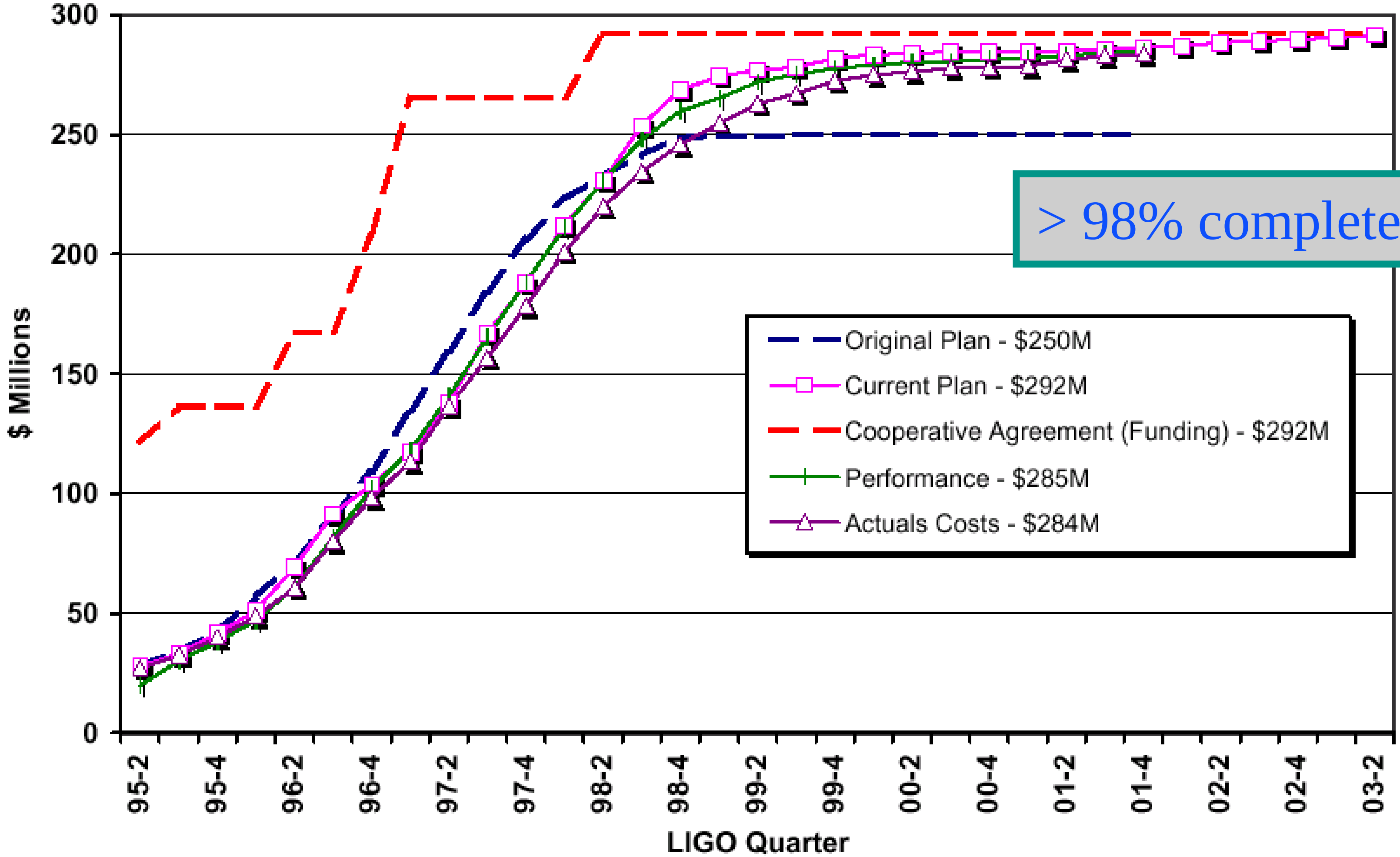
State of the LIGO Project

Gary Sanders
LIGO Laboratory
LSC Meeting, March 2002
Baton Rouge

LIGO-G020026-00-M

Construction Cost/Schedule Performance

Support buildings and LDAS remain



> 98% complete

LIGO Plans
schedule

1996	**Construction Underway** **(mostly civil)**
1997	**Facility Construction** **(vacuum system)**
1998	**Interferometer Construction** **(complete facilities)**
1999	**Construction Complete** **(interferometers in vacuum)**
2000	**Detector Installation** **(commissioning subsystems)**
2001	**Commission Interferometers** **(first coincidences)**
2002	**Sensitivity studies** **(initiate LIGO I Science Run)**
2003+	**LIGO I data run** **(one year integrated data at $h \sim 10^{-21}$)**
2006+	**Begin 'advanced' LIGO installation**

2007

August 2001 LIGO Lab Planning Memo (M010216-A-M)

- "…The LIGO Laboratory will carry out the E7 run before the end of the year. We anticipate that the run will take place during December and will be scheduled for two full weeks. The run is an engineering run and will be the responsibility of the LIGO Laboratory…"
- "…The S1 run will be held in May 2002. The prime purpose for this run is to carry out the first scientific searches. This run will be the joint responsibility of the Laboratory and the LSC. The sensitivity goal is a two site coincidence with 3 interferometers running and the achieved scientific reach (volume searched x observation time in coincidence) should be an order of magnitude better than achieved in the E7 run. At least one interferometer at each site should be operated in the full recycled configuration…"

March 2002 LIGO Lab Planning Memo (M020136-A-M)

- The Upper Limits Runs S1 and S2 –

3. "… schedule the S1 run to begin at 8:00 am Pacific time on Saturday, June 29 and to be completed at 8:00 Pacific on Monday, July 15...The sensitivity goal is a two site coincidence with 3 interferometers running and the achieved scientific reach (volume searched x observation time in coincidence) should be an order of magnitude better than achieved in the E7 run. At least one interferometer at each site should be operated in the full recycled configuration."
4. "The S2 run will have a goal of at least an order of magnitude improvement in scientific reach … beyond S1 and should follow successful completion of analysis of the S1 data…we will schedule the next science run to begin at 8:00 am Pacific Friday November 22, 2002 with completion at 8:00 on Monday, January 6, 2003."

