STATUS OF LSC ACTIVITIES

- **TECHNICAL DEVELOPMENT GROUPS**

  Stochastic Forces - Isolation systems and suspensions *David Shoemaker*
  Sensing Noise - lasers and optics *Eric Gustafson*
  Interferometer Configurations *Ken Strain*

  White paper
  baseline plan September 1998
  Use by NSF/ LIGO PAC
  Iteration in September 1999
  Project/LSC definition of costs and schedule

- **NOMINATIONS COMMITTEE**

  Candidates for 2 year term
  LSC Spokesperson
  3 Technical development chairs
  Report at business meeting

- **DATA ANALYSIS GROUPS**

  Astrophysical Source Identification and Signatures *Bruce Allen / Tom Prince*
  Detection Confidence and Statistical Analysis *Sam Finn / Albert Lazzarini*
  Detector Characterization *Keith Riles / Daniel Sigg*

  White paper
  baseline plan September 1999
  prioritization
  assignment of tasks
  schedule for delivery

- **FORUM ON ORGANIZATION OF LSC DATA ANALYSIS EFFORT**

- **NSF REVIEW COMMITTEE RECOMMENDATIONS**
  Review in October 1998 ⟶
  Initial response at April 27 - 29, 1999 review

  Steps taken:
  Monthly meetings of LDAS staff with LSC data analysis chairs/liaison
  Full day meeting of LDAS and LSC with consultants, February 26
  LSC data analysis chairs members of PDR panel for LDAS, March 11

Executive Summary

The regular semi-annual review of the Laser Interferometer Gravitational Wave Observatory (LIGO) was conducted by a review committee of experts on behalf of the National Science Foundation on October 27-29, 1998 at the LIGO Hanford Observatory (N 46 degrees 27.293 minutes, W 119 degrees 24.407 minutes) in Hanford, WA. The focus of this review was on the technical and detector installation and commissioning aspects of the LIGO Project. The NSF charge to the review committee is provided in Appendix A of this report. Members of the review committee and the observers from the NSF are listed in Appendix B.

Written material provided by LIGO to the committee in advance of the meeting was examined, oral presentations were heard and subgroups of the committee met with appropriate members of the LIGO team to explore details of the project. The format of the review followed the one used during the last review at Caltech in Pasadena with short overview sessions followed by expanded breakout sessions with individual groups for in depth discussions. As at Caltech this arrangement provided a very effective format for the review of the project. Based on these evaluations, the committee discussed its findings in executive session and generated the written summary conclusions and observations given below. Details of the assessment of the LIGO project status are given in the full text of this report.

The LIGO Review Committee formulated the following summary observations:

- LIGO is to be congratulated on the successful start of the installation of the 2 km detector at the Hanford Observatory.

- LIGO is to be commended on the successful completion of the conventional construction and installation of the vacuum system elements at both observatories and the successful bakeout of the first 2-km section of beam tube at Hanford.

- The Committee notes the successful start of the diverse LIGO Advanced R&D program.

- The LIGO Scientific Collaboration (LSC) and LIGO should organize a series of beginning-to-end infrastructure and data analysis software validation tests.

- The LIGO Director and the LSC Spokesman must find a way to provide validated physics analysis software for the collaboration and exercise it through the above system.

- The LSC Spokesman should assure that the constraints inherent in the computing model adopted by the LIGO Laboratory are well understood by the LSC.

- The operations plan for the central LIGO computing facility, and a description of CACR's plans for the support of the facility should be presented at the next review.

Presently, LIGO is 88% complete and the construction of all the major facility cost items is essentially complete. The costs of these major items have been at or below the estimates. All detector systems have had their preliminary design reviews, nearly all have had their final design reviews, and most items are in production. Detector installation has started at Hanford and detector installation at Livingston is expected to begin in early January 1999. The LIGO team continues to make excellent progress towards the goal of triple coincidence operation at the initial strain sensitivity of 10^{-20} by December 2000. The Committee is confident that the LIGO construction project will be completed within the project budget and the triple coincidence operational milestone will be achieved.

Some major parts of the data acquisition on-line software system and companion documentation exist and have been tested.

While progress on the analysis framework is encouraging, the current staffing level is not adequate to meet the schedule. The staff must rapidly be doubled by the addition of the four software professionals included in the budget.

At this time, there is a gap in the manpower chain required for writing physics analysis software. LIGO does not have the required manpower and it is not yet clear whether the LIGO Scientific Collaboration (LSC) has the expertise to produce such "production quality" code. The LSC may be able to create algorithms and test code produced by others.

LIGO plans to develop a central computing facility for analysis at the Center for Advanced Computing Research (CACR) at Caltech.

Comment

The software model and plans, as well as the nominal hardware plan, are very encouraging in their depth and detail. They appear adequate to meet the specified requirements.

The postulated analysis model, which is consistent with the projected available resources, makes specific assumptions, and imposes limits on the compression of data that must be achieved. In addition, it makes assumptions on the mode and frequency of access to raw and reduced data sets, and on the number of retrospective or concurrent analyses that can be performed. We are unsure of the extent to which these assumptions are known by the ultimate user-group.

It is plausible, but not proven, that a fully staffed group can complete the hardware and software structure on schedule.

Because of the difficulty in retaining software staff and the time criticality of the analysis software, LIGO should consider hiring "ahead of the curve" even though that may at times result in a somewhat larger staff than originally planned.

Based on roughly equivalent undertakings on other experiments and based upon their nominal plans, the estimated hardware budget seems to be adequate.

As part of these comments, the current schedule for software task completion as a basis for further evaluation at the next review in approximately six months is attached at the end of this section.

Recommendations

1) The LSC and LIGO should organize a series of beginning-to-end infrastructure and data analysis software validation tests including embedded signals (Mock Data Challenges, MDC). The first should occur immediately after the Beta2 release of the analysis software currently scheduled for December 1999. These tests should involve moving data (simulated or from the 40m interferometer) through the infrastructure and analysis filters to validate that the complete analysis system is functioning. These tests should also be scheduled for future releases.

2) The LIGO Director and the LSC spokesman must find a way to provide validated physics analysis software for the collaboration and exercise it through the Mock Data Challenges. The scope and delivery schedule for this software should be determined by a joint LIGO Laboratory and LSC working group.

3) The LSC spokesman should assure that the constraints inherent in the computing model adopted by the LIGO Laboratory is well understood by the LSC. Important aspects include total processing and storage capacities, data compression, centralized analysis, and the limited parallel access to archived data.

4) Given the distributed and broad nature of the LIGO Scientific Collaboration, access to data for analysis will require either a central computing facility open to all participants or a highly distributed system. Because the plans for LIGO focus on the central approach, the NSF must make arrangements to assure that any central computing facility is fully open to the LIGO community and that it is able to provide adequate user support. The operations plan for the central LIGO computing facility, and a description of CACR's plans for the support of the facility, should be presented at the next review.

5) The LIGO leadership should aggressively seek to fill the four budgeted software positions and should be somewhat flexible about hiring conditions (salary, telecommuting, consultants, contractors) in order to find qualified staff in a timely manner.

6) Because simulations are very important, we recommend that status and plans for simulation software, including the end-to-end simulation support package, be an additional focus of the next meeting of this panel.

7) The LIGO Laboratory should evaluate the need for expanded software manpower in the operations phase to support data analysis for the LSC. This evaluation should be completed on a time scale that will allow for an additional budget request.