LIGO

Advanced LIGO Team Monthly Update, August 2008

28 Aug 08

David Shoemaker

(non-technical) Project Status

- Project is now ~5 months old, learning first words, gets around well on all fours, starting to eat voraciously
- ~1.1% complete – compared with planned ~2.5% complete (end July)
  - » slow start in procurements for SEI, FMP, and COC
  - » Not significant, and the procurements tangle is disappearing
- Procurements….
  - » Overall plan for FY08 approved, 3 exceptions taken by NSF, all resolved, the last one just yesterday:
  - » “Caltech's request dated July 1, 2008 as modified by the e-mailed responses dated July 9, July 25, and August 25, 2008, requesting NSF approval to enter into a Firm Fixed-Price Subaward with the University of Florida for input optics subsystem is hereby approved by the NSF.”

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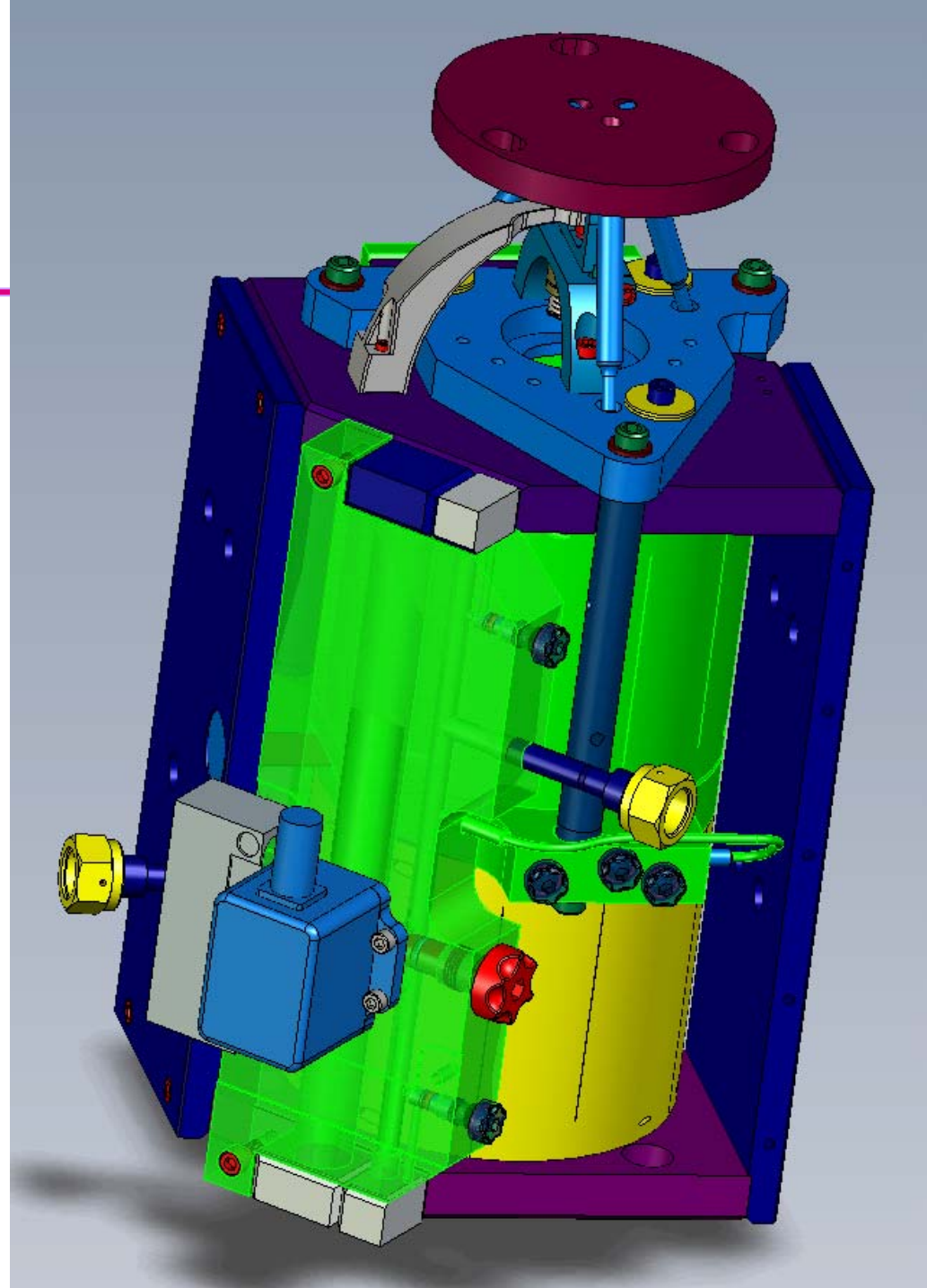
HEPI Actuator