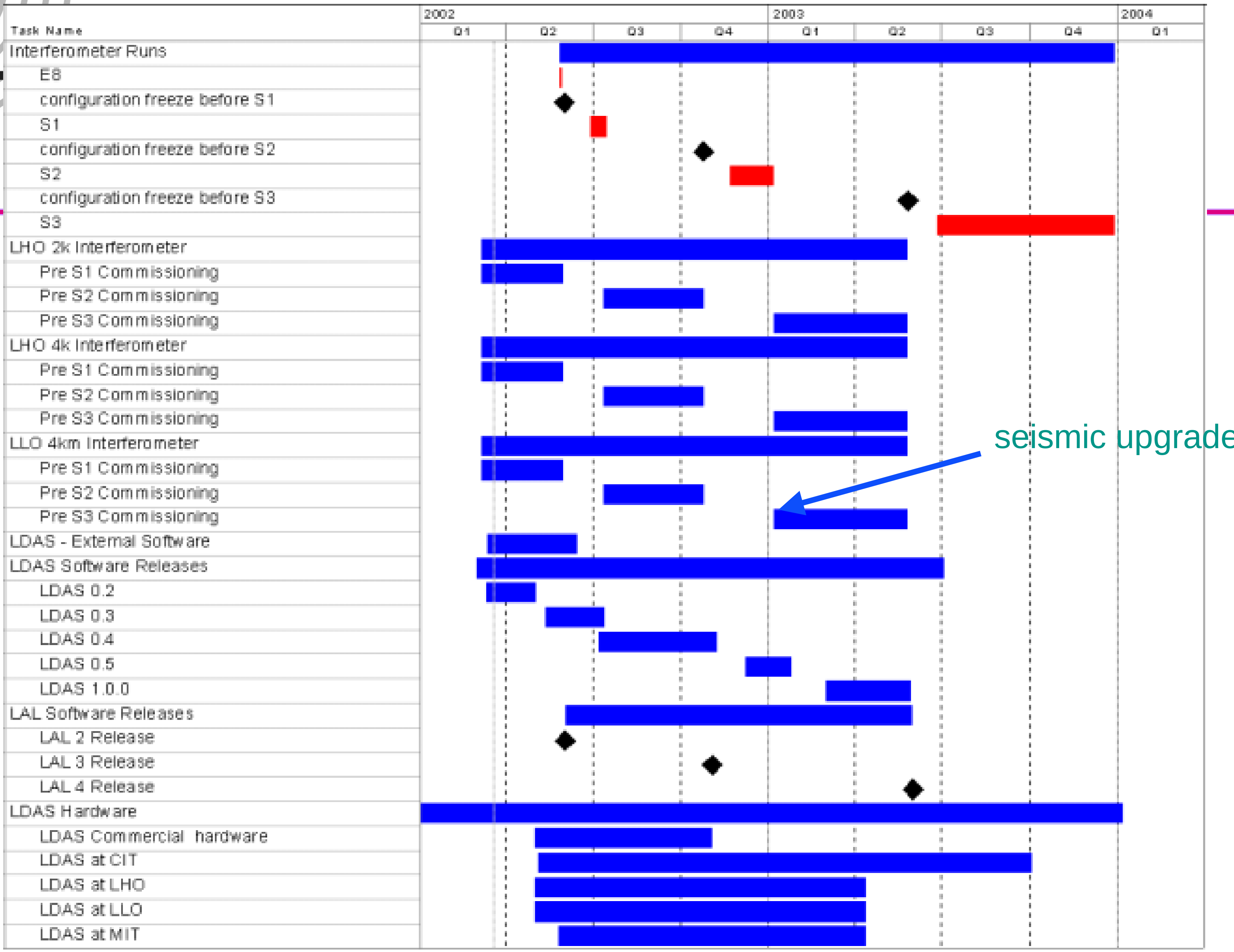
"These two runs will complete the upper limit running and the orientation for the LIGO running experience. We believe that this should lead to a broad set of new publishable limits, well beyond what has been previously published."

March 2002 LIGO Lab Planning Memo (M020136-A-M)

- Extended Search Runs

6. "The S3 run will mark the beginning of true search running, representing a step beyond setting upper limits on selected gravitational wave searches. S3 will be intended to accomplish a real search for gravitational waves with *significant* astrophysical *significance*. We expect to schedule S3 to commence about June 27, 2003 and this run will be planned for several months duration."

7. "During 2003 and 2004, we will plan to run in this search mode for at least 50% of the calendar time, followed by the planned one year integrated LIGO science run at design sensitivity. This science run will be completed prior to proposed major interferometer replacements."


Task Name
2002
2003
2004
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Interferometer Runs
E8
configuration freeze before S1
S1
configuration freeze before S2
S2
configuration freeze before S3
S3
LHO 2k Interferometer
Pre S1 Commissioning
Pre S2 Commissioning
Pre S3 Commissioning
LHO 4k Interferometer
Pre S1 Commissioning
Pre S2 Commissioning
Pre S3 Commissioning
LLO 4km Interferometer
Pre S1 Commissioning
Pre S2 Commissioning
Pre S3 Commissioning
LDAS - External Software
LDAS Software Releases
LDAS 0.2
LDAS 0.3
LDAS 0.4
LDAS 0.5
LDAS 1.0.0
LAL Software Releases
LAL 2 Release
LAL 3 Release
LAL 4 Release
LDAS Hardware
LDAS Commercial hardware
LDAS at CIT
LDAS at LHO
LDAS at LLO
LDAS at MIT
seismic upgrade

LIGO + GEO Achievement: Running in Quad Coincidence

- From Gabi Gonzalez compilation
- Single IFO locked times
  - » GEO: 258 hrs, or 77.1
  - » LIGO H1: 293 hrs, or 87.5 %
  - » LIGO H2: 212 hrs, or 63.5 %
  - » LIGO L1: 284 hrs, or 84.8 %
- Double coincidence segments
  - » GEO-H1: 184 hrs, or 55.2 %
  - » GEO-H2: 120 hrs, or 35.8 %
  - » GEO-L1: 176 hrs, or 52.7 %
- Triple coincidence segments
  - » GEO-H1H2: 100 hrs, or 29.9 %
  - » GEO-L1H1: 142 hrs, or 42.4 %
  - » GEO-L1H2: 86.8 hrs, or 26 %
- Quadruple coincidence
  - » 77 hrs, or 23 %

- For segments longer than 15 min
- Single IFO locked times
  - » GEO: 211 hrs, or 63.1 %
  - » LIGO H1: 231 hrs, or 69 %
  - » LIGO H2: 157 hrs, or 46.9 %
  - » LIGO L1: 249 hrs, or 74.5 %
- Double coincidence segments
  - » GEO-H1: 105 hrs, or 31.5 %
  - » GEO-H2: 62.2 hrs, or 18.6 %
  - » GEO-L1: 113 hrs, or 33.9 %
- Triple coincidence segments
  - » GEO-H1H2: 40.9 hrs, or 12.2 %
  - » GEO-L1H1: 65.6 hrs, or 19.6 %
  - » GEO-L1H2: 35.7 hrs, or 10.7 %
- Quadruple coincidence
  - » **26.1 hrs**, or 7.81 %

LIGO + GEO Achievement: Running in Quad Coincidence

- Longest segments
  - » GEO: 3.82 hrs
  - » LIGO H1: 5.91 hrs
  - » LIGO H2: 7.58 hrs
  - » LIGO L1: 3.97 hrs
    GEO-H1: 1.97 hrs
  - » GEO-H2: 1.59 hrs
  - » GEO-L1: 1.66 hrs
  - » GEO-H1H2: 1.23 hrs
  - » GEO-L1H1: 1.08 hrs
  - » GEO-L1H2: 1.09 hrs
  - » **GEO-L1H1H2: 1.08 hrs**

- Running was carried out in coincidence with ALLEGRO in 3 orientations as “rehearsal” for stochastic searches

