



State of the LIGO Project

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Caltech

LSC Meeting

LLO, March 16, 2000



LIGO Schedule at Very Top Level

- 1996 Construction Underway
 - » mostly civil
- 1997 Facility Construction
 - » beam pipe and enclosure
- 1998 Construct Detectors
 - » completion of vacuum systems
- 1999 Install Detectors
 - » interferometers in vacuum
-  2000 Commission Detectors
 - » first light in arms; subsystem testing
- 2001 Engineering Tests
 - » sensitivity: engineering run
- 2002 LIGO I Run Begins
 - » $h \sim 10^{-21}$

Last Year
LSC
Florida



Future Scenario

YEAR	LIGO I	LIGO II
2000	Installation and commissioning	R&D
2001	Installation and commissioning	R&D
2002	Science run starts	MRE/R&D funds start, R&D, design, long lead items
2003	Science run	R&D, design, fabrication
2004	Science run	Fabrication, on-site assembly
2005	LIGO I interferometers removed	Fabrication, on-site assembly, installation into vacuum system
2006		Installation and commissioning



Construction Project Status

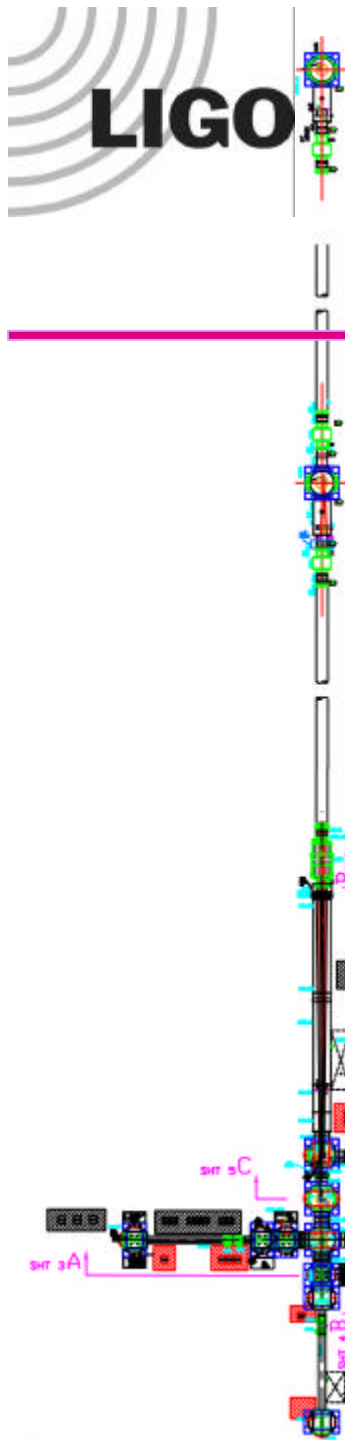
- 97.5% complete
- construction will finish on the budget
- Hanford buildings complete, including staging building
- Livingston complete except for erosion control and staging building construction
- 7 of the 8 beam tube modules (2 km each) baked



No more bullet holes in Livingston,
but in Hanford...



LIGO-G000018-00-M



Hanford Observatory Installation Status Overview

- **Washington 2 km Interferometer**

- » Laser installed; frequency and intensity stabilization operational
- » Seismic Isolation installation essentially complete
- » All suspended optics (input & core) installed and aligned; suspension electronics are functioning, but need tuning
- » ~Half of the output optics & sensors are installed
- » Laser locked to Modecleaner & performance testing in progress
- » Both 2 km arm cavities have been locked; characterization to be complete 4/00
 - Earth tides observed, wavefront sensing in, 2 hour arm lock!
- » Data Acquisition & an initial Global Diagnostics System installed

