
LIGO Overview

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LIGO

Progress, Status and Plans

- NSF Cost/Management Review (9/94)
 - » Reorganization and restructuring of LIGO
 - » Cost estimate
 - » Project Management Plan
 - » Technical and construction status
 - » Broadening involvement
 - » Plans for the future
- NSF Cost/Management Review (5/95)
 - » PMCS
 - Initiated system for cost/schedule tracking; measuring earned value, cost schedule variances, etc
 - » Technical status
 - R&D Progress; Detector Implementation Plan; Facilities technical status
 - » Operations proposal (1997-2001)
 - establish and operate the sites
 - commission the facilities and detectors
 - reach sensitivity of $h \sim 10^{-20}$ by July 2000
 - conduct initial search for gravitational waves
 - achieve sensitivity $h \sim 10^{-21}$ by end of 2001

LIGO Status

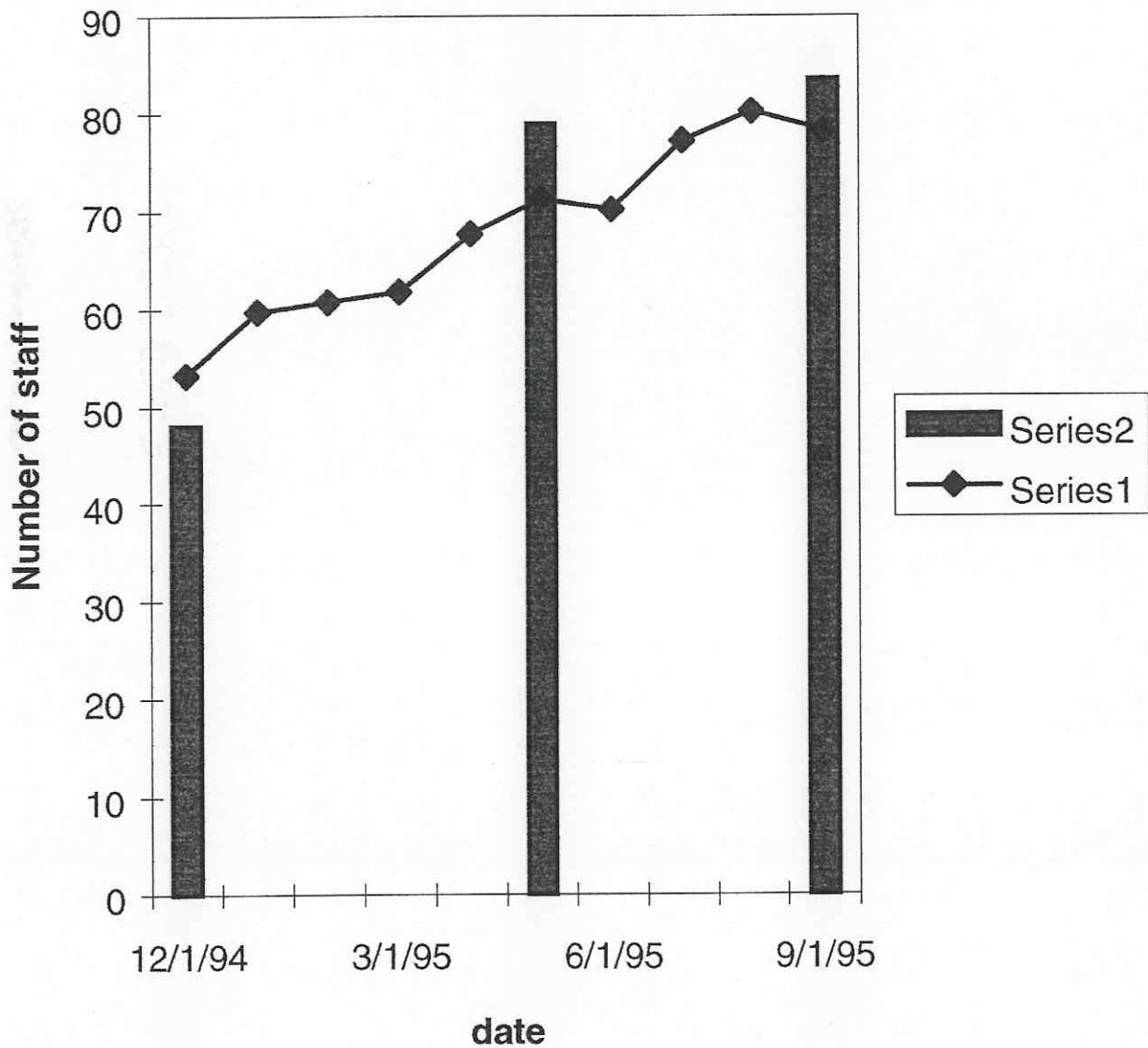
Organization and Staffing

- Project reorganization
 - » New project structure fully operational
 - Product oriented
 - Parallels the WBS system
 - Time phased tasks are resource loaded
 - » All key position filled; staffing on schedule
 - Present LIGO staff ~80
 - » Project Management Plan approved
 - » Cooperative agreement amended
 - » MIT-Caltech MOU and attachment signed
 - MIT responsibilities delineated
 - » New MOUs with collaborating groups
 - many signed, others underway
 - include agreements with Stanford, LSU, VIRGO

LIGO Status

Baseline Staffing Plan

Total Staffing vs Planned Staffing



LIGO Status

Staffing as of October 1995

Task	Caltech	MIT	Total
Proj Mgt	6	0	6
Admin	6	2	8
P Control	9	0	9
Syst Int	7	1	8
Facilities	8	0	8
Detector	15	2.5	17.5
R&D	10	7	17
Grad Stud	4	5	9
TOTAL	65	17.5	83.5

