometer components ready for installation, and the expenditure of the construction phase funds for these approved deliverables. During the period in which LIGO construction overlaps the initial operation of the LIGO Laboratory, the two governing documents coexist. The LIGO Project Management Plan governs LIGO construction. This charter governs LIGO Operations, R&D and other programs. If a conflict exists between the two documents during the transition, the LIGO Project Management Plan takes precedence.

Institutional Roles and Responsibilities

Hierarchy

The LIGO Laboratory reporting and oversight is defined in the organizational hierarchy shown in Figure 3.

Figure 3: LIGO Laboratory Reporting and Oversight



NSF

NSF is responsible for providing funding, general oversight, monitoring, and evaluation to help assure Laboratory performance in accordance with approved workplans. NSF will strive to obtain funding consistent with the Target Funding Levels set forth in the Cooperative Agreement. The actual funding available for LIGO will be negotiated with the Laboratory on the basis of the Annual LIGO Work Plan which, upon approval by NSF, will constitute the official operating plan for the year. Within the framework of the annual operating plan, NSF will undertake to provide the funding in a timely fashion and to provide the necessary document reviews and approvals as indicated in the Work Plan. NSF involvement includes the following:

- provision of advice;

- review and, where required by the Agreement, approval of required subcontracts, reports, and plans submitted by Caltech;
- assessment of progress by the NSF Program Manager and external reviewers.

NSF Program Manager

Within the NSF, the LIGO Program Manager is responsible for scientific, technical, cost and schedule review and agency guidance. Review of progress and programmatic review of annual work plans is the responsibility of the LIGO Program Manager. Direct communication between the LIGO Program Manager and the LIGO Laboratory is the method by which this review and guidance will be accomplished. Performance of work under the Cooperative Agreement is subject to the general guidance and monitoring of the NSF Program Manager for LIGO.

NSF Division of Grants and Agreements

The NSF Division of Grants and Agreements is responsible for Cooperative Agreement matters between the NSF and Caltech. Formal communications related to contracts and required Cooperative Agreement designated approvals will be accomplished by the Division of Grants and Agreements and the Caltech Office of Sponsored Research. Annual funding increments and contractual obligations flow from the Division of Grants and Agreements (DGA), National Science Foundation (NSF) to Caltech, under the Cooperative Agreement. Excluding certain contractual arrangements, all subcontracts in excess of $100,000 issued by Caltech are subject to approval by DGA/NSF.

Caltech

Caltech is accountable, as the awardee, for the performance of the LIGO Laboratory, as described in the LIGO Annual Work Plan. Caltech is responsible for staffing the Laboratory, providing institutional support and ensuring adequate oversight of the execution and performance of the program. Caltech's Office of Sponsored Research is responsible for matters between Caltech and NSF that pertain to the administration of the terms and conditions of the Cooperative Agreement and will accomplish this through formal communications with the NSF Division of Grants and Agreements. Legal review and matters related to real property and property management will be the responsibility of the Caltech Legal Counsel reporting to the President and the Caltech Treasurer, respectively.

MIT

The LIGO Laboratory encompasses a joint effort of Caltech and MIT. The MIT roles and responsibilities are defined through a Memorandum of Understanding and subcontract with Caltech, with details defined in an attachment and updated as necessary. The MIT subcontract is subject to NSF approval. The MIT administration shares responsibility with the Caltech administration for overall oversight of the execution and performance of the LIGO program through representatives on the LIGO Oversight Committee. The MIT administration is also responsible for oversight, staffing and support of the MIT LIGO Group and for insuring that it

successfully meets its institutional commitments. It is the policy of the LIGO Laboratory to have a fully integrated MIT participation with institutional boundaries minimized.

Caltech Reporting

LIGO activities at Caltech, like other research programs directed by physics faculty, are part of the Division of Physics, Mathematics and Astronomy (PMA) through which academic appointments and educational matters are administered. The Division also provides administrative and logistical support to LIGO and oversight of the Caltech effort on LIGO.