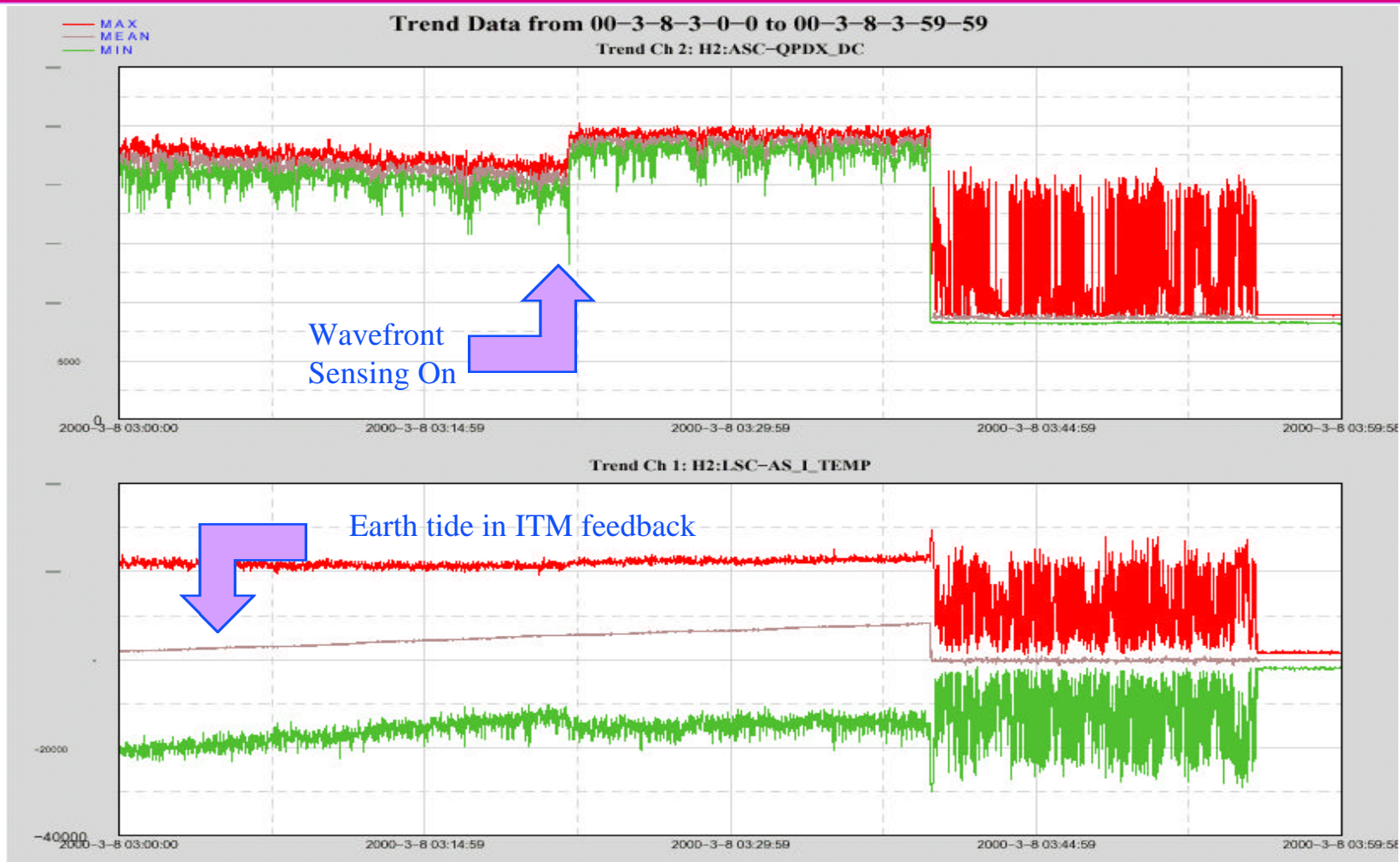
- **Washington 4 km Interferometer**

- » Seismic isolation installation ~75% complete
- » Racks, trays, feedthroughs, viewports & PSL enclosure in place

