NSF Review

LIGO Progress,

Status and Plans

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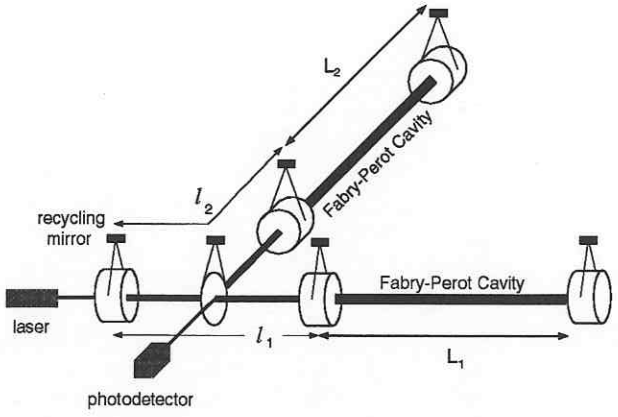
May 22, 1995

Transition to Construction

- LIGO has transitioned from an R&D/conceptual design activity to a construction project.
- Industry is now designing all major facility systems.
  - ›› Vacuum Equipment
  - ›› Beam Tube
  - ›› Beam Tube Enclosure
  - ›› Conventional Construction
- The Detector Group
  - ›› Detector Implementation Plan
  - ›› consolidating design requirements
  - ›› initiating early industrialization
- The R&D Group
  - ›› final tasks needed for the baseline freeze
  - ›› exploiting our prototypes as testbeds for LIGO systems.

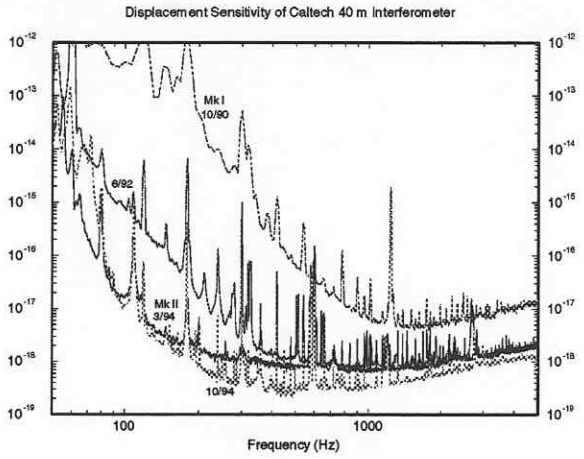
Power Recycled Fabry-Perot Interferometer



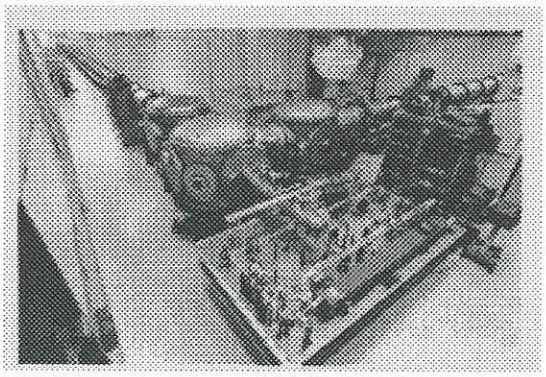
R&D Progress

- 40 Meter Interferometer at Caltech
  - ›› Mark II upgrade substantially improved seismic isolation during 1992
  - ›› During 1994, composite test masses were replaced by "high Q" monolithic test masses to improve displacement noise performance in region limited by internal thermal noise of test masses
    - This step was completed since the September, 1994 NSF review and it yielded predicted improvement in noise performance
- 5 Meter Interferometer at MIT
  - ›› High stored power will be used to measure the noise limits due to optical phase noise. We expect a sensitivity better than 10^{-10} $Hz^{-1/2}$.
  - ›› MIT group has suspended optics and is on schedule in the construction

Progress in Displacement Noise R&D



Mark II 40 Meter Interferometer



Mark I vs. Mark II Seismic Isolation

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Composite vs. Monolithic Test Mass

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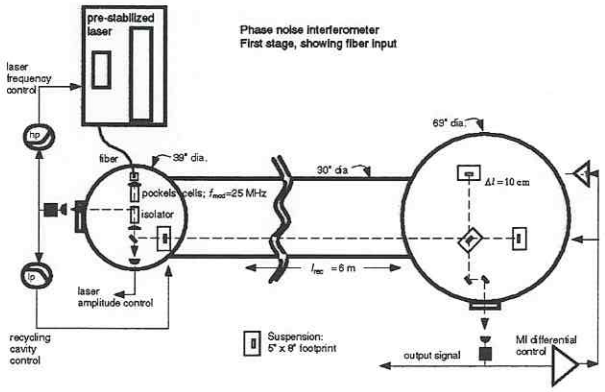
Initial Phase Noise Interferometer



R&D Plans

- Recombination in progress now
  - ›› 40 Meter Prototype reconfiguration and realignment done
  - ›› Shakedown and first attempts to lock arms in progress
- New Prestabilized Laser with LIGO Controls under construction for installation in 40 Meter
- 12 Meter Mode Cleaner passed its performance review in April
  - ›› Move into 40 Meter Prototype scheduled later this year
- New suspension to be tested later this year
- Power Recycling scheduled early next year
- Wavefront sensing with Fixed Mass Interferometer at MIT in progress
- Increased attention to operational reliability and procedures development needed for LIGO operational capability