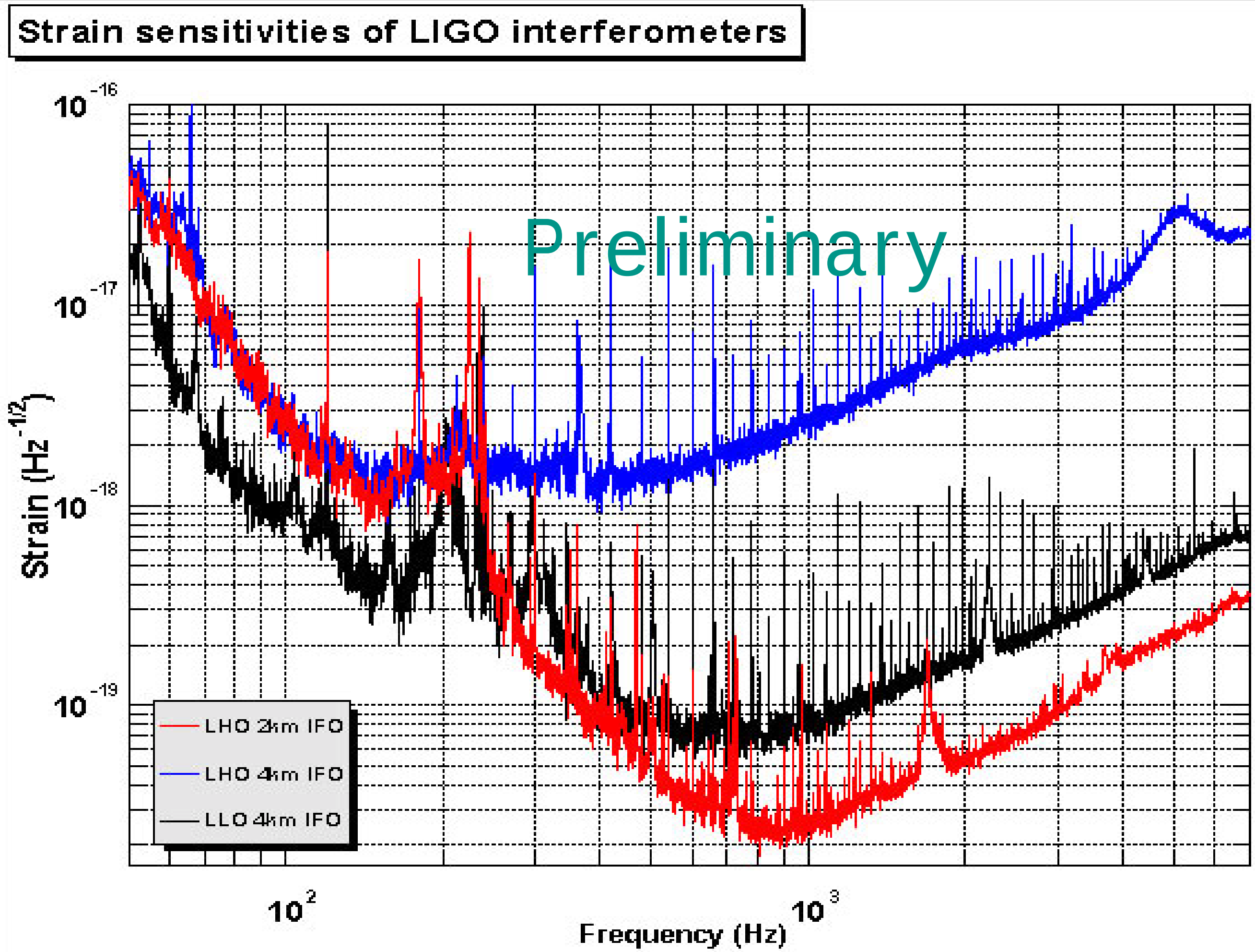
LHO interferometers at last LSC meeting (Aug 2001)

- 2 km
  - » Earthquake repairs complete
  - » Locked in full recycled configuration
  - » 1 W power into mode cleaner (attenuators at photodiodes gave effective input power 10-20 mW)
  - » DISPLACEMENT Sensitivity ~ 3 x 10^{-16} m/$Hz^{1/2}$
- 4 km
  - » Installation complete
  - » All suspended optics under control
  - » Modecleaner locked
  - » No light down the arms

LHO interferometers at E7 (Dec 2001 – Jan 2002)

- 2 km
  - » Operated in full recycled configuration (recycling factor up to 25, but typically ~15)
  - » Tidal feedback operational (lock duration up to 15 hours)
  - » DISPLACEMENT Sensitivity improved to ~ 5×10^{-17} m/Hz$^{1/2}$
- 4 km
  - » Operated in recombined Fabry-Perot/Michelson configuration
  - » Tidal feedback operational (locks up to 4 hours; less range in digital suspension controllers
  - » Noise substantially poorer than 2 km or LLO 4 km; less mature

E7 Strain Sensitivities



LHO interferometers since E7…

- 2 km
  - » Common mode servo implemented (frequency stabilization from average arm length); establishes control system “gain hierarchy”
  - » Power increased to 5 W into the modecleaner (effective input power increased to 50-100 mW)
  - » Electronics noise reductions
  - » Sensitivity improved to ~ 2 x 10^{-17} m/$Hz^{1/2}$

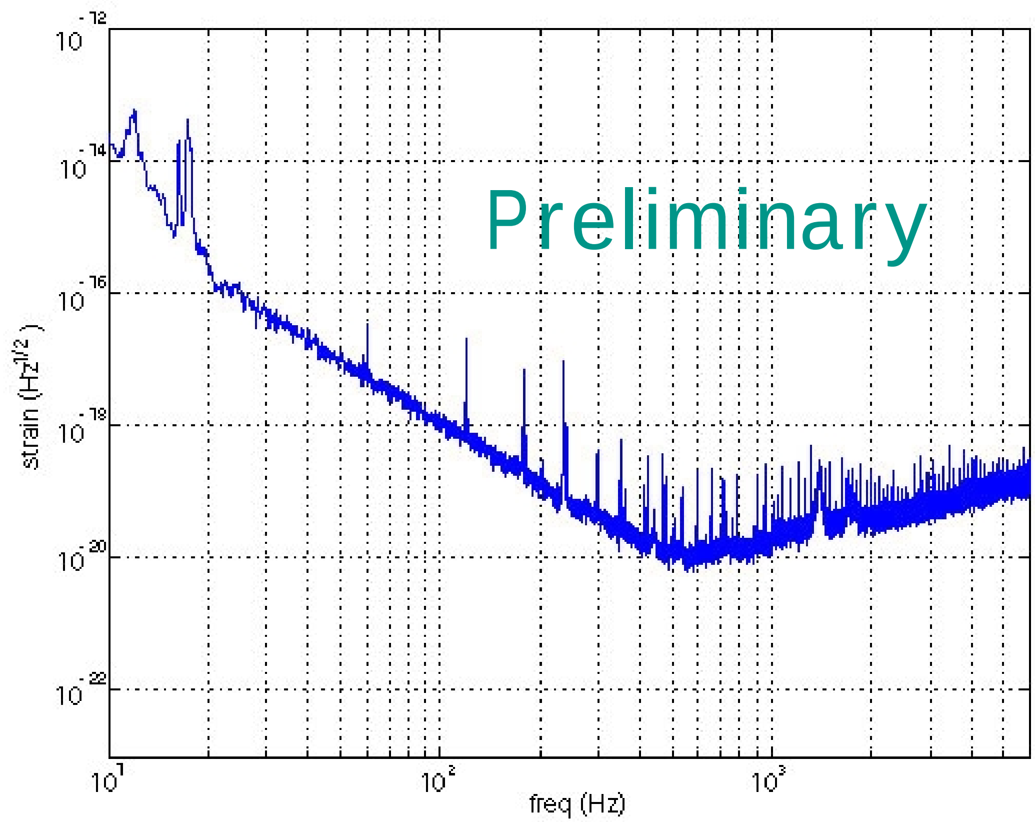
…LHO interferometers since E7

- 4 km
  - » Locked in full recycled configuration (recycling factor up to 40); increased range on suspension controller
  - » Added filtering on MC suspensions -> improvements in laser frequency noise
  - » Frequency dependent output matrices implemented and tested on digital suspensions