LIGO Status

Project Management

● Project Controls

- » Project Management Control System (PMCS)
 - measure cost and schedule performance vs baseline -- reports variances, earned value, etc
 - reviewed and approved by NSF review committee (Spring 95)
 - cost accounts are reviewed monthly at Project Control Meeting
- » Configuration Management
 - change technical, cost and schedule baseline
 - change control board -- about 20 actions so far
- » Document Control
 - complete records for all contractual communications
 - technical reports, publications, etc
- » Procurement and Contracting
 - strengthened and systematized to handle size and large number of contracts
- » Accounting and Tracking System in Place
 - interface between LIGO and Caltech accounting
 - MIT reporting
 - contractors reporting

LIGO Facilities

Civil Construction

- **A & E Contract**

- » R. M.. Parsons -- initiated Jan 95
- » scope: design and construction management for buildings, enclosures, offices etc
- » requirements for seismic stability, noise sources, cleanliness
- » conceptual design approved in July for scope consistent with LIGO budget
- » final design proceeding as “design to cost”

- **Status of Construction**

- » Both sites acquired; no major problems remain
- » Washington:
 - rough grading completed; settling
- » Louisiana:
 - cleared and grubbed;
 - pipeline reconfigurations solved and underway
 - rough grading bids received, begin soon

LIGO Facilities

Vacuum Equipment

● Characteristics

- » mostly standard vacuum equipment
 - 1st stage roughing atm -> 0.1 torr
 - 2nd stage roughing 0.1 torr -> 10^{-6} torr
 - steady state - ion/getter pumps
- » large gate valves (4 ft diam)
 - access and flexibility
- » controls and monitoring

● Status

- » Science requirements and review 6/94
- » RFP issued for design contract only
- » Two competitive contracts awarded (CB&I, PSI)
- » Final design and manufacturing
 - down select (6/95) to PSI
 - cost (\$39.1M), including change control actions is about \$2M under budget
 - approved by NSF and contract awarded!!

LIGO Facilities

Beam Tube

- **Characteristics:**
 - » length = 4 km (4 arms)
 - » diameter = 4 ft
 - » volume = 20, 000m³
- **Design Contract with CBI**
 - » Design report accepted
 - thin wall stainless spiral weld structure
 - 65 foot sections with bellow
 - quality control in material selection, welding, cleaning, etc
 - » Qualification test -
 - 130 ft section assembled, cleaned, baked and tested -- achieved design
- **Construction contract**
 - » Negotiate option with CB&I, but be prepared to compete
 - » Status -- final price agreed; negotiating detailed scope; contract soon.
 - » Cost (~ \$40M) is about \$5M over budget

LIGO Detectors

R&D Program

- Sensitivity

- » main features of 40 m spectrum understood
- » monolithic test masses improve sensitivity

- Demonstration Experiments

- » optical recombination demonstrated on 40 m
- » acquisition locking with LIGO controls
- » MIT phase noise experiments underway

- Pre- [detector design freeze]

- » Program testing directed at tasks that could effect design over the next two years

- Post- [detector design freeze]

- » Program directed at improved sensitivity; experience running an interferometer facility

LIGO Detectors

Lasers

- Working decision to switch to Nd:YAG lasers for LIGO
 - » Study initiated in May '95; study and discussion meetings during summer, decision in Sept '95
 - » YAG chosen for reliability and because it is the most direct path toward high power (improved sensitivity)
 - » Switch now to invest all our resources toward final laser type and to build optics at longer wavelength.
 - » Now developing plan to integrate into LIGO baseline
 - acquire low power Nd:YAG soon and stabilize
 - install in 40 m to test in interferometer
 - design/acquire laser with LIGO power and test
 - integrate into detector design
 - » official change control action when plan is developed and cost/schedule impact understood

LIGO Detectors

Integration/System Eng.

- Science Goals for initial and improved detectors
- Establish Systems Requirements
 - » First draft document
- Modeling
 - » environment - AVS
 - » end to end model - underway
 - » lock acquisition, optics, etc
 - » help final design and understand performance
- Interfaces
 - » facilities, detector

LIGO Detectors

Detector Implementation

- Detector baseline established for Costing (9/94). This baseline is 'consistent' with sensitivity goals.

- Detector requirements being established from sensitivity goals

- Detector Implementation Plan (1/95)
 - » Two Groups
 - interferometer (mechanical/optical systems)
 - control data systems (electronics, controls, data)
 - » Design over next two years (now underway)
 - design requirements for subsystems
 - interfaces
 - preliminary designs
 - » Development work
 - mirror coatings, etc
 - » Final design and construction

LIGO

Committees and Community

● Committees

- » Caltech/MIT Oversight (chaired by L Allen) meets quarterly
- » Pre-program Advisory Committee (chaired by P. Saulson - Syracuse) met September advised on formation of LIGO Users, program committees

● Community

- » User Group with elected executive committee being formed
- » Meeting this winter in Aspen
- » WWW information on LIGO is extensive and growing
- » direct collaboration being discussed and formed
- » international agreements with VIRGO and GEO underway
- » exchange of scientists - S. Kamamura visiting Japan with exchange Japanese visitor
- » Visitors Program being formed and already active - B. Allen, D. Gustafson, P. Saulson visiting Caltech; K. Sliwa sabbatical at MIT

LIGO Status and Plans

Conclusions

- The LIGO Project
 - » We are still growing rapidly and entering into major contracts
 - » We are strictly building to cost
 - » The coming year should see most major contracts established and actual construction of facilities well underway
 - » technical considerations for civil construction and vacuum systems mostly in hand
- Detector design
 - » development and design phase
 - » develop design and reconcile with requirements
- Detailed site planning underway
 - » staffing and organization
 - » plan for installation, commissioning and operations
- Outside community being included, informed and organized