



Planning For *LIGO II*



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Caltech

LSC Meeting Hanford
August 2000

Advanced LIGO

?



This Talk

- R&D
- LIGO Lab Facility Preparation
- Astrophysics Motivations
- System Planning and Requirements
- Cost/Schedule Planning
- Proposal Preparation
- Industrial Partnerships
- Funding in 2002 and Beyond



R&D...

- R&D in full swing following the plan set in the White Paper with recent attention to thermal noise issues.
- Seismic Isolation
 - » technical approach selected after intense program by both teams
 - » work plan under development for “stiff” approach for next phase
 - » “soft” team implementing system with TAMA collaborators
- Suspensions
 - » fiber, attachment, Q research in full swing
 - » conceptual design, requirements being refined
- Laser
 - » Adelaide, Stanford, Hannover research underway
 - » exploration of industrial partnership nearing decision process
 - business climate has changed



... R & D ...

- Input Optics

- » Components (isolators, modulators,...) research underway
- » Requirements being defined
- » thermal studies soon

- Auxiliary Optics

- » thermal compensation research underway at MIT
- » Output mode cleaner to be considered

- Core Optics

- » sapphire research underway at Caltech, Stanford in coating absorption, Q-effects, stress induced birefringence, crystal growth, homogeneity, bulk absorption
 - most activities making good progress
 - bulk absorption is a thorny problem



...R&D...

- Core Optics

- » polishing, coating of sapphire in early stages
- » preparation of improved metrology at Caltech
- » *source of coating will be an issue*

- Interferometer Sensing and Control

- » considerable progress has been made in trade studies of sensing and control schemes
- » system exercises have traded off thermal issues, optical design, control and readout of the GW signal
 - offset locking, DC readout scheme gaining support
- » photodetector research is proceeding at Stanford



LIGO Lab Facility Preparation

- 40 Meter Interferometer Upgrade is in the demolition stage
 - » This LSC meeting can help to consolidate some key scope/design questions
- LASTI infrastructure being installed
 - » This LSC meeting can help to define scope of program
- TNI experiment readying “arm” cavity optics, controls for full lock
 - » default program of silica/steel, sapphire/steel, sapphire/silica will proceed
 - » new thermal noise interferometer experiments in early stages of discussion
 - this LSC meeting should consider new ideas



Astrophysics Motivations for Improving LIGO

- Lazzarini, Thorne, others are contributing to a discussion of this
- R-modes workshop at Santa Barbara
- Drexel Workshop in late October
- Aspen Winter meeting may have an overlap with the astrophysics workshop
- We need a thorough consideration of this



System Planning and Requirements...

- The system requirements are under active study
- A working group was formed consisting of the 3 LSC Working Group chairs, Dennis Coyne and Peter Fritschel to refine the requirements. This group brings together the LSC and Laboratory leadership. Peter has taken the active lead in this exercise and he has hosted two working meetings at MIT with a broader membership of experts in the key areas. This has been quite successful in driving the system studies, interferometer concept and subsystem requirements.



...System Planning and Requirements

- LIGO II sensitivity and noise floor
- Does sapphire provide a significant advantage?
- How much thermal compensation will we need?
- Laser power?
- Mode cleaner length?
- Power on output detector?
- Isolation requirements on non-core optics?
- Role of a narrow-band capability?



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LIGO II PROGRAM SITE

This web site is a place for posting information, plans, schedules and links to useful documents, related to the LIGO II Proposal effort, in particular information that is in draft form, or otherwise not ready for prime time. The documents are for LIGO internal use only. For now, Thomas Frey (tfrey@ligo.caltech.edu) will be the moderator of content.

This site is best viewed with IE 5.x at 1024x768 resolution or better.

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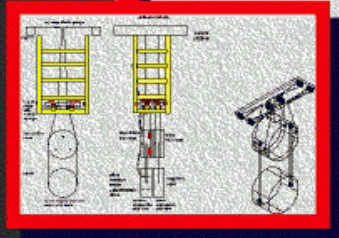
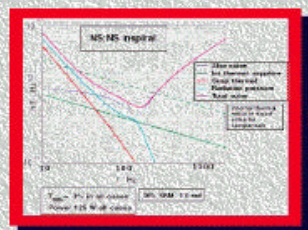
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LIGO II PROGRAM SITE

LIGO-II Proposal Development

This page has pointers to documents & information pertinent to the development of the LIGO-II proposal.
Adobe's Acrobat Reader version 4.0 is required to read some of the documents. You can [download](#) a copy for virtually any platform.