- For me, a signal event: HEPI Actuator procurement now underway
- 3 good bids received, low bid aligned with cost book
- A few million dollars ready to be spent on something complicated (material, welding, assembly, etc.)
- Really feels like the nuts and bolts of the project – and another 1% of the project funds spent in one fell swoop!

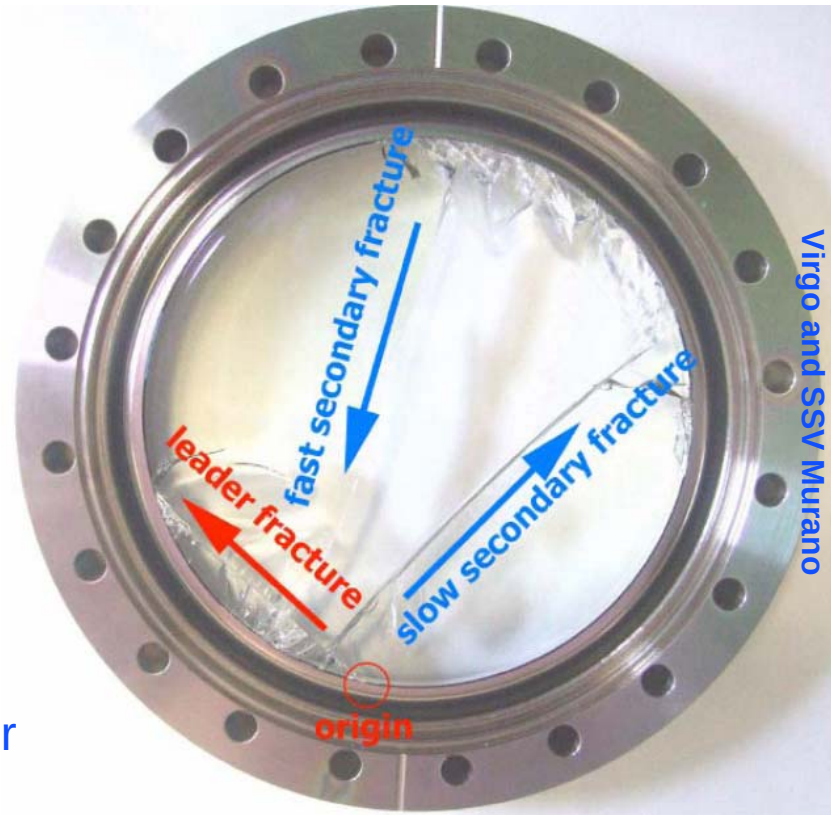


Other-than-subsystem stuff

- Dedicated Safety and Quality Assurance people on board
  - » David Nolting, Safety stationed at LLO, but traveling
  - » Mick Flanigan, QA stationed at LHO, but traveling
  - » Objective: relieve technical folk of some of the current burden in these areas, and give us vendor oversight, a helping hand, etc.
- Risk Management Team (mostly subsystem leaders) getting together to review where we think things could go wrong – updating the 'Risk Register'. Ask me if curious, please help me out when I ask.
  - » I wrote this several months ago – will put this on front burner for completion mid-September
- First Quarterly report submitted to NSF, and monthly reports as well
  - » We see from comments/questions that the Director of the NSF reads them!
- New software for the DCC – I have hopes for a October rollout
- Inventory tracking system – in development at LLO, specifications being nailed down

