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**NSF Review -  
Detector and R&D**

**S. Whitcomb**

**9 April 1996**



# Outline

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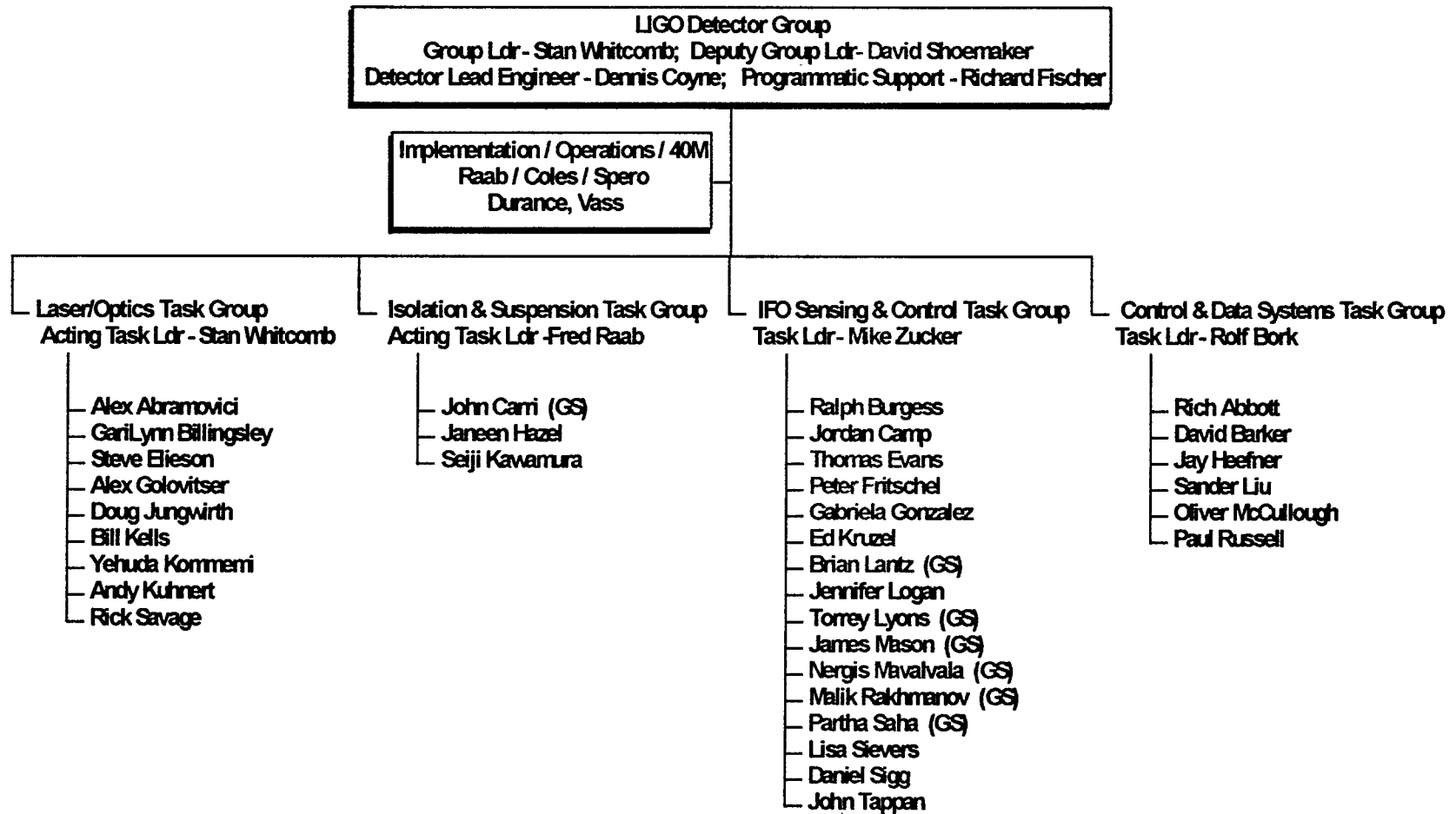
- **Detector Group Reorganization**
- **Progress and Accomplishments Since the Last Review (David Shoemaker)**
- **Detector Replan**
  - ›› Schedule Changes
  - ›› Budget Changes
- **Response to Committee Recommendations**