MIT Reporting

At MIT, academic appointments and educational aspects of LIGO are administered through the Department of Physics; research activities are supported through the Center for Space Research. The Department of Physics and the Center for Space Research provide oversight of the MIT effort on LIGO and they report to the President of MIT through the Dean of Science.

Oversight Committee

The presidents of Caltech and MIT have established a LIGO Oversight Committee, chaired by a member appointed by the Caltech President and composed of two members from each institution appointed by their respective presidents after mutual consultation. The Oversight Committee reports to the presidents through the Chair of Physics, Mathematics and Astronomy at Caltech and the Dean of Science at MIT. It will regularly provide review of LIGO program status and progress as required. The Oversight Committee functions under a formal written charge.

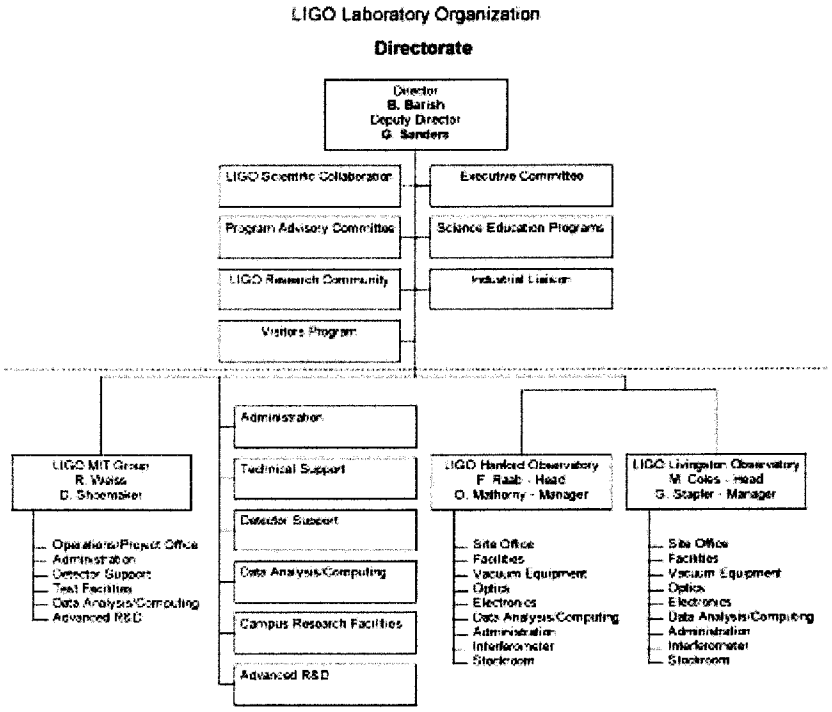
Director and Deputy Director

The LIGO Laboratory Director is appointed by the Caltech President in consultation with the MIT President and with the approval of NSF. The Director performs his/her responsibilities in close association with the LIGO Laboratory Deputy Director, who is appointed by the Director with the approval of the Presidents and the NSF. Other key personnel in the LIGO Laboratory, as defined in the Cooperative Agreement, are appointed by Caltech and MIT with the approval of NSF. The LIGO Laboratory Director, in association with the Deputy Director, reports progress on a quarterly basis to the LIGO Oversight Committee.

Organization of the LIGO Laboratory

The organization of the LIGO Laboratory is shown in Figure 4. It is a site-based organization in which each site is organized functionally. The LIGO Laboratory has a flat hierarchy.

Figure 4: LIGO Laboratory Organization



Directorate

The LIGO Laboratory Directorate consists of the Director and the Deputy Director. Although each has different well-defined primary responsibilities, the overall Laboratory direction is fully shared and either can speak for the Laboratory. Both the Director and the Deputy Director are fully informed on all major decisions and will be mutually involved in the decision making as appropriate. The LIGO Laboratory Director has overall responsibility for the LIGO Laboratory. The Director's primary responsibility is to ensure the development and implementation of the LIGO Laboratory program in a timely and cost effective manner with the goal of detecting gravitational waves and carrying out a program of gravitational wave astronomy. The Deputy Director is primarily responsible for executing the LIGO program and for organizing and

directing the Laboratory team composed of Caltech and MIT staff. The Director is the principal point for communication and interaction with NSF, through its LIGO Program Manager. The Director is also responsible for maintaining interactions and collaboration with the scientific community (both national and international).