Good Progress, Stan ! but still a long way to go

2 km Spectrum
(late January)

Still needs factor
of 30-100
improvement
at high frequencies,
factor of 10^4 near 100
Hz.



Next steps for the LHO interferometers

- 2 km
  - » Electronics noise reduction
  - » Increase the power used at the antisymmetric port
  - » Finish commissioning wavefront sensing alignment
  - » Identify low frequency f^{-3} noise source
- 4 km
  - » Concentrate on validation of digital suspensions: noise, range, robustness
  - » Common mode servo: implementation with digital suspensions
  - » Electronics noise reduction
  - » Begin implementing wavefront sensing

LHO Observatory Status since E7

- Last of construction passes ground-shaking stage ➔ daytime locking
- Attempted 24-hr commissioning in late Jan & Feb
- Have cut back to 19-hr schedule to better concentrate resources

OSB East: LDAS, Science office/lab space; auditorium; on-site traffic stop

LHO Emphasis Looking Toward S1

- Commission two interferometers with 7x24 coverage to meet goals
- Develop technical skills of operations staff
- Institute 24-hr shift rotations
- Complete building construction (scheduled for Aug 02)
- Seek to improve strength by encouraging visiting scientists and developing of local university resources

E7 Performance at LLO

- E7 PERFORMANCE: Recombined Fabry-Perot/Michelson Interferometer
  - » Sensitivity: h(100Hz) ~ 10^{-18}/sqrt(Hz), h_{min}(700 Hz) ~ 10^{-19}/sqrt(Hz)
  - » Duty cycle ~ 60% comprised of nights, Sat, Sun and holidays all day

LLO Status Since E7

- Interferometer operates in power recycled configuration during periods of low seismic activity – at night, on Sundays, etc.
- Microseismic feed forward actuation on ETMs commissioned. Suppresses differential microseismic motion by about an order of magnitude
- Angular control using optical lever damping
- Common mode servo installed. Tune up of gains and crossover frequencies in progress.
- Acoustic isolation chamber and new input periscope installed to minimize acoustic coupling to input beam
- 16 node Beowulf cluster and 7 Tbytes of disk storage installed
- Site-wide laser safety interlock system installed and operational
- Commissioning activities continue 20 hours per day, every day

Steps toward S1 at LLO…

- Improvements in sensitivity
  - » Increase light on photodetectors: remove attenuators, possibly increase input power from 1 to 5 watts.
  - » Improve common mode servo: increase gain and improve compensation
  - » Reduce angle to length coupling: position beams on mirrors close to center of mass
  - » Reduce noise in angular damping loops: software with adjustable filters, centering of optical levers
  - » RFI and power line pickup reduction: program of electronics architectural changes
  - » Understand and remove the present excess $1/f^3$ noise

…Steps toward S1 at LLO

- Improvements of reliability and interferometer stability
  - » Installation of antisymmetric wavefront sensor
  - » Installation of differential tidal servo
  - » Exploration of range of alignment and servo gain values to allow rapid acquisition of the fully recycled interferometer
  - » Application of the data analysis algorithms to search for non-Gaussian behavior: on-line histograms in the control room
- Operational improvements
  - » Automatic locking and alignment scripts and sequences