Coyne, Shoemaker

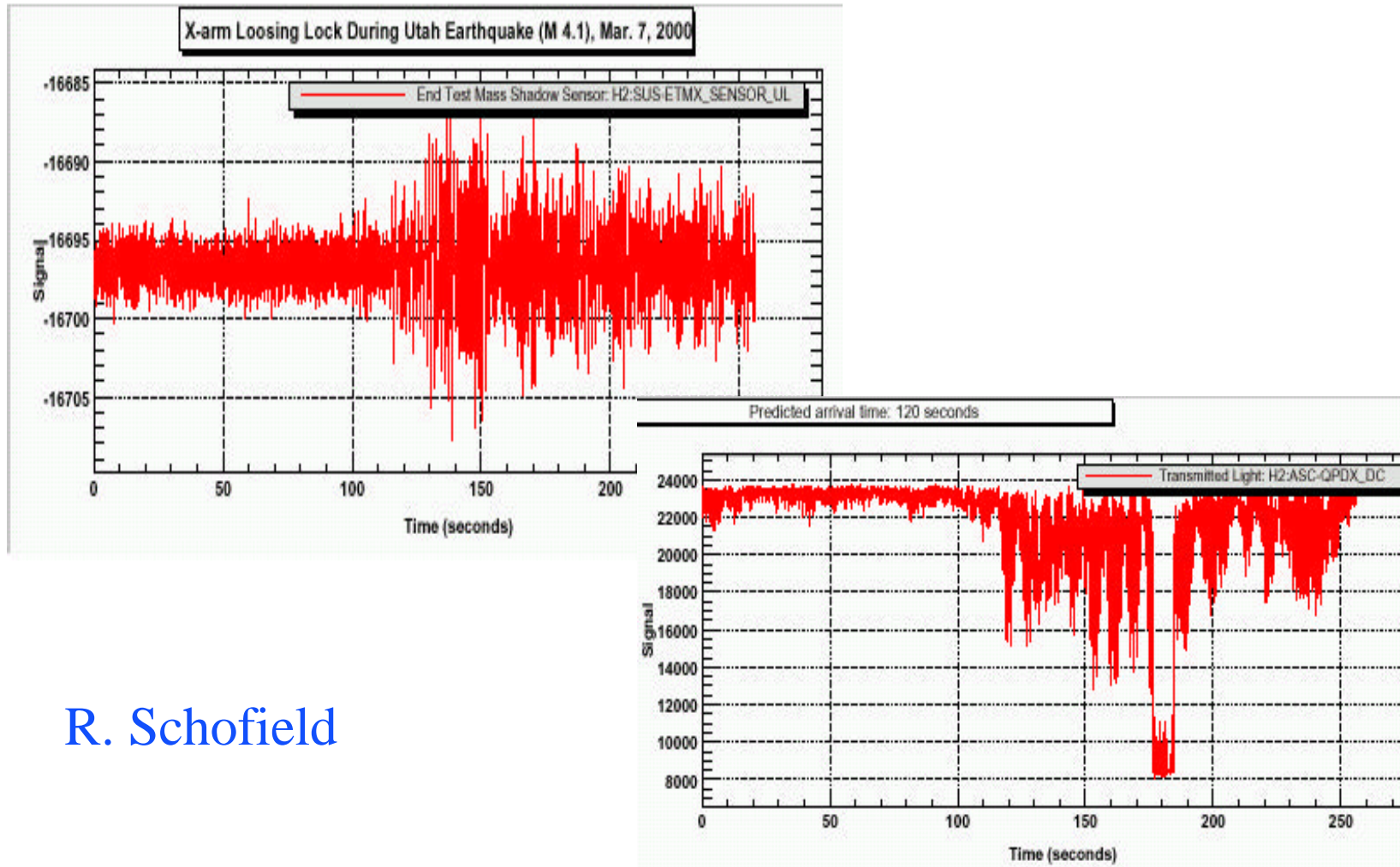


LHO 2 km Arm Cavity Lock With Wavefront Sensing





LHO Detects Utah Earthquake



R. Schofield



Progress...

Date	Duration of lock
1 Dec 99	Flashes of light
9 Dec 99	0.2 sec
14 January 00	2 minutes
19 January 00	60 seconds
21 January 00	5 minutes (other arm!!)
12 February 00	18 minutes
7 March 00	2 hours +