# Goals of Detector Reorganization

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- **Integrate R&D and Detector Design Activities**
- **Create Task Groups with Critical Mass**
- **Eliminate Sharing of Personnel Between Different Tasks (“One person, one boss”)**
- **Link Management of Closely Coupled Detector Subsystems**
- **Strengthen the First Level Management**

## NEW DETECTOR ORGANIZATION



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# **Progress and Accomplishments**

**David Shoemaker**



# Detector Replanning - Motivation

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- **Need to Accommodate New Laser Development**
- **Slower-than-Expected Staffing Has Led to Delays in Several Technical Areas**
- **New Organization**
  - ›› Places Broader Responsibility in Task Leaders' Hands
  - ›› Integrates R&D and Detector Design Activities
- **Better Understanding of Detector Requirements and Design**

# Replanning Process

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- **Develop Detailed Schedule With Task Leaders**
  - ›› Realistic Assessment of Current Status
  - ›› Revisit Linkages and Estimated Durations
  - ›› Modify Work Plan if Needed
  - ›› Adjust to Match Realistic Staffing Profile
  - ›› Distribute Budget for Remaining Work Against New Schedule
- **Review with Management**
  - ›› Integrate with Facilities Schedules
  - ›› Ensure Consistency with Overall Project Plan
- **Formal Adoption by CCB**
  - ›› New Schedule Baseline Matched to Current Status
  - ›› Current Cost Variance Shows Up in Estimate-to-Complete

**Level 1 Milestone Comparisons - Detector**

4/4/96

<b>Milestone Description</b>	<b>Project Mgmt Plan Dates</b>	<b>Proposed Project Mgmt Plan Dates</b>	<b>Change</b>
<b>Core Optics Support FDR</b>	<b>Nov-96</b>	<b>Apr-97</b>	<b>(107)</b>
<b>HAM Seismic Isolation FDR</b>	<b>Dec-96</b>	<b>Jul-97</b>	<b>(151)</b>
<b>Core Optics Components FDR</b>	<b>Jan-97</b>	<b>Jul-97</b>	<b>(129)</b>
<b>BSC Seismic Isolation FDR</b>	<b>Nov-96</b>	<b>Jul-97</b>	<b>(172)</b>
<b>WA Cntl Area/Net Sys Ready To Install</b>	<b>Sep-97</b>	<b>No Change</b>	
<b>Detector System Prelim Design Review</b>	<b>Jan-97</b>	<b>Dec-97</b>	<b>(237)</b>
<b>Alignment FDR</b>	<b>Nov-97</b>	<b>Apr-98</b>	<b>(107)</b>
<b>Input/Output Optics FDR</b>	<b>Jun-97</b>	<b>Apr-98</b>	<b>(216)</b>
<b>Control Data System DAQ FDR</b>	<b>Apr-98</b>	<b>No Change</b>	
<b>Length Sensing/Control FDR</b>	<b>May-98</b>	<b>No Change</b>	
<b>Physics Environ Monitoring FDR</b>	<b>Jun-98</b>	<b>No Change</b>	
<b>Begin WA IFO Installation</b>	<b>Jul-98</b>	<b>No Change</b>	
<b>Prestabilized Laser FDR</b>	<b>Aug-97</b>	<b>Aug-98</b>	<b>(260)</b>
<b>Begin LA IFO Installation</b>	<b>Jan-99</b>	<b>No Change</b>	
<b>Begin Coincidence Tests</b>	<b>Jul-00</b>	<b>Dec-00</b>	<b>(107)</b>
<b>Achieve Detector Design Sensitivity</b>	<b>Dec-01</b>	<b>No Change</b>	



# Workplan Modifications to Reduce Schedule Slippage

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- **Use of Nd:YAG Prestabilized Laser Prototype for First WA Interferometer Installation**
  - ›› Keeps Laser Development From Becoming Critical Path
- **Elimination of First Article Fabrication and Test for Seismic Isolation Stacks**
  - ›› Replace with (Limited) Prototype Testing During Final Design
  - ›› Reduces Fabrication Time with Minimal Risk
- **Accelerated Optics Procurement**
  - ›› Issue Polishing RFP as Soon as All Polishing Issues Resolved (Prior to FDR)
  - ›› Reduces Total Fabrication Time After FDR
- **Integrated Detector Fabrication and Installation Schedules**
  - ›› Reduces Schedule Contingency Built into Previous Plan