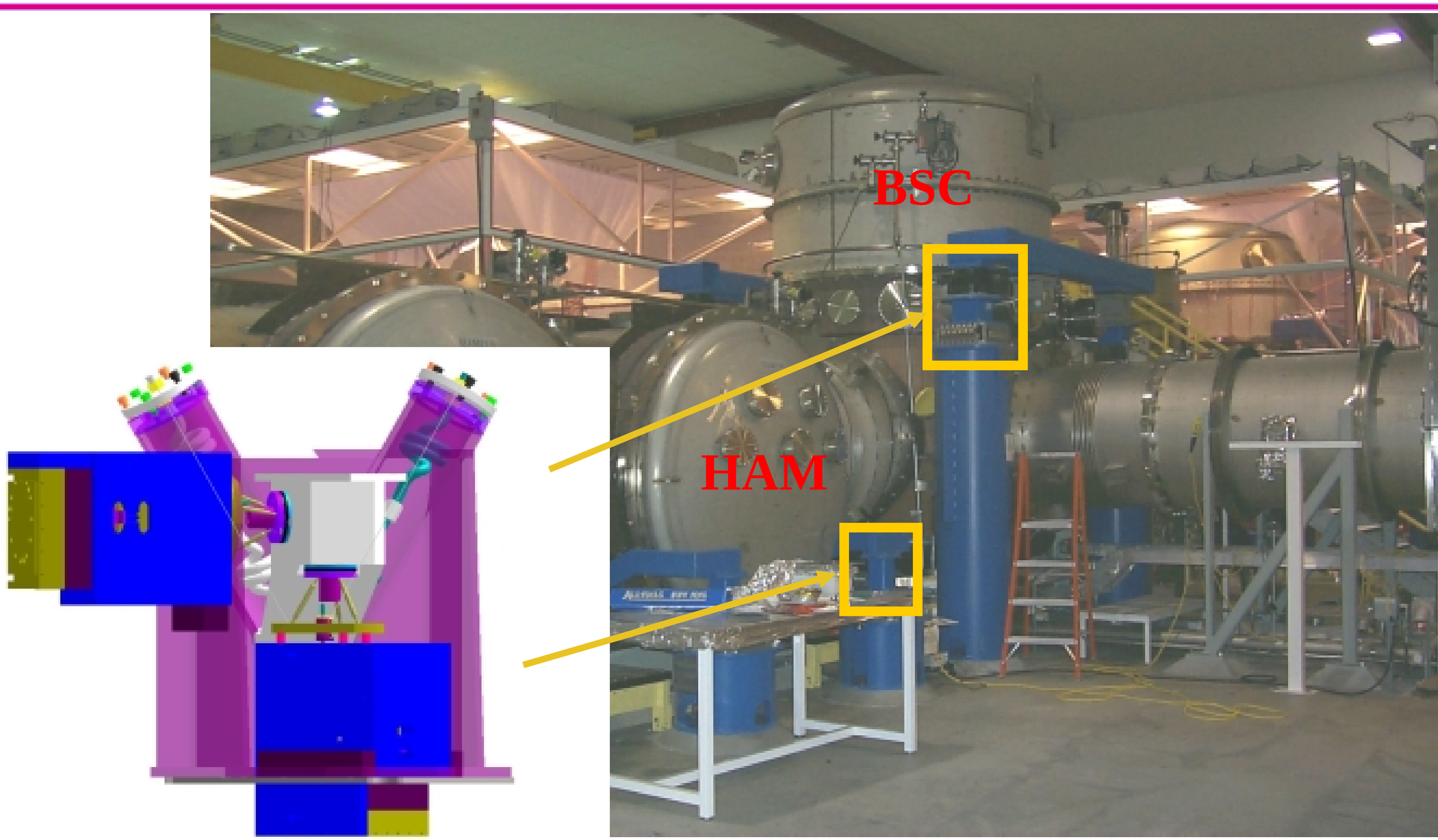
Anticipated S1 Performance at LLO

- ANTICIPATED S1 PERFORMANCE: Recycled Fabry-Perot/Michelson Interferometer
  - » Sensitivity: 5×10^{-20}/sqrt(Hz) < h(100Hz) < 5×10^{-19}/sqrt(Hz)
  - » 1×10^{-20}/sqrt(Hz) < h_{min}(700Hz) < 2×10^{-20}/sqrt(Hz)
  - » Lower values at 100 Hz associated with finding source of $1/f^3$ present noise but not repairing coil driver noise.
  - » Lower values at minimum associated with increased light on photodiodes
  - » Duty cycle ~ 60% same as E7

Improved LLO seismic isolation after S1 and S2

- Fine actuation system stack mode suppression
  - » End test mass chambers for S1
  - » Input test mass chambers also for S2
  - » Possibly added to the Hanford observatory for S3
- Seismic retrofit with an active pre-isolation system
  - » Planned at the Livingston observatory right after S2
  - » The active pre-isolation system is placed under the existing passive stack, external to the chamber
    - – actuation is either hydraulic or electro-magnetic (both concepts are being developed & tested at LASTI)
- Active internal damping system to increase stack mode damping (if required)

Planned Initial Detector Modifications



Planned Initial Detector Modifications

Category	Task	Science Run		
		S1	S2	S3
Added Capability	Wavefront Sensor (WFS) and Optical Levers for LLO 4k (before DSC)	x		
	LSC & ASC code with new digital filter modules	x		
	Fine actuator tidal control for LLO 4k	x		
	Microseismic peak reduction for LHO 2k & 4k		x	
	Implement fine actuator 1-3 Hz isolation on ETMs for LLO 4k	x		
	Implement fine actuators & 1-3 Hz isolation on ITM chambers for LLO 4k		x	
	Automate FP arm cavity angular alignment	x		
	Digital Suspension Controls (DSC) for LHO 2k, LLO 4k		x	
	PSL Intensity Stabilization Servo (ISS) outer loop		x	
	Auto-centering for beams to ISC tables and transmission quad PDs		x	
	Coordinated software/hardware switch ramping for de-whitening filters		x	
Direct Noise Reduction	Suspension Coil Driver electronic noise reduction		x	
	RFI & 60 Hz clean up	x	x	
	Mode Cleaner servo variable gain	x		
	Timing modules with variable delay	x		
	Optical Lever laser noise reduction		x	
	DSC: DAC Diff. driver/receiver, stack mode resonant gain stages, etc.	x		
	Seismic retrofit at LLO			x
	Lower noise Digital to Analog Converter (DAC)			x
	Further Noise Reduction TBD		x	x
Detector Data	CDS object code & filter parameter tagging	x		
	All slow channels in frames	x		
	EPICS LSC name cleanup	x		
	FrameBuilder reads arbitrary trend data	x		
	Frame version 5 implementation		x	

Advanced LIGO R&D Status

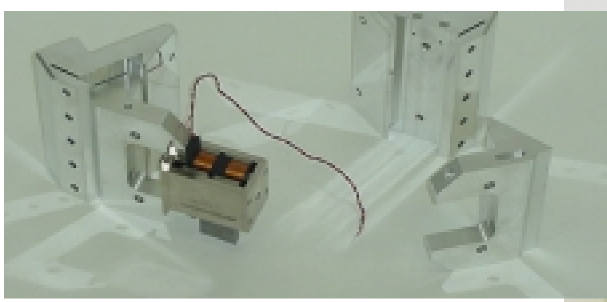
- A general overview of motivations and plans was presented to the LSC a year ago (G010082)
- At August, 2001 LSC meeting the planning & implementation strategy was presented (G010282-00)
- Update:
  - » Decision made to delay MRE(FC) proposal to **Fall 2002**
  - » "bottoms-up" costing has nearly been completed
  - » Plan assumes MRE(FC) funding available 1Q2005
  - » Supports an installation start of 1Q2008
    - – delayed in part due to insufficient funds, and new congressional directive, which prevents the first set of core optics from being purchased on R&D funding
  - » Soon ready to confront scope decisions (number of interferometers, trimming features to control costs, etc.)
  - » Advanced R&D program is proceeding

Advanced LIGO R&D Status

- Interferometer Sensing & Control (ISC):
  - » GEO 10m “proof of concept” experiment:
    - – Preparation proceeding well
    - – Results available for 40m Program in early 2003 (lock acquisition experience, sensing matrix selection, etc.)
  - » 40m Lab for Precision Controls Testing:
    - – Infrastructure has been completed (i.e. PSL, vacuum controls & envelope, Data Acquisition system, etc.)
    - – Working on the installation of the 12m input MC optics and suspensions, and suspension controllers by 3Q02
  - » Gingin facility for High Power Testing:
    - – Within the next year the LIGO Lab will deliver two characterized sapphire test masses and a prototype thermal compensation system (beam scan and/or ring heater)
    - – The facility development is advancing nicely
    - – Activities closely linked with subsystem, LASTI R&D plan

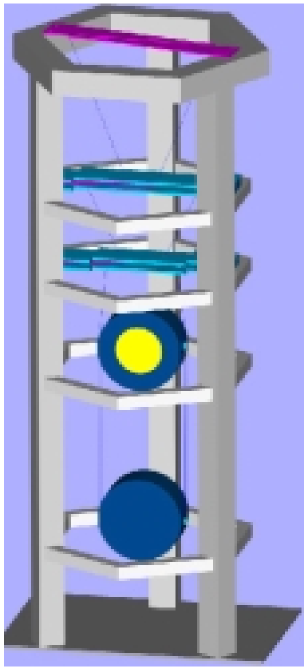
Advanced LIGO R&D Status

- Seismic Isolation system (SEI):
  - » Development of pre-isolation system accelerated for use in retrofit on initial LIGO
    - – hydraulic & electro-magnet actuation variants
    - – To be tested at the LASTI facility
  - » “Technology Demonstrator” system has been fabricated
    - – a two stage, 12 degree of freedom active, stiff, isolation system
    - – being installed into the Stanford Engineering Test Facility (ETF)
- LASTI infrastructure has been completed (including BSC stack to support pre-isolation full scale testing for initial LIGO)