LIGO Scientific Collaboration

The LIGO Scientific Collaboration (LSC) will carry out the LIGO research and development program, develop priorities, and enable participation by collaborating groups. It will be organized as a separate entity distinct from the LIGO Laboratory. Through its Spokesperson, the LSC will communicate with the Laboratory through the Laboratory Directorate.

Collaborative work between the LIGO Laboratory and the LIGO Scientific Collaboration will be defined in Memoranda of Understanding (MOU) between the Laboratory and responsible institutions. Specific tasks will be included in Attachments to these MOUs with defined deliverables and periods of performance.

Other Scientific Collaborations

As the field of experimental gravitational wave research develops, it may become appropriate to form additional and independent scientific collaborations. These collaborations will, as well, be governed by MOUs and Attachments

LIGO Research Community

The LIGO Research Community (LRC) consists of all scientists interested in the scientific opportunities offered by LIGO. Membership in the LRC is open to all interested parties and, unlike, the LIGO Scientific Collaboration, requires no formal research commitment and responsibilities. The LRC communicates through its elected Chair with the Laboratory Directorate. The LRC has a separate charter.

LIGO Program Advisory Committee

The LIGO Program Advisory Committee (PAC) is the principal source of advice to LIGO on scientific policy, technical choices, support of the scientific community and organizational matters. It provides peer review of scientific and technical proposals for the scientific use of LIGO. This peer review will be considered by the Laboratory Directorate in making decisions on disposition of proposals.

The Committee meets several times per year and will be asked for advice through a written charge provided by the LIGO Laboratory Director. The Committee's advice will be used by the Directorate in making decisions.

The Committee members are appointed for an initial term of three years, after which new members will be appointed with staggered terms to assure continuity and renewal of the Committee.

LIGO Laboratory Executive Committee

The Executive Committee is the principal management body used by the Laboratory Directorate to review Laboratory program execution and status and to develop the basis for management decisions. The Executive Committee will meet regularly and be chaired by the Director, in association with the Deputy Director. It will consist of the managers of each of the LIGO Laboratory functional groups, LIGO Laboratory senior scientists, and all LIGO professorial faculty members at Caltech and MIT.

LIGO Visitors Program

The LIGO Laboratory operates an NSF-supported Visitors Program intended to provide research opportunities for scientific visitors to the campuses and Observatory sites and for visits by Laboratory staff to other research groups and sites. Supported visits are expected to be of significant duration (one month or longer) and are proposed as research projects to the Laboratory Directorate for review and subsequent support.

Science Education Program

As a national facility based upon an exciting scientific research mission, LIGO can provide a focus for educational programs in science. A Science Education Program will reach beyond the traditional university role of educating undergraduate and graduate students to reaching K-12 grade level students. The managers of the Caltech, MIT, Hanford and Livingston groups will develop and lead programs in educational outreach to the general public, in on-site educational programs at the Observatory sites, as well as the university campuses, and in supporting program development consistent with other NSF educational initiatives.

Industrial Liaision Program

An Industrial Liaison Program will supplement the extensive industrial participation in LIGO construction. LIGO development of enabling technologies promises to provide new capabilities of interest to industry. These include advanced laser and optical technology, and new capabilities in vibration and acoustic isolation. An Industrial Liaision Program Manager will lead direct efforts to inform, collaborate and cooperate with industrial partners. This role will be carried out by a senior scientist or engineer reporting directly to the Laboratory Directorate.

LIGO Laboratory Groups

Each LIGO Laboratory group reports to the Directorate and is led by a Group Leader and a Deputy Group Leader. These positions serve as line management for the respective group. Each group is represented on the Laboratory Executive Committee. Staff assignment to a functional group represents the principal assignment for each staff member. It is expected, however, that scientific and technical staff will participate significantly in activities of other functional groups. While each group has a primary function and funding source, it is expected that there will be substantial overlap in activities commensurate with the requirements of scientific research.