Virgo – Vacuum accident

- On 9 May 2008, a glass viewport on the NE end station vacuum system broke (imploded) during pumpdown
- Virgo Committee, LIGO Rep Mike Zucker
- Cause well understood – problem with viewport glass connection design
- Present (and future!) LIGO viewports are not susceptible to this problem
- Wakeup, though, to risks associated with viewports
  - » ZnSe TCS viewports may be a special risk – stay tuned
- Several important outcomes for us:
  - » Follow rules for working near viewports
  - » Clear all viewport procurements with Vacuum Review Board, John Worden Chair
  - » All persons installing viewports to do final visual check



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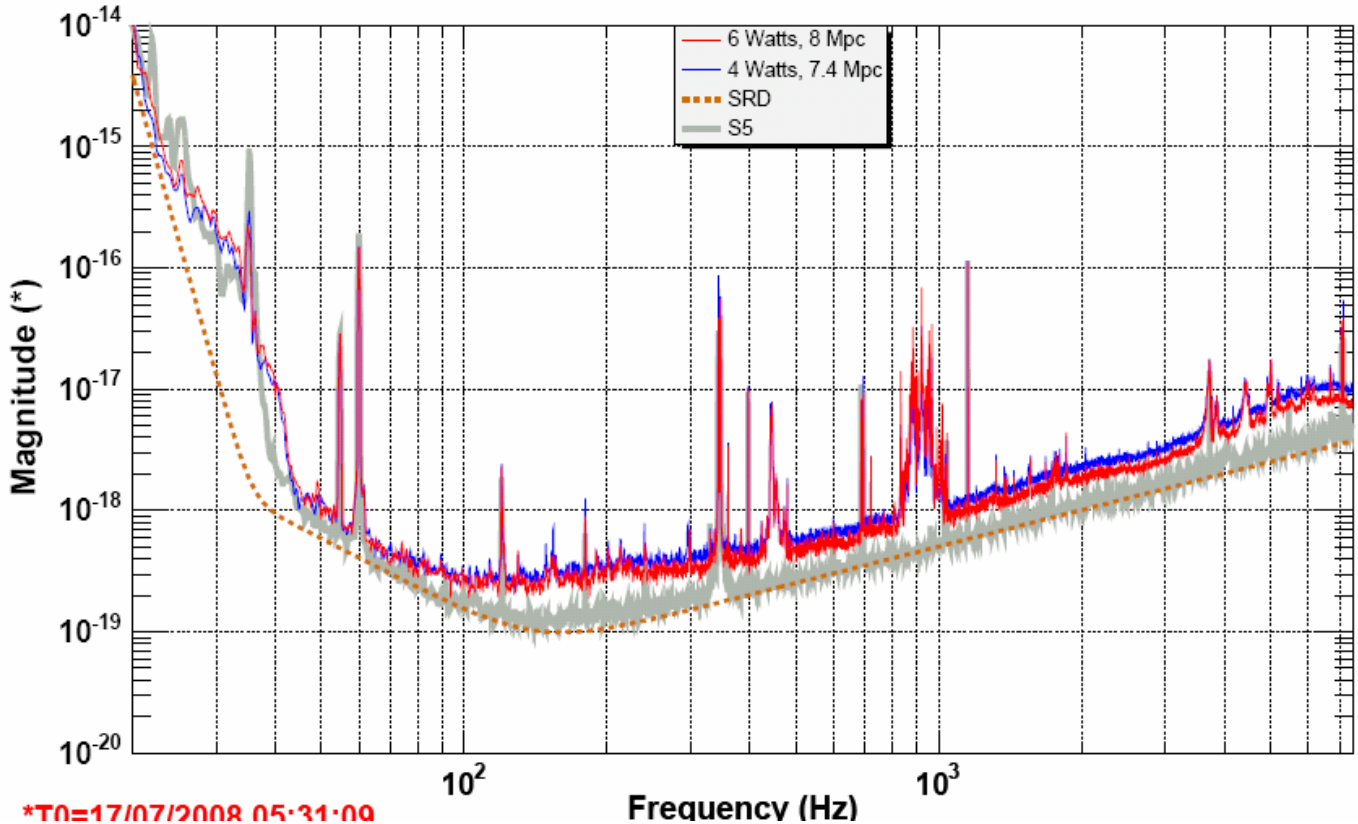
Companion projects