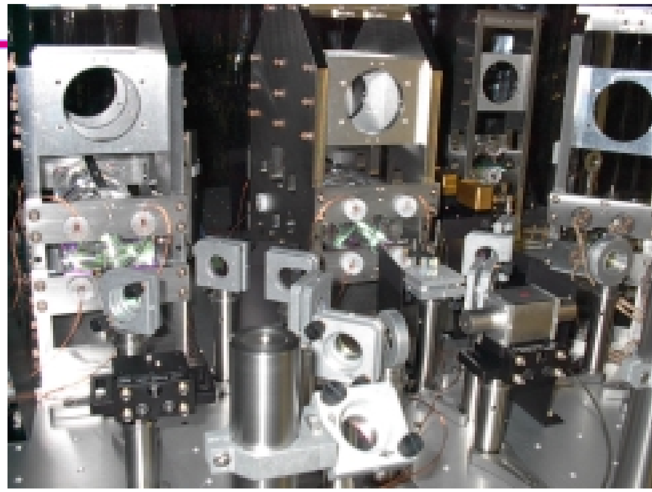


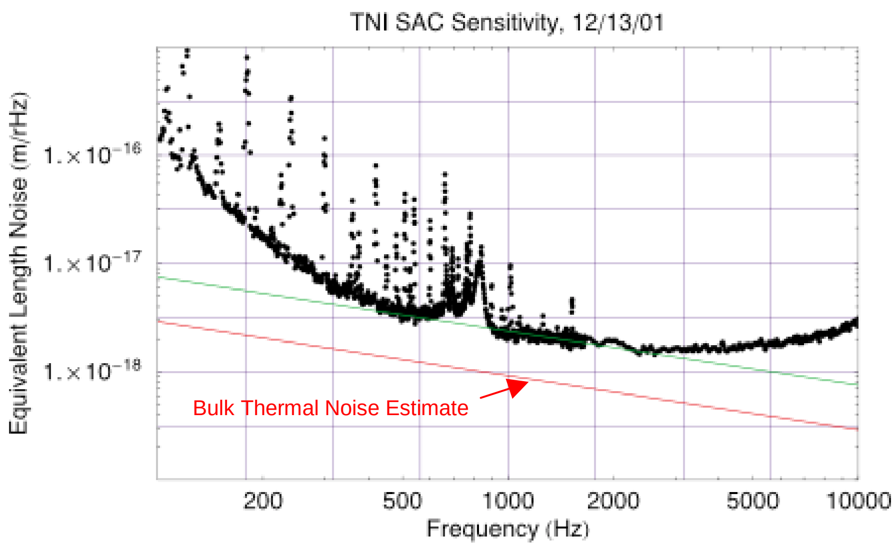
Advanced LIGO R&D Status

- Suspension System (SUS):
  - » Complete fused-quartz fiber suspensions functioning in the GEO-600 interferometer
  - » Progress, in theory and in experiment, on both circular fibers (tapered) and ribbons
  - » Dynamics testing is underway on a quadruple pendulum prototype
  - » Silica-sapphire hydroxy-catalysis bonding looks feasible; silica-leadglass to be explored
  - » Significant design work underway for 'triple' suspensions
  - » TNI nearing final results for fused silica; sapphire mirrors ready in Fall 2002 for next phase



Thermal Noise Interferometer (TNI)

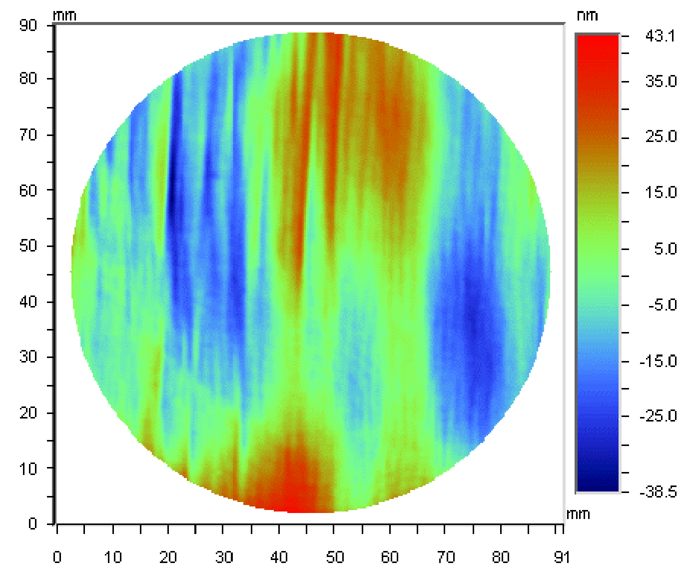




- Tests sapphire for advanced LIGO under realistic conditions: High-Q, suspended optics, broadband measurement of thermal noise.
- Initial stage uses fused silica mirrors, provides data on bulk and coating thermal noise.
- Current sensitivity appears to show coating thermal noise from 300*Hz* to 3*kHz.*
- Sapphire optics received 3/6/02. Installation scheduled for Summer 2002. Data to be provided to downselect committee.

Advanced LIGO R&D Status

- Core Optics Components (COC):
  - » New optical homogeneity measurements along the 'a' crystal axis are close to acceptable (13nm RMS over 80mm path length)
  - » Tests to compensate for optical inhomogeneity if required, look promising (computer controlled 'spot' polishing and ion beam etching)
  - » Recent sapphire annealing efforts are encouraging (reductions to 20 ppm/cm vs a requirement of 10 ppm/cm)
  - » Coatings on large optics show sub-ppm losses (SMA/Mackowski)
  - » Coating mechanical loss program in full swing; materials rather than interfaces seem to be the culprit



Date: 10/25/2001
Time: 13:59:18
Wavelength: 1.064 um
Pupil: 100.0 %
PV: 81.6271 nm
RMS: 13.2016 nm