Laboratory groups consist of three site-based groups and several Laboratory-wide functional

groups.

Hanford Observatory - Livingston Observatory

The Hanford Observatory and the Livingston Observatory are organized as separate functional groups within the LIGO Laboratory. Each is responsible for the effective operation of the facilities and scientific programs at the respective Observatory site. Each Observatory is led by a scientist who serves as the Head of the Observatory. In addition, each group includes a Site Manager who is responsible for the technical and operational effectiveness of the site facilities and staff. The Site Manager serves as the lead Environment, Safety and Health Officer for the Observatory site, reporting to the Head and, in this capacity, directly to the LIGO Laboratory Deputy Director. The staff at each Observatory is structured to support operations, maintenance and the scientific program. The staff is sufficient to assure adequate local human resources for all normal operations including scientific and technical expertise at the site. Each Observatory will work with LIGO staff from the Caltech and MIT groups in executing enhancements, upgrades and new capabilities and in carrying out the scientific program. Each Observatory organizes its activities according to the cost accounts shown in Figure 4. These include the Site Office, Facilities Support, Vacuum Equipment, Optics and Lasers, Electronics, Data Analysis/Computing, Administration, Interferometer Support, and Stockroom.

MIT Group

The MIT Group supports the LIGO Laboratory program in operations, advanced R&D and gravitational wave research. The functions and activities in this group are reflected in their cost account structure which includes Operations/Project Office, Administration, Detector Support, Test Facilities, Data Analysis/Computing, and Advanced R&D.

Administration

The Administration Group is responsible for program planning support, for all business operations including budgeting, funds management, cost accounting, procurement, property management, personnel actions and effort reporting, for document and records management, for environment, safety and health programs, and for management of Laboratory Policies and Procedures. The Administration Group prepares Laboratory Proposals to the NSF and coordinates all formal communications with the NSF through the Caltech Office of Sponsored Research. The Administration Group provides administrative support for the Observatory sites, collaborative matters and administrative assistant and secretarial support to the LIGO Laboratory.

Technical and Engineering Support

The Technical and Engineering Support Group is responsible for all engineering design and analysis and design drafting for LIGO scientific programs, facilities, research and development tasks. Members of this group team with LIGO staff and collaborators to support all activities requiring mechanical, optical and electrical engineering. Configuration management, quality assurance and technical standards are provided by this group.

Detector Support

The Detector Support Group is responsible for assuring and improving the performance of the LIGO detector systems used in gravitational wave research. The group supports detector operations and data collection at the Observatory sites, conducts operational detector research and development with the goal of improving detector operational system performance and sensitivity, and provides scientific leadership in specifying and introducing detector improvements and upgrades, in association with the staff at the Observatory sites.

Data Analysis and Computing

The Data Analysis and Computing Group is responsible for the hardware and software systems for LIGO modeling and simulation and for data analysis including analysis of gravitational wave signal channels. The primary responsibility for all software standards and software engineering used in LIGO research is carried by this group. Systems for general computing are implemented and supported in this group. The group supports modeling of sources, algorithm development in support of detection, and computational technology in support of extraction of astrophysical information.

Campus Research Facilities

Test and research facilities at the universities and Observatory sites not normally used for gravitational wave research are managed by the Campus Research Facilities Group. These include the MIT test interferometer and the Caltech test interferometer, as well as supporting infrastructure including special setups used for optics, laser and noise research, metrology and materials research. The group is responsible for the readiness and availability of the research facilities, and for supporting the research and test activities carried out by LIGO Laboratory and collaborator investigators using these facilities. This includes calibration, procedures documentation and training of investigators.

Advanced Research and Development

The Advanced Research and Development Group leads the execution of the R&D program to define future LIGO detector upgrades and to new detectors. The program of this group is primarily supported by NSF Advanced R&D funding which is distinct from Laboratory Operations funding.