Software tools for Diagnostics

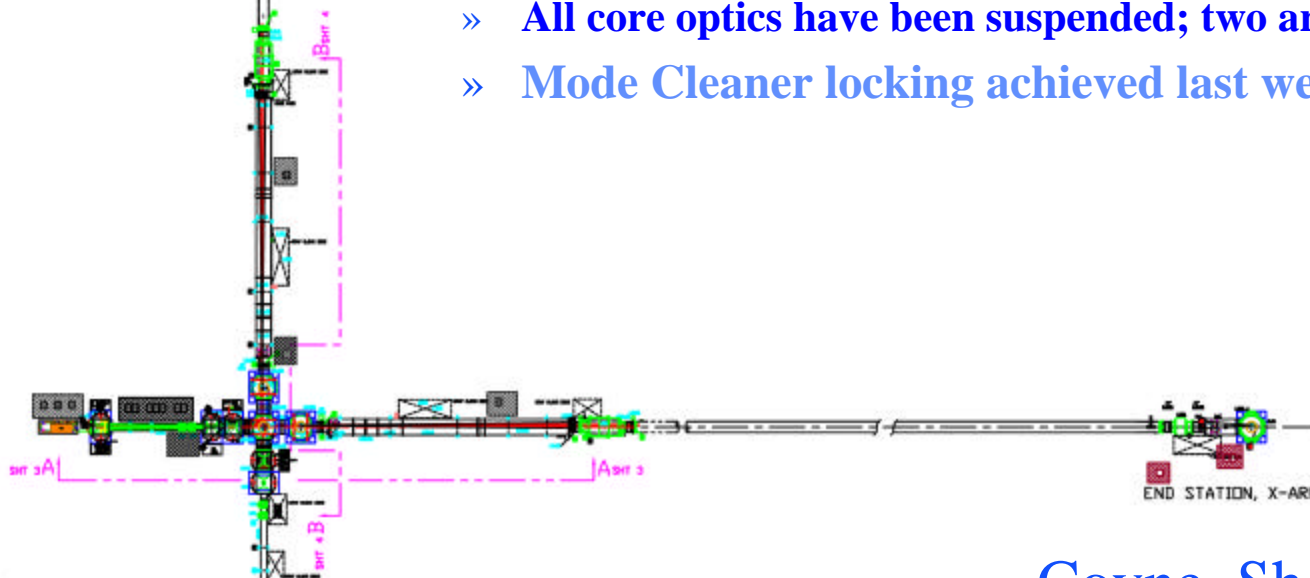
- Data acquisition system
 - » site-wide, synchronized, flexible
 - » reduced data sets for later study
- time series viewing tools
 - » multiple time series, trends
- diagnostic analysis tools
 - » Fourier transforms, coherence, etc.
- Change of paradigm:
research performed in the control room



Livingston Observatory Installation Status Overview

- **Louisiana 4 km Interferometer**

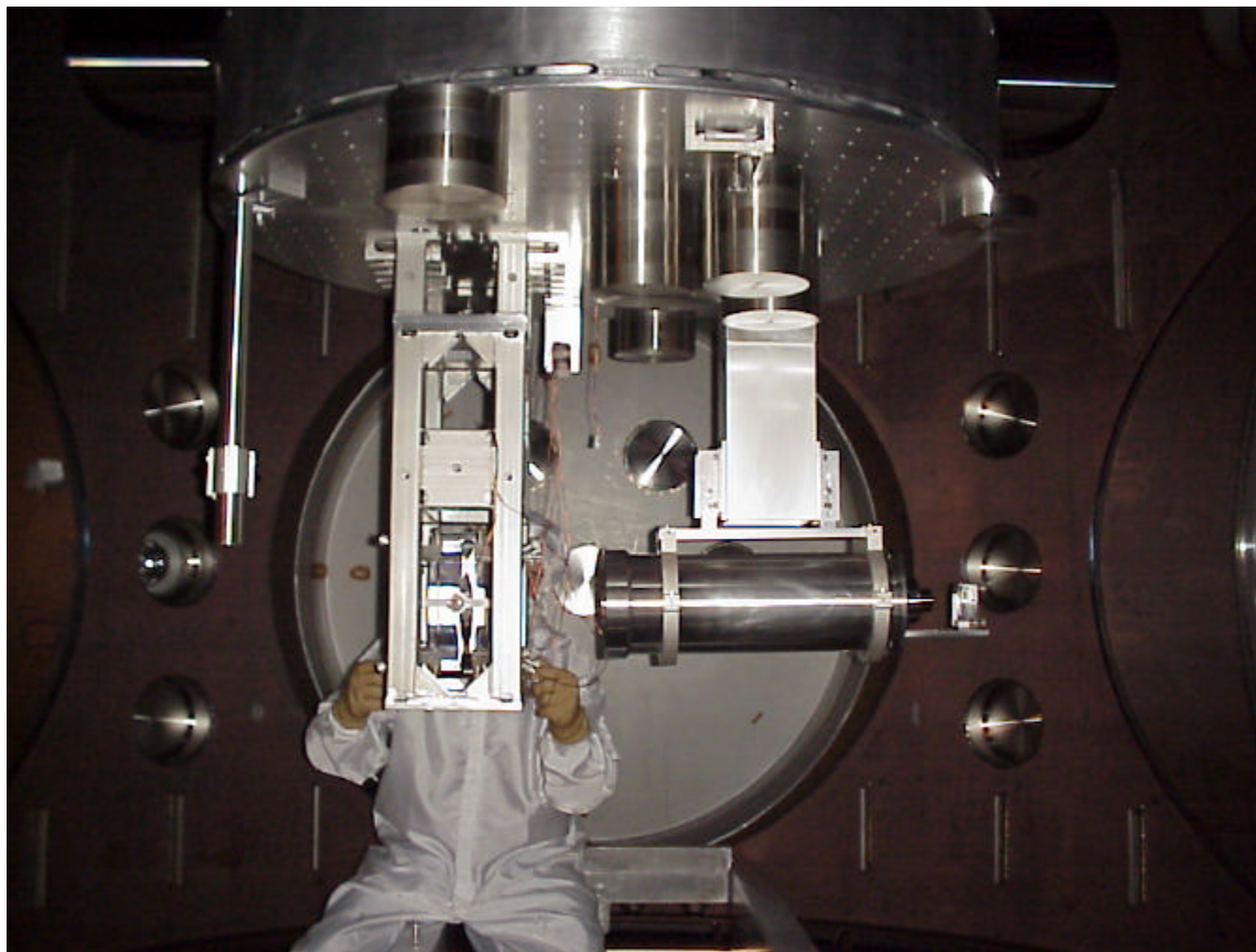
- » Laser installed on optical table; frequency and intensity stabilization loops being tested and debugged
- » Seismic isolation installation complete
- » Input Optics installation is ~ 90% complete
- » All core optics have been suspended; two are installed
- » Mode Cleaner locking achieved last week !