- Virgo+ and Advanced Virgo still planned on same time scales as eLIGO and AdL
  - » Viewport validation performed and order placed for full replacement
  - » First batch of new viewports arrived and examined, being installed
  - » Input Mode Cleaner had been relocked with new mirror; transmissivity significantly increased
  - » North End mirror being prepared for installation in tower
- Advanced Virgo moving forward in planning process
  - » Working through stable/marginally stable recycling cavity decision
  - » Two-step project review in front of an international panel. First meeting in November, second (and hopefully final) in May.

- Now, a bit of a technical update

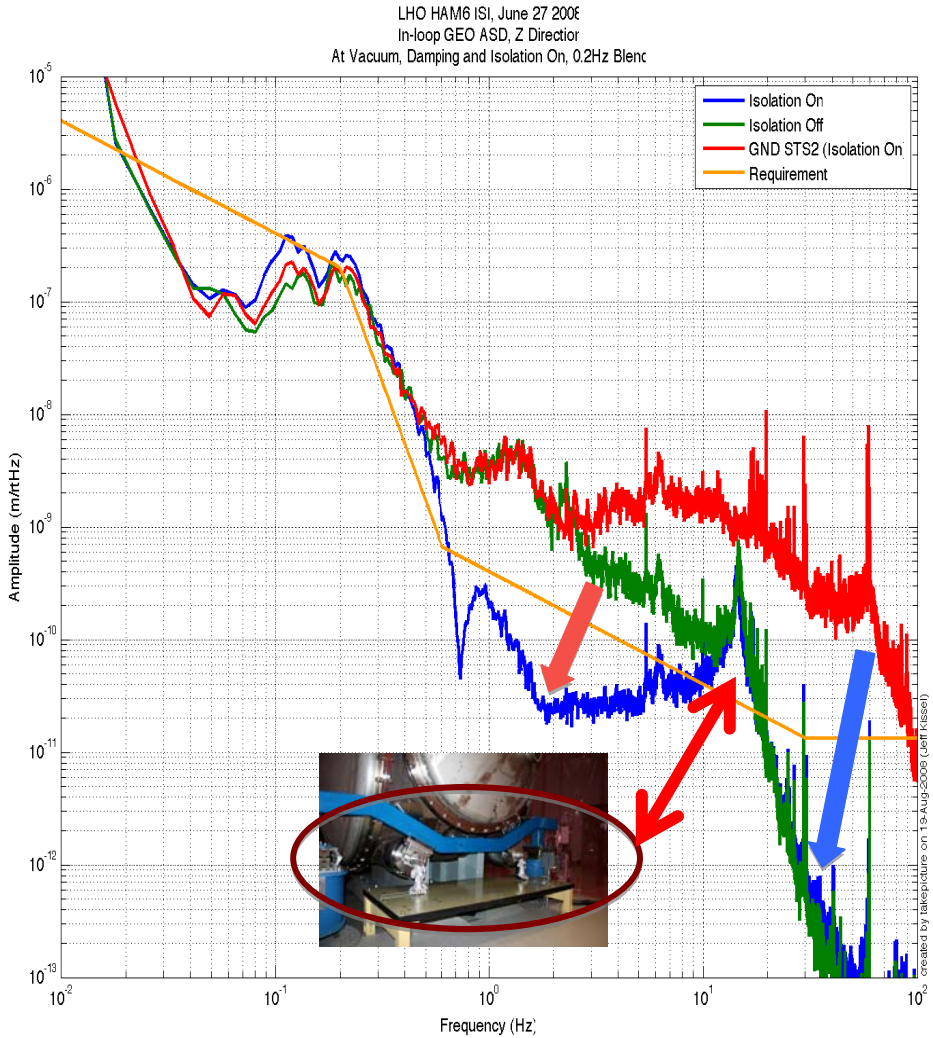
eLIGO !