Environment, Safety and Health Protection

ES&H is a line management responsibility. The LIGO Laboratory Deputy Director is responsible for ES&H programs throughout LIGO. At each Observatory site, the Site Manager serves as the primary manager responsible for ES&H programs and, in this capacity, the Site Manager is directly responsible to the Deputy Director.

Objectives

The LIGO ES&H program has the following specific objectives:

- to prevent personnel injury or loss of life;
- to prevent any environmental contamination;
- to prevent damage to equipment caused by accidents;
- to comply with all federal, state and local laws, rules and regulations.

Responsibilities

The LIGO ES&H program is the responsibility of the Deputy Director. The Deputy Director has responsibility to insure that LIGO staff members and collaborators identify specific ES&H issues and risks, and establish appropriate safeguards and procedures for addressing those risks.

Environmental Protection

The LIGO Laboratory shall follow standards and practices which fully support all applicable environmental protection policies and requirements.

Safety and Health Protection

Caltech has an established Safety Office, responsible for the Institute's overall safety and health program, and LIGO management will implement the applicable health and safety program elements as outlined in the Caltech Safety Manual. The Caltech Safety Office policies will be applicable to the Observatory sites, supplemented by additional policies developed by LIGO staff in consultation with the Caltech Safety Office. For work performed at MIT, the safety and health protection measures adopted by MIT will similarly apply.

Employee Training

Laboratory employees will be provided with procedures, training and information to ensure their safety. Briefings and presentations will be made to managers and supervisors to communicate ES&H policies and procedures.

Contractors, Collaborators and Visitors

Contractors and visitors to the LIGO operational sites will be informed of ES&H rules and procedures applicable to the specific area. Hosts will be responsible for the safety of visitors.

Documentation

The LIGO Laboratory shall provide hazard assessments, safety analyses and evaluations as required. Specific procedures and training documents will be prepared and released.

Governmental Code Requirements

The LIGO Laboratory, including its contractors, will comply with applicable US Federal Codes, laws and regulations, industrial codes and state rules, regulations and codes. The Administration Group, together with the Deputy Director, will be responsible for clarifying compliance requirements and the resolution of safety issues.

Procurements and Subcontracts

Policy

LIGO procurements occur at both Caltech (including the Caltech-managed Observatory sites) and MIT. These are processed according to the procedures established by the Purchasing Department at the host institution and approved by the Office of Naval Research under OMB requirements.

All LIGO facilities and equipment procurements will be processed and administered by the Caltech or MIT Purchasing Department depending upon the institution originating the procurement, assisted by the LIGO Laboratory staff.

Major procurements involving substantive efforts (subcontracts valued in excess of $100,000) will be submitted to NSF for approval or concurrence, in accordance with the Cooperative Agreement. Subcontract technical and programmatic management is performed by LIGO Laboratory staff. All procurements and subcontracts will be subject to the terms and conditions of the Cooperative Agreement and the requirements of land sale and lease documents pertaining to the LIGO Observatory sites.

Responsibilities

The LIGO Deputy Director is responsible for ensuring that all aspects of LIGO facilities and equipment procurement are managed and planned successfully. A written acquisition plan will support the procurement approach for major procurements in excess of $500,000. The Deputy Director, in association with the Director, shall approve all major subcontracts. Procurement for the LIGO Laboratory is supported by the Administration Group which is responsible for preparing, facilitating and administering the procurement documentation associated with major LIGO procurements. Subcontracts and procurements will be initiated by the cognizant technical Task Leaders. Working closely with the Administration Group, the Task Leaders will be responsible that all procured components, items, services and construction are produced and delivered as required to support the LIGO Laboratory objectives. The Task Leaders will also provide technical direction and oversight of these contracts and procurements.

Approach

Procurement policies and procedures, embodied in the Caltech Purchasing Policy and Procedure Manual, will be utilized for all facilities and equipment procurement actions originating at

Caltech. This manual establishes compliance with the NSF Cooperative Agreements. All major procurements which require NSF concurrence will be identified and scheduled in the annual Work Plan. Similarly, LIGO Laboratory procurements originating at MIT may be placed using corresponding policies and procedures at MIT. Both Caltech and MIT have procurement systems approved by the Office of Naval Research under OMB requirements.