LIGO-G000018-00-M

Coyne, Shoemaker

LLO End Test Mass Installation





Readonly Access to Log Books is Public!

- Livingston
 - » <http://abundance.ligo-la.caltech.edu/ilog/>
- Hanford
 - » <http://blue.ligo-wa.caltech.edu/ilog/>



Progress Against Schedule?

- Installation and commissioning of the interferometers have been progressing and preliminary results are encouraging
- However, there have been delays and problems:
 - » production start problems in seismic isolation and a slow early production pace
 - » process control problems for the magnet/standoff assembly adhesion to the optics
 - » handling and fixture problems associated with the transport and alignment of completed suspension assemblies
 - » re-manufacture of much of our flourel component stock as a result of losses from a tornado which destroyed the manufacturing facility
 - » re-baking of the flourel spring seats (and associated seismic stack rebuild) to mitigate water load on the vacuum system
 - water load is now an operational constraint



Strategy Evolving: Look Over the Original Planning Horizon

- Slow the installation into 3rd interferometer (LHO 4-km) to permit use of reworked components
- Move to coincidence running as soon as 2 interferometers are at useful sensitivity
 - » makes coincidence data stream available earlier than waiting for triple coincidence
- Path to Science Run should be smoother with this approach
 - » 3 interferometer Science Run begins mid-2002
 - » First search papers by mid-2002 based upon engineering running?!
 - Engineering run guided by engineering needs, but...
 - We are scientists, not just instrument builders.



Top Level Schedule

ID	Task Name	1998			1999				2000				2001				2002				
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1	LHO 2km IFO	[Timeline bar from Q2 1998 to Q4 2001]																			
14	LLO 4km IFO			[Timeline bar from Q3 1998 to Q4 2001]																	
30	LHO 4km IFO	[Timeline bar from Q2 1998 to Q4 2001]																			
44	Coincidence Engineering Run starts																				
45	Observatory Operations & improvements																				
46	Science Run starts																				



LIGO I Science Run

- Begins with reliable and calibrated coincidence data on three interferometers and stable configuration
 - » Formally recognized by LIGO Laboratory
 - » “Ownership” of running then guided by science
- Improvements to reach final design goals in sensitivity and reliability will be alternated with data running
 - » Scientific running experience informs detector development
- Goal is to obtain at least one year of integrated sensitivity at $h \sim 10^{-21}$ before initiating LIGO II



Future Scenario: The Next 5 Year Plan

YEAR	LIGO I	LIGO II
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LIGO II Scope ?

Last Year
LSC
Florida

- When are we ready to document a strawman LIGO II configuration, with well-defined options?
- LIGO Laboratory is ready to support the LSC in laying out a schedule and cost baseline
- NSF is already engaged in long term planning for construction of upgrades
- This meeting might consider this as we work towards revisions in White Paper



This Meeting

- R&D for LIGO II
 - » Consolidate planning for R&D and LIGO II proposal
 - » Cope with thermal noise bombshell
 - » advisory groups meet on 40 Meter, LASTI, selection of LIGO II seismic isolation approach
- 3 “software” working groups
 - » Advance the White Paper
- 6 month Attachments