- 8 Mpc Binary Inspiral range best to date
- Sources of at least some peaks identified, in treatment
- **eLIGO installation effectively complete!**



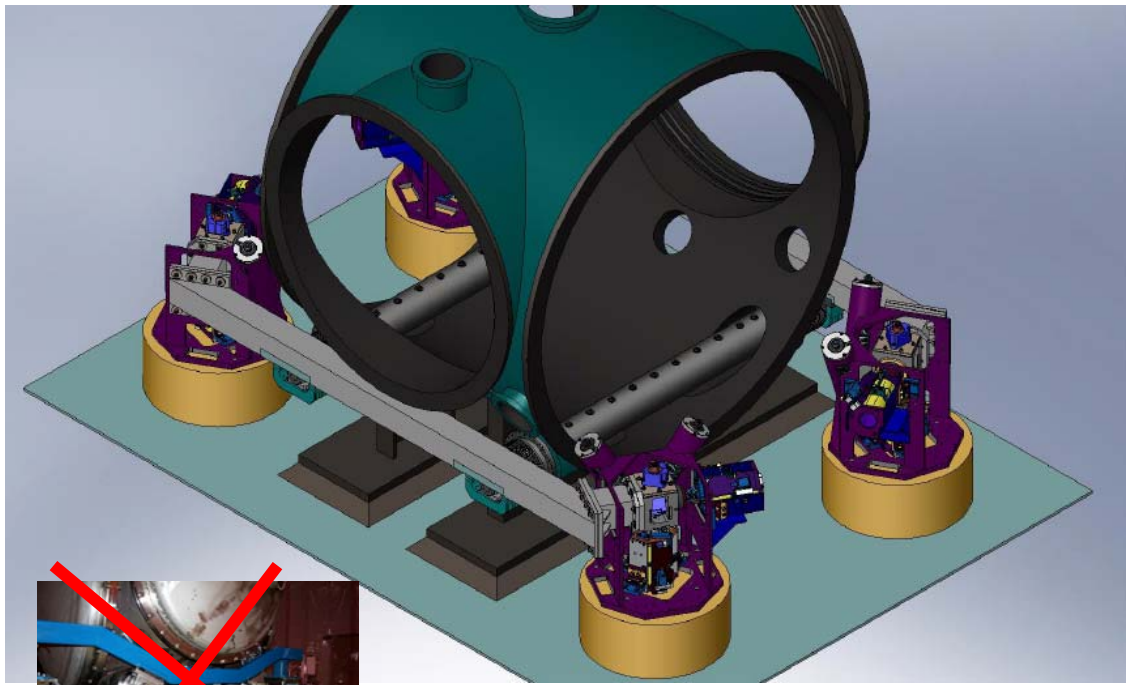
HAM Seismic Isolation

- Ham Seismic Isolation installation complete for both LLO and LHO
- Effectively meets requirements at LHO (LLO yet to be commissioned)
  - » Cross-beam resonance addressed in new design
  - » Feedforward/sensor correction at lower frequencies
  - » Allows concrete data to be used for e.g., ISC designs
- May be able to use present 'prototypes' as actual Advanced LIGO units!