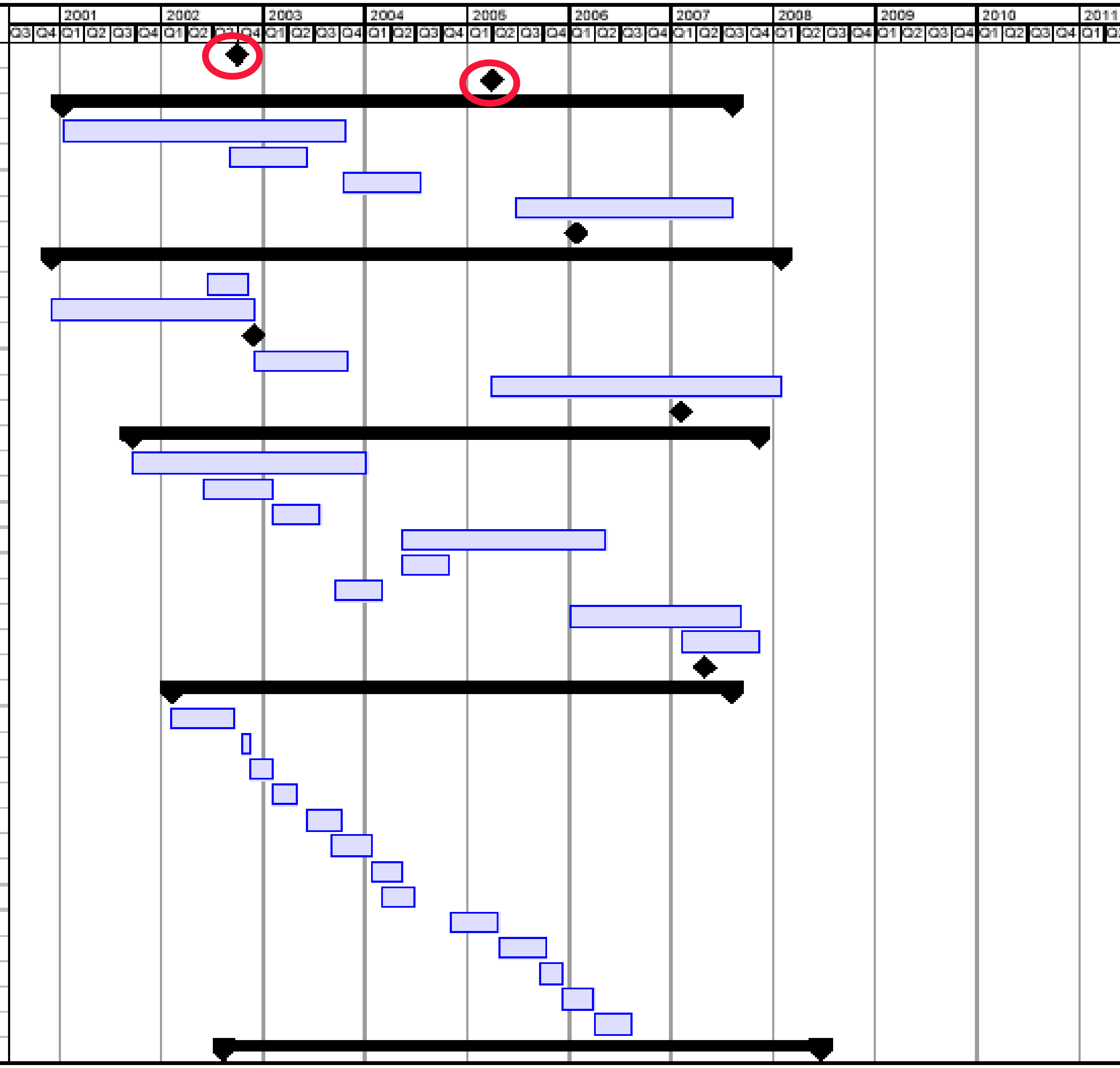
X Center: 172.00
Y Center: 145.00
Radius: 163.00 pix
Terms: None
Filters: None
Masks:

Advanced LIGO R&D Status

- Input Optics
  - » **Modulator** with RTA shows no evidence of thermal lensing at 50W
  - » Demonstrated 45 dB attenuation and 98% TEM00 mode recovery with a thermally compensated **Faraday Isolator** design (-dn/dT materials)
  - » RTA-based **EOMs** are currently being fabricated
- Pre-Stabilized Laser (PSL)
  - » Three groups pursuing alternate design approaches to a 100W demonstration by ~mid 2002
    - – Master Oscillator Power Amplifier (MOPA) [Stanford]
    - – Stable-unstable slab oscillator [Adelaide]
    - – Rod systems [Hannover]
  - » Concept down select ~Aug 2002

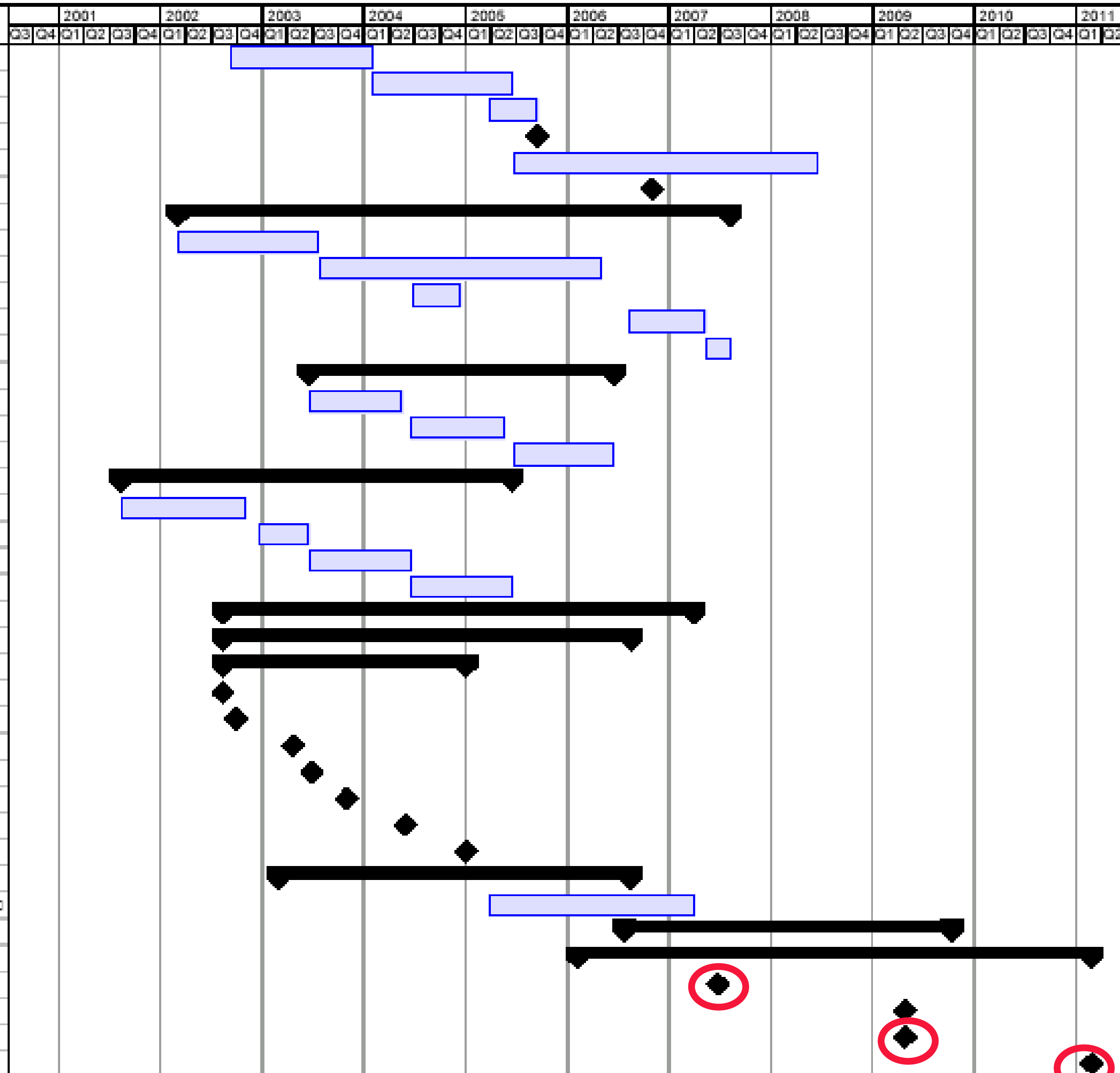
ADVANCED LIGO SUMMARY SCHEDULE 3/18/2002 [derived from LIGO-M020121-A]