Detector Progress

- Detector Implementation Plan approved by the Project in January
  - ›› All design, fabrication activities included
  - ›› Resources assigned
- Prestabilized Laser Design Requirements Review held
- Alignment Sensing and Control Design Requirements Review held
- Core Optics Coating trial with industry initiated
  - ›› REO
- Core Optics Polishing trial with industry initiated
  - ›› Hughes Danbury Optical Systems
  - ›› CSIRO

40 Meter Optic vs. LIGO Optic

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Facilities Progress

- Vacuum Equipment
  - ›› Consists of vacuum pumps, gate valves, manual controls, gauges and large detector vacuum chambers
  - ›› Science Review of System Specification held and all action items required for Preliminary Design have been resolved
  - ›› Interfaces with Control and Data System elaborated
  - ›› Acquisition Planning exercise selected phased contracting methodology. Strategy:
    - Two Phase A contractors to be selected to carry out Preliminary Design and to provide fixed price proposal for fabrication/ installation
    - One contractor to be selected for fixed price Phase B
  - ›› Phase A contracts have been awarded and design is in progress
    - Chicago Bridge & Iron
    - Process Systems International
  - ›› Phase B downselection scheduled by July

Test Mass Chamber

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Facilities Progress

- Beam Tube
  - ›› Phase A Design/Qualification Test contract now completed with Chicago Bridge & Iron
  - ›› Final Design Review completed in 1994
  - ›› Qualification Test completed successfully
    - Significant augmentation of the cleaning process developed during Qualification Test
  - ›› Modified Final Design package delivered this week
  - ›› Contract includes option for Caltech to negotiate Phase B fabrication/installation
  - ›› Acquisition Planning exercise carried out for Phase B
    - Introduce competitive pressures to lower Phase B cost
    - Treat high risk tasks outside of fixed price approach
  - ›› Decision made to request CB&I proposal and offer early negotiations prior to "go/no go" compete decision
  - ›› RFP and Notice of Intent to Exercise Option to be released June 1

View Through the Beam Tube

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Beam Tube Section

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Expansion Joint and Beam Tube Wrapped for Bakeout

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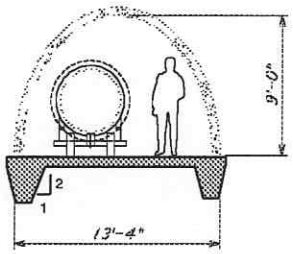
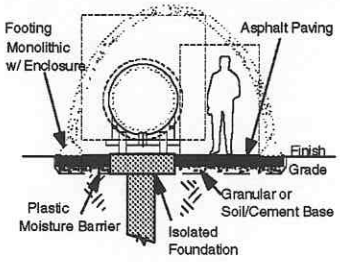
Facilities Progress

- Beam Tube Enclosure
  - ›› Required for elimination of wind noise, acoustic, thermal and moisture isolation and protection from projectiles (hail) and bullets
  - ›› Conceptual design contracted with Concepts in Concrete
  - ›› Parsons conceptual design reviewed and trade study recommended
    - Enclosure big enough to accommodate personnel access vs. minimal enclosure requiring removal for access
    - Standard slab foundation vs. minimal foundation with piling support for beam tube
  - ›› Trade study results
    - Cost reductions smaller than anticipated
    - Life cycle enclosure removal costs and risks very large
  - ›› Parsons instructed to design personnel accessible enclosure and to study slab type constructability for Louisiana before selection of slab type
  - ›› On schedule for enclosure/slab construction package

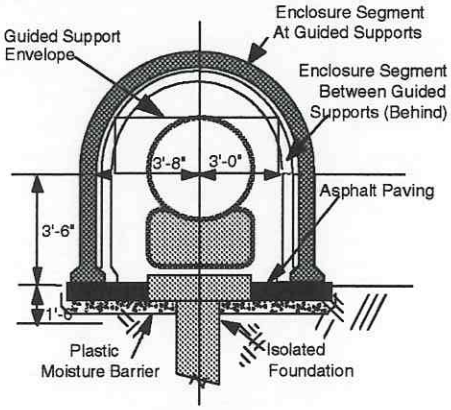
Enclosure Alternate 1



Enclosure Alternate 2



Enclosure Alternate 4



Alternate 4

Facilities Progress

- Conventional Construction
  - ›› Washington
    - Rough grading completed
    - Site settling in progress
  - ›› Louisiana
    - Site purchased and leased by NSF
    - Site characterization completed
    - Access road design initiated by Louisiana
    - State of Louisiana funding being appropriated
    - Pipeline crossing plans nearly complete for 2 of 3 pipelines
    - "Clearing and Grubbing" contractor selected and contract submitted for NSF review. Clearing planned by month end.
    - Rough grading design initiated

LIGO Aerial Painting

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Rough Grading in Hanford

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Current Hanford Aerial View

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Louisiana Site

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Facilities Progress

- Conventional Construction
  - ›› Architect/Engineer - Ralph M. Parsons Company
    - Design initiated January with kickoff attended by NSF
    - Completed 30% conceptual design DCCD review
    - Completed 60% design concept presentation (NSF attendance)
    - Completed 90% design concept review
    - Building trade study in progress
    - Conceptual design to be approved by July

Parsons' Facility Solid Models

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