# Detector Cost Status

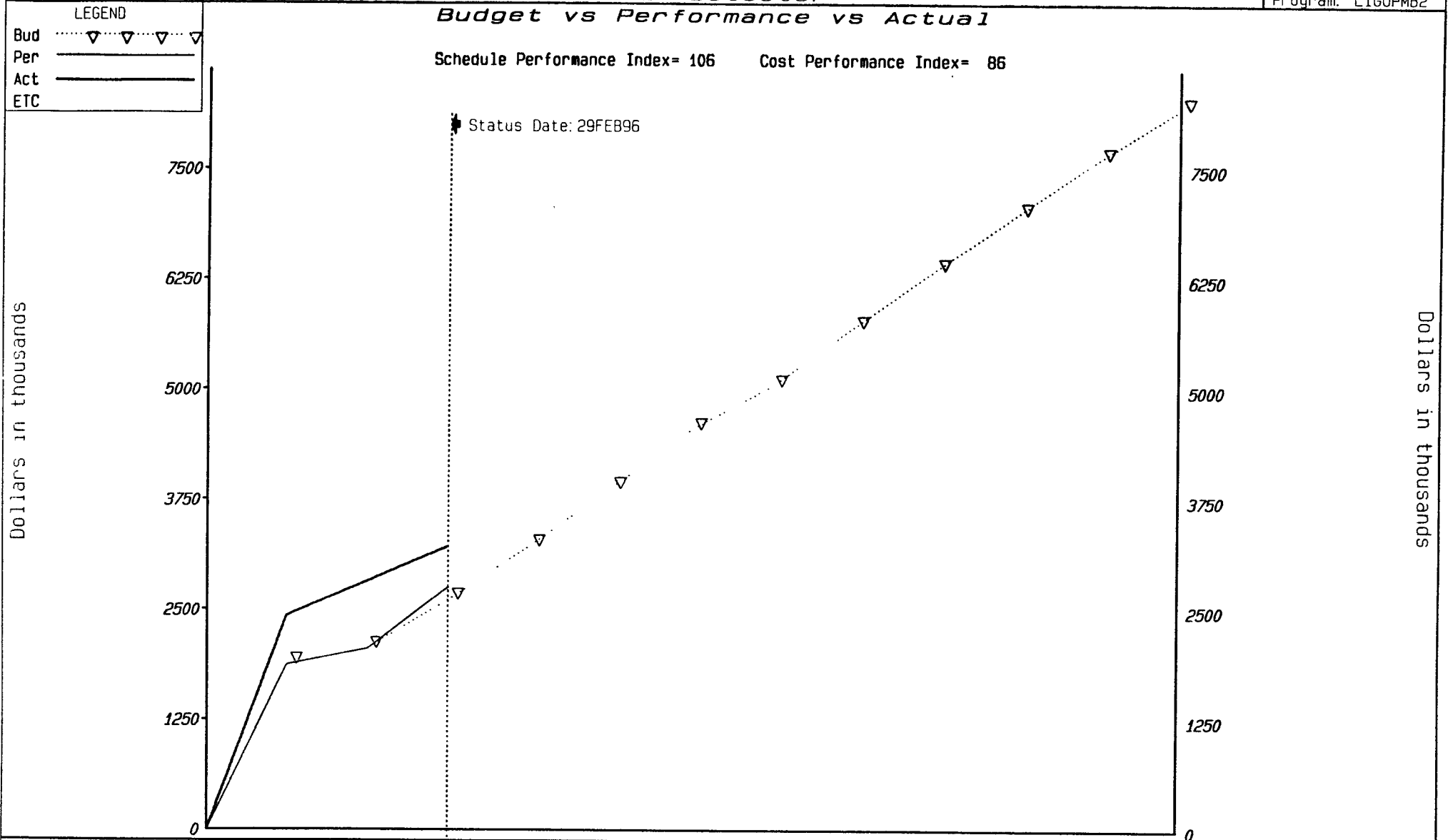
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- **Respread Unspent Budget to New Schedule**
- **Cost Growth Due to Change in Laser Wavelength**
  - ›› Identified All Changes Required to Accommodate New Wavelength
  - ›› CCB Action Added \$3.39 M to Detector Cost
- **Current Estimate-to-Complete = Budget-to-Complete + \$700k**
- **Working to Realize Cost Savings in Several Detector Subsystems**
  - ›› Seismic Stack Weight Reduction
  - ›› Core Optics Fabrication