Reporting and Reviews

Quarterly Reports

Three LIGO Laboratory Quarterly Reports will be prepared and submitted to NSF annually for the first three quarters of each fiscal year. This report is prepared in accordance with the Cooperative Agreement and shall consist of a summary of work accomplished during the reporting period including major scientific and technical accomplishments, and a status of action items affecting LIGO/NSF responsibilities. This report shall also include management information such as changes to personnel, financial status report and other financial information including actual or anticipated underruns or overruns, and any other action requiring NSF or other Federal Agency notification.

Annual Report

An Annual Report will be prepared and submitted to NSF, in lieu of a fourth Quarterly Report, containing a summary of overall progress, including results to date, and a comparison of actual accomplishments with the proposed goals of the period; indication of any current problems or favorable or unusual developments; and a summary of work to be performed during the succeeding year; and any other pertinent information.

Annual Work Plan

Each year, through the Caltech Office of Sponsored Research, the LIGO Laboratory shall negotiate and submit an annual Work Plan and funding request to the NSF on October 1 for the December 1 annual award date. The Annual Work Plan is prepared in accordance with the most current version of the NSF Grant Proposal Guide. This Plan shall discuss scientific and program achievements and compare achievements with the projected goals in the currently approved Work Plan. It will summarize the proposed goals for construction, R&D, science and collaborative programs for the program year for which funds are sought. Significant staffing changes, and an organization chart and description of the LIGO organization in the new program year will be presented, together with an explanation of any changes. The Plan shall include a statement of the LIGO annual calendar including proposed dates for meetings of the LIGO Oversight Committee, Program Advisory Committee, scientific workshops and reviews. The Plan shall include an acquisition plan for all procurements in excess of $100K, including the proposed date of submission to NSF and the type of procurement.

Other Reporting

The Caltech Office of Federal Financial Activities submits to NSF a quarterly reconciliation report covering all NSF sponsored grants at Caltech, including LIGO. This report identifies the incurred expenditures for the quarter, cumulative expenditures effective at the close of the quarter, and the available balance against the allocation for the LIGO Laboratory.

Caltech will submit for approval by NSF all collaborative Memoranda of Understanding.

LIGO Oversight Committee

The LIGO Oversight Committee will hold regular meetings to review progress and to resolve institutional issues. Special meetings may be held to resolve particular issues which must be resolved before the next scheduled meeting.

LIGO Program Advisory Committee

NSF shall be informed of all meetings of the PAC, shall be invited to attend, and shall receive copies of relevant reports.

NSF Site Visits/Panel

The NSF may conduct periodic site visits to review LIGO activities.

The NSF may convene a Panel to conduct periodic reviews of the LIGO Laboratory, covering technical and management issues. NSF shall provide the Laboratory with a copy of the charge to the Panel prior to the review, with adequate time to agree on the agenda and to prepare the necessary presentation material.

Workshops

The LIGO Laboratory will sponsor or participate in workshops on specific topics relevant to the development of gravitational-wave interferometers. The frequency of such workshops and the topics they address will be determined in consultation with interested outside scientists, such as LIGO Research Community, the LIGO Scientific Collaboration and the other international groups pursuing laser interferometer gravitational-wave detection.

Technical Reports

To enhance the participation of the general scientific community in gravitational wave research, the LIGO Laboratory will continue the publication of research results in refereed journals, and will make unpublished internal technical reports available to the general scientific community on request.

References

[1] Cooperative Agreement No. PHY-9210038 between the National Science Foundation, Washington, D.C. 20550 and the California Institute of Technology, Pasadena, CA 91125, dated May 1992.

[2] The Construction, Operation, and Supporting Research and Development of a Laser Interferometer Gravitational-Wave Observatory, proposal submitted to the National Science Foundation, December 1989.

[3] Technical Supplement to the LIGO Construction Proposal (1989), dated May 1993.

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