WORK BREAKDOWN STRUCTURE

- [Work Breakdown Structure \(WBS\)](#) (version 11.0 release 1) [Spread Sheet File](#), [PDF Version](#)
- [Work Breakdown Structure \(WBS\)](#) (version 7.0 release 1) [Spread Sheet File](#), [PDF Version](#)
- [Sample WBS Dictionary](#) (partial sample of SUS subsystem)

PROPOSAL PLANNING AND SCHEDULE

- [Proposal Development Baseline Schedule Version 7.0](#)
- [Proposal Development Baseline Schedule Version 8.0](#) - This includes a Progress Spotlight highlighting the week ending 8.11.00.
- [Download Primavera Post Office](#) - Self Extracting Zip File. This is the PC application that is used to update the PRD file used for collection progress data. For a plain ZIP file use this link [PRMPOST Zip FILE](#)
- [Proposal Development Schedule Update Progress as of 7.7.00](#) - Based upon progress as of July 7, 2000 the early completion is now forecast to be November 28, 2000.
- [Proposal Development Schedule Update Progress as of 7.21.00](#) - Based upon progress as of July 21, 2000 the early completion is now forecast to be December 12, 2000.
- [Proposal Development Schedule Update Progress as of 7.28.00](#) - Based upon progress as of July 28, 2000 the early completion is now forecast to be December 19, 2000.
- [Proposal Development Schedule Update Progress as of 8.4.00](#) - Based upon progress as of August 4, 2000 the early completion is now forecast to be December 28, 2000. Included in this update is a Progress Spotlight highlighting the week ending 8.11.00.

AUXILIARY DOCUMENTS

- [Proposal Outline and Responsibilities](#)
- [Supporting Information and Responsibilities](#)
- [Guidelines for Detector Construction Design Activities](#) (definition of the design phases)
- [DRD Template Document for MS Word](#) - Send comments to [Dennis Coyne](mailto:Dennis.Coyne)

To [LIGO Home Page at Caltech](#), and to [LIGO Home Page at MIT](#). Send Comments to: tfrey@ligo.caltech.edu

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LIGO II 40 Meter Upgrade Project Schedule Development

This page has pointers to documents & information pertinent to the development of the LIGO II 40 Meter Upgrade Project Development. Adobe's AcroBat Reader version 4.0 is required to read some of the documents. You can [download](#) a copy for virtually any platform.

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SUPPORT DATA

- [40 Meter Weekly Report by Alan Weinstein](#)
- [40 Meter Prototype Upgrade Page](#)

PLANNING DATA

- *** [40 Meter Lab WBS and Responsibility](#) - Click here for the [PDF file](#).
- [40 Meter Upgrade Milestones and Objectives](#)
- [40 Meter Upgrade Project Schedule Version 5](#) - Forecast occupancy of 10/17/00 and completed upgrade of 02/06/03.
- *** [40 Meter Upgrade Project Schedule Version 6](#) - Forecast occupancy of 11/17/00 and completed upgrade of 04/22/03. **Progress Highlight through 9.8.00.**
- [40 Meter Upgrade Project Schedule Progress as of 07.28.00](#) - Forecast occupancy of 10/25/00 and completed upgrade of 04/22/03.
- *** [40 Meter Upgrade Project Schedule Progress as of 08.04.00](#) - Forecast occupancy of 11/01/00 and completed upgrade of 04/22/03. **Progress Highlight through 9.8.00.**

Questions or comments?

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 Cost, schedule email: tfrey@ligo.caltech.edu

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Proposal Preparation...

- Working Groups have been carrying on R&D as planned
- Working Groups have held monthly progress telecons
- Systems group is working to define baseline definition and requirements to be iterated with subsystems
- Lab is pulling together requirements documents, reference designs, WBS, WBS dictionaries, Cost estimates and schedules



...Proposal Preparation

- Proposal chapter writing to be completed in September
- Full R&D proposal together in November with R&D funds request through LIGO Laboratory for FY2002 and 2003. Transition to MRE funds under discussion with NSF (previous talk).
- Collaborating institutions need to have equipment, special items, etc. included in this proposal.
 - » This only includes costs related to LIGO II R&D, not other R&D.
- In most cases, collaborators already involved in this process.
 - » Attachments B, C, and D define activities.



Industrial Partnerships...

- US and European economy doing well
 - » traditional GW community partnerships subject to changes in business models (SDL, ...)
- Laser
 - » Lightwave Electronics has a new business focus
 - » TRW and Boeing also interested but in the context of their business models
 - » GEO-Hannover partnership with LZH offers an “in-collaboration” option to approach laser + PSL subsystem
 - » Lab/LSC have carried out an exercise since last LSC meeting to meet with potential partners and to educate ourselves for a choice
 - » this LSC meeting should consider the different technical approaches and a possible GEO-Hannover program
 - technical issues to be emphasized



...Industrial Partnerships

- Coating

- » Traditional source for LIGO has been REO
- » In an age of optical communications, coating capacity is a critical business asset.
- » Future coating will likely mean that the LIGO community (other GW projects ?) will have to capitalize a coating facility and team in order to have any control of quality and schedule.



Funding in 2002 and Beyond

- R&D and Prototype Testing must move forward in order to address the technical risks
- NSF Physics Division is expressing its interest in supporting this program
 - » our proposal is very important
- When would we install upgraded interferometers?
 - » 3 interferometers at once is technically and scientifically not favored
 - » when and how to phase this program
 - » current baseline assumption is first interferometer upgraded in 2005-2006, others in 2007-2008.
- This LSC meeting is the last one before proposal is submitted to define R&D/prototyping in 2002-...



Exploiting the Full LIGO Capability

- Initial LIGO detector system
- Quantum Limited Interferometers
- Terrestrial Limit for LIGO

Physics “reach” follows these steps