ID	Task Name
1	MRE Proposal submitted
2	MRE funding available
3	**Seismic Isolation (SEI)**
5	Prelim Design
6	pathfinder fab (HAM & BSC)
10	Final Design
13	production
14	first article avail
16	**Core Optics Components (COC)**
18	Preliminary Design
19	Sapphire Development
22	PDR/ select Sapphire or FS
23	polish & coat LASTI Sap noise optics
26	blanks, polish, coat
29	IFO1 set avail from QA
30	**Suspension (SUS)**
32	Preliminary Design
34	TM Controls Prototypes Fab
36	non-TM Final Design
38	TM Final Design
39	TM 'noise' prototype fab
40	non-TM 'noise' prototype fab
42	production
43	Assembly
44	first article completed
46	**LASTI Experiments/Tests**
47	seismic pre-isolator tests
50	install HAM suspensions
51	HAM SUS Controls stand-alone testing
52	laser intensity stabilization testing
53	HAM SEI stand-alone testing
54	BSC SEI stand-alone tests
55	BSC SUS Controls stand alone tests
57	HAM SUS assy/instal/test 'noise' SUS proto.
59	TM assy/instal/test 'noise' SUS proto.
60	cavity tests
61	install PSL, IO
62	commission PSL
63	PSL-MC Integ Test
66	**Prestabilized Laser (PSL)**



ADVANCED LIGO SUMMARY SCHEDULE 3/18/2002 [derived from LIGO-M020121-A]

ID	Task Name
69	preliminary design
71	final design
73	pathfinder
74	pathfinder ship to LASTI
75	production
76	Ship PSL to LLO
77	**Input Optics (IO)**
79	prelininary design
82	final design
84	mod/isolator prototype fabrication
87	fabrication
88	assembly
89	**Interferometer Sensing and Control (ISC)**
91	prelininary dsign
93	final design
95	fabrication
96	**40m**
98	preliminary experiments/shakedown
100	ISC controls fab
102	experiment phase 1
103	experiment phase 2
104	**Auxiliary Optics (AOS)**
106	**active optics compensation**
118	**Gingin High Power Experiment**
119	LIGO delivers ring heater parameters
120	LIGO delivers sapphire test masses (2)
121	LIGO delivers prototype AOC system
122	Gingin delivers 1st exper. Results
123	UFla delivers modulators/isolators
124	Gingin delivers results on mod/isol
125	Gingin delivers final results to LIGO
126	**photon drive**
136	Data Acquisition, Networking & Supervisory Cont
138	**Facility Modifications (FAC)**
143	**Installation (INS)**
145	start LLO install
148	start LHO install
152	LLO operational
153	LHO operational



Simulation & Modeling

- Basic LIGO simulation package available
  - » Used to design the lock acquisition code for length control servo
  - » Limiting h[f] noise curve can be simulated in time domain
    - – Includes seismic, thermal and shot noise.
- Enhanced simulation package under development
  - » To study lock acquisition strategy with thermal effect
  - » To simulate the noise curve more accurately
    - – Realistic length control servo
    - – 3D mirror with 4 actuators,
    - – digital suspension controller,
- E2E school held on 2002.03.18
  - » Presentation materials: http:// www.ligo.caltech.edu/~e2e
- Monthly detector and modeling meeting held by D.Coyne and David Shoemaker

LIGO Data Analysis System (LDAS)

- E7 performance:
  - » LDAS ran for full E7 Run: Dec. 28th, 2001 - Jan. 14th, 2002
  - » Approximately one job every 10 seconds and five rows every second (averaged).
  - » Greater than 90% of jobs completed successfully
  - » Pre-Release testing revealed 0.3% failure rate!
    - – Pre-release dominated by dataConditionAPI thread problems mpiAPI/wrapperAPI communications issues.
- Plans for rest of 2002, 2003:
  - » Successive LDAS releases coordinated with LAL releases
    - – S1 -- Last release planned for late April
    - – S2 -- Last release planned for September
    - – S3 -- Last release planned for April (2003)
  - » Incremental hardware build-up for S1, S2
  - » Final build-up1Q2003 will take advantage of 64 bit Intel architecture

E7 Data Analysis

- Different LIGO, LSC resources allocated to UL analyses
  - » MIT LDAS for burst group, simulation
  - » LHO LDAS for creating Short Fourier Transforms (SFTs) for all CW searches
    - – Directed source search to be done at LHO
  - » UWM LDAS/Condor cluster for inspiral searches, stochastic background search, Hough CW search, simulation
- Analyses at different stages of development:
  - » Inspiral: flat search implemented for templates; fast chirp transform being developed at Caltech
  - » Burst: calibrating trigger methods, use of vetoes
  - » Stochastic: first look reveals relatively “clean” cross spectrum for LLO-LHO
    - – ALLEGRO ran in coincidence -- 3 different orientations
  - » CW: producing short Fourier transforms at LHO for use by all subgroups
    - – Large area search code being developed at AEI by GEO
    - – Directed search version implemented as shared object for integration into LDAS
- Reduced data sets produced by Oregon (I. Leonor)
  - » Frames with greatly reduced channel count, for upper limits analysis

Grid Computing

- GriPhyN research continues
  - » Development of a grid interface for LDAS
    - – Allows federation of different LDAS sites -- enhancement beyond original design, scope
    - – Publish available data onto grid resources to permit users to access data more easily
    - – Security will be based on grid tools for secure data transfer
  - » Porting of LAL (“stand alone wrapper” code version) search code to grid resources
    - – e.g., Teragrid project (CACR/SDSC/NCSA/ANL)
      - 500+ GFLOPS for, e.g., CW large area search
  - » Working on data replication, redundant backup of deep archive using grid resources at CACR, SDSC, NCSA, ANL
- International Virtual Data Grid Laboratory (iVDGL)
  - » LIGO, LSC represented on several key working groups:
    - – Facilities (B. Allen, co chair)
    - – Applications (S. Finn, co chair)
    - – Integration (S. Koranda)
  - » Tier 2 center at PSU to be built with iVDGL funds
  - » Maintenance, upgrade of UWM center
- LIGO working to implement higher bandwidth access to observatories
  - » Holding discussion with commercial and government (state, federal) groups

LIGO-GEO Data Exchange

- Agreement is now in place
- Data is exchanged through the GEO and LIGO directorates only
  - » Exchange through the directors brings with it the implication that
    - – the data is of sufficient quality for the exchange
    - – the exchange is sanctioned
  - » Uncontrolled data exchange between upper limits working groups is not sanctioned
  - » Exchanged data is archived at a LIGO Laboratory archive and a site designated by GEO

Summary

- E7 run accomplished a great deal
- GEO and Allegro coincidence running also a landmark
- LSC analyzing E7 data
- On to S1, S2 and S3 with interleaved analysis, detector development and engineering runs
- LDAS and simulations toolkits advancing
- Advanced R&D program making significant progress
- Advanced LIGO proposal planned late this year