

LIGO II SUSPENSIONS DEVELOPMENT PLAN

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Overview

The LIGO II Suspension work will be accomplished by a collaboration between GEO and the LIGO Lab. Work will be performed by both the GEO and the LIGO Lab groups throughout all program phases. GEO will take the lead responsibility through the Preliminary Design Review and then will turn over the lead responsibility to the LIGO Lab through the final design phase, construction, assembly and installation.

Table 1: LIGO II SUS Construction/Installation Summary

Milestones	Date
SUS Design Requirements Review (DRR)	4Q00
Controls prototypes delivered to LASTI for test (2 BSC & 3 HAM)	1Q02-2Q02
SUS Preliminary Design Review (PDR)	4Q01
Noise prototypes delivered to LASTI	2Q03
SUS Final Design Review (FDR)	3Q03
First Article Fused Silica delivered to LASTI	1Q04
SUS Assembly start at the sites	2Q04
SUS Installation starts	1Q05

Conceptual Design

The Design Requirements Document will be written together by the LIGO Lab and GEO. It will be completed by 3Q00. The Design Requirements Review will occur in the next quarter (4Q00) with a review board composed of knowledgeable personnel from both groups. It will take place at either site, with both parties involved, with GEO taking the lead.

The Conceptual Design Document (CDD) will be written by GEO with assistance from the LIGO Lab, principally for interface design and compatibility. It will be an updated version of the LIGO-T000012, LIGO II Suspension: Reference Designs document. It will be completed in 3Q00. With this short schedule, there will likely be many items as yet to be determined (TBDs) in the document, which is acceptable. The CDD is a work in progress and will be updated as changes and advancements occur. The Conceptual Design Review will occur after completion of the document. The same review board for the DRR will oversee the CDR. GEO will take the lead in presenting this review.

In 1Q01, a LIGO Lab scientist will visit GEO for approx. 6 months to assist design, research and development issues for the LIGO II suspensions. LIGO Lab personnel will be visiting GEO sites during this time to come up to speed on the design and to aid with any design or technological issues that cannot be addressed by GEO alone, with emphasis on interface, assembly, handling and installation issues. At this time, the LIGO Lab will start to review the designs provided by GEO for the two principal LIGO II suspensions: the Input Test Mass Suspension (nominally a BSC quadruple pendulum) and a Mode Cleaner Optics Suspension (nominally a HAM triple pendulum). Procurement of component parts for the 5 prototypes (2 BSC and 3 HAM types) for LASTI will be performed by the LIGO Lab staff around 2Q01, using machine shops and vendors who may participate in production where possible. GEO will be responsible for the design and documentation of the assembly and installation fixtures along with the electronics and controls design, with support from the LIGO Lab.

The two BSC and three HAM prototypes for LASTI are to demonstrate mechanical and controls requirements, but not all noise (electrical or mechanical) requirements. Thus, they can utilize aluminum masses rather than fused silica or sapphire and will use metal suspension wires. Similarly, electronics for these prototypes may not be final, but will be functionally complete. Electronics for these prototypes will be procured and fabricated by GEO, with interface, command and communication standards from LIGO. Initial testing of the prototype designs will be performed by GEO, followed by assembly of the LASTI prototypes at MIT by GEO and the LIGO Lab.

Preliminary Design

The Preliminary Design Review for the suspension may be broken up into two reviews - one for the HAM suspension, which is anticipated to be similar to the GEO suspension, and then later one for the BSC suspension. The goal of the PDR is to determine that the design meets the requirements. GEO shall take the lead in preparing and presenting this review. Once the preliminary design is accepted, the lead will start to transition from GEO to the LIGO Lab.

In 2Q03, the noise prototypes will be delivered to LASTI. They will have fused silica fibers and sapphire test masses. They may have some components in common with the controls prototypes they are replacing.

Final Design

The LIGO Lab will start incorporating test data from the LASTI tests at this point. Long lead procurement of production parts/assemblies will also commence after approval of the PDR. The LIGO Lab will produce the appropriate drawings, specifications and documentation that will allow for timely fabrication, assembly and installation of the LIGO II suspensions, all in close collaboration and consultation with GEO.

Again, the reviews themselves may be separate with the HAM suspension FDR coming first. The LIGO Lab will take the lead in preparing and presenting the review with assistance from GEO. A final design package is prepared prior to the FDR that includes detailed drawings and specifications, procurement and contract documentation, inspection and test documentation and assembly and installation documentation.

In 1Q04, the First Article suspension will be delivered to LASTI for testing. It is assumed that this suspension will satisfy the first article testing requirements.

Fabrication, Assembly and Installation

The LIGO Lab will direct the procurement, fabrication, assembly and installation activities with the assistance of GEO. The suspensions will be assembled at the LIGO sites in optics labs prepared for this work. The suspensions will be assembled, tested and queued for installation in these buildings. GEO will assist in the assembly, installation and commissioning of the SUS subsystem with the LIGO Lab team taking the lead.