# Nd:YAG Laser Cost Increase

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Power Laser Development	\$1.20 M
Core Optics Changes	\$1.73 M
PSL Update	\$0.19 M
Optical Test Facilities Upgrade	\$0.27 M
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Total Cost for Laser Change	\$3.39 M



	DEC95	JAN96	FEB96	MAR96	APR96	MAY96	JUN96	JUL96	AUG96	SEP96	OCT96	NOV96	SCALE
Budget	1,872	2,054	2,607	3,220	3,878	4,547	5,040	5,707	6,359	6,993	7,619	8,192	K\$
Performance	1,872	2,054	2,759										K\$
Actual/Forecast	2,429	2,820	3,218										K\$
Schedule Variance	0	0	152										K\$
Cost Variance	- 557	- 766	- 459										K\$

Schedule Variance = Perf-Budg    Cost Variance = Perf-Actual    Schedule Performance Index= Perf/Budg    Cost Performance Index= Perf/Actual

## Recommendations From Last Review

# Controls

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- **“Keep up the good work.”**
  - ›› Completed Design Requirements Review and Conceptual Design for Control and Monitoring System
    - Included Vacuum Cabling and Feedthroughs
  - ›› PSL Installed on 40 m Interferometer
    - Valuable Integration/Operation Experience
  - ›› Vacuum Controls Design Requirements Scheduled for Review May 1

# 40 m and Phase Noise IFO's

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- **“Increase the level of effort of senior staff devoted to operating these key facilities. Depending on graduate students with limited interaction with the senior people in the project, while an excellent training ground for graduate students, has significant risks for timely completion of the necessary research in support of critical designs for the project.”**
  - ›› Assignment Of Bob Spero as 40 m Leader Adds 15+ Years of Experience
  - ›› Greater Participation of CDS Staff in R&D Program
  - ›› Hiring of New Scientific Staff at Caltech and MIT Should Increase Available Resources

## Recommendations From Last Review

# Seismic Isolation

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- **“The definition of the seismic isolation system should receive immediate attention.”**
  - ››HYTEC Design Study started
    - R. Vogt, Acting Technical Representative
    - 3 Written Reports and 1 Meeting/Discussion (April 4)
    - Significant Weight Reductions Appear Possible
  - ››Design Requirements being Defined by Fred Raab
    - Scheduled for Review April 29

# Laser

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- **“The Byer group at Stanford University has developed most of the technology for stabilized, high power 1064 nm lasers. They have not, however, approached LIGO requirements in any single system. The LIGO and Byer groups should begin to work intensively together to transfer knowledge (in both directions). Short and long-term visits should be arranged to give both groups hands-on experience with the others’ hardware and software.”**
  - ››Period of Strong Interaction With Byer Group During Development of Specification of Power Laser
  - ››No Contact Regarding Lasers During Procurement Process Due to Potential Conflict of Interest
  - ››Planning Increased Level of Collaboration to Begin Within a Few Months



## Recommendations From Last Review

# Laser

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- **“Optimism about potential capabilities should not become a substitute for engineering experience. In particular, the details of the noise dynamics are likely to be different, especially in the bands used for modulation. A prototype stabilized master-oscillator should be implemented as soon as possible (based on a commercially available laser) and transferred to the PNI at MIT.”**
  - ›› Master Oscillator Stabilization Under Way
  - ›› Materials to Convert PNI to IR On Order
- **“A fully engineered two-stage 10 W 1064 nm PSL with mode cleaning cavity, etc. should be developed on a deliberate schedule, with full understanding of the trade-offs involved. The extra cost can be recovered from the savings anticipated from longer laser lifetimes.”**
  - ›› RFP for Development Issued, Proposals Currently Under Evaluation

# Summary

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- **New Detector Organization in Place and Functioning**
- **Significant Progress on Detector Design and Prototyping Activities**
- **Detector Schedule Replanned to Accommodate New Laser and Experience to Date**
- **Some Slippage of Intermediate Milestones, but Minimal Impact on Final Operation**
- **Costs Have Increased due to Change in Wavelength, but No Major Surprises**