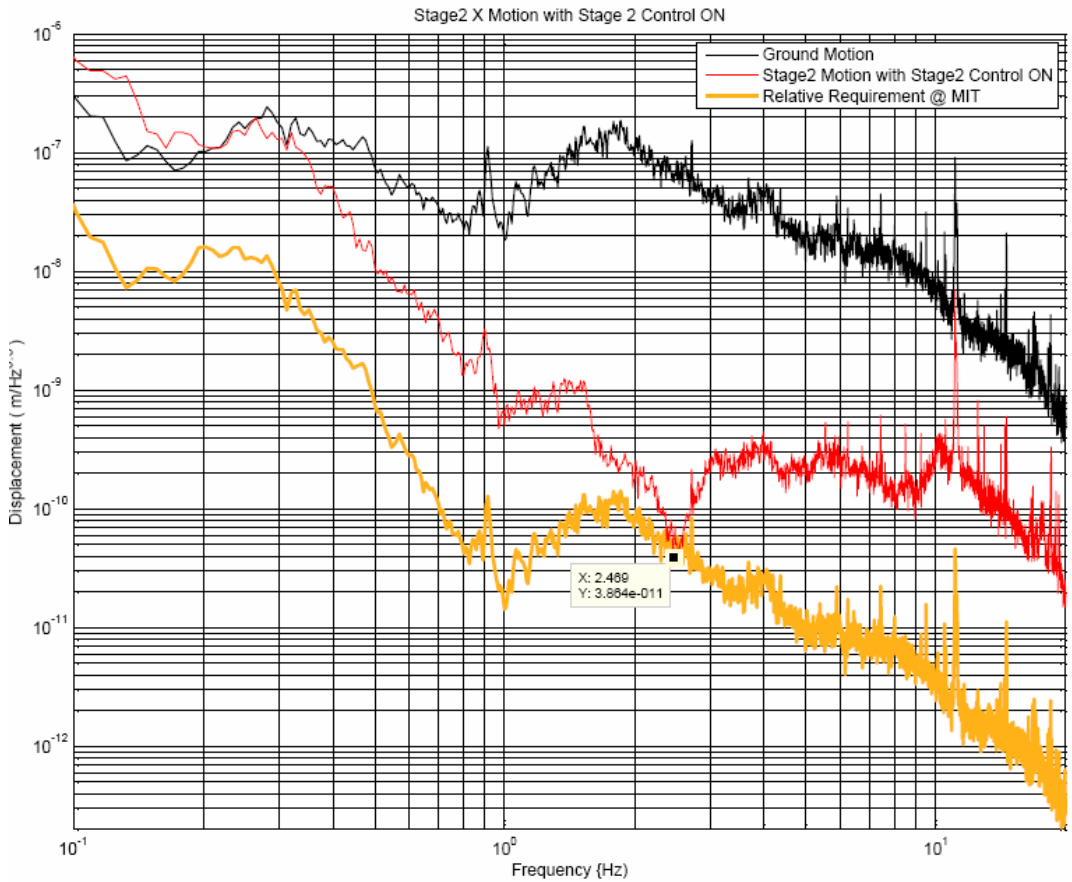
Seismic: HEPI

- HEPI (Hydraulic External Pre-Isolator) successfully reviewed, procurement underway – first major assembly activity at observatories (LHO)
- Stiffer cross-beam part part of the new design
- First AdL deliverable received: Frame for the hydraulic pump



BSC Seismic Isolation

- Eliminated apparent rubbing (…just what was it?)
- Now in commissioning;
  - » all 12 Degrees of Freedom running, all loops closed
  - » Quad suspension attached, damping running
  - » (simple control laws, only one loop with LF blend)
  - » (no sensor correction)
  - » (no feedforward)
  - » (no active HEPI)
- Work to do, but looks as good as hoped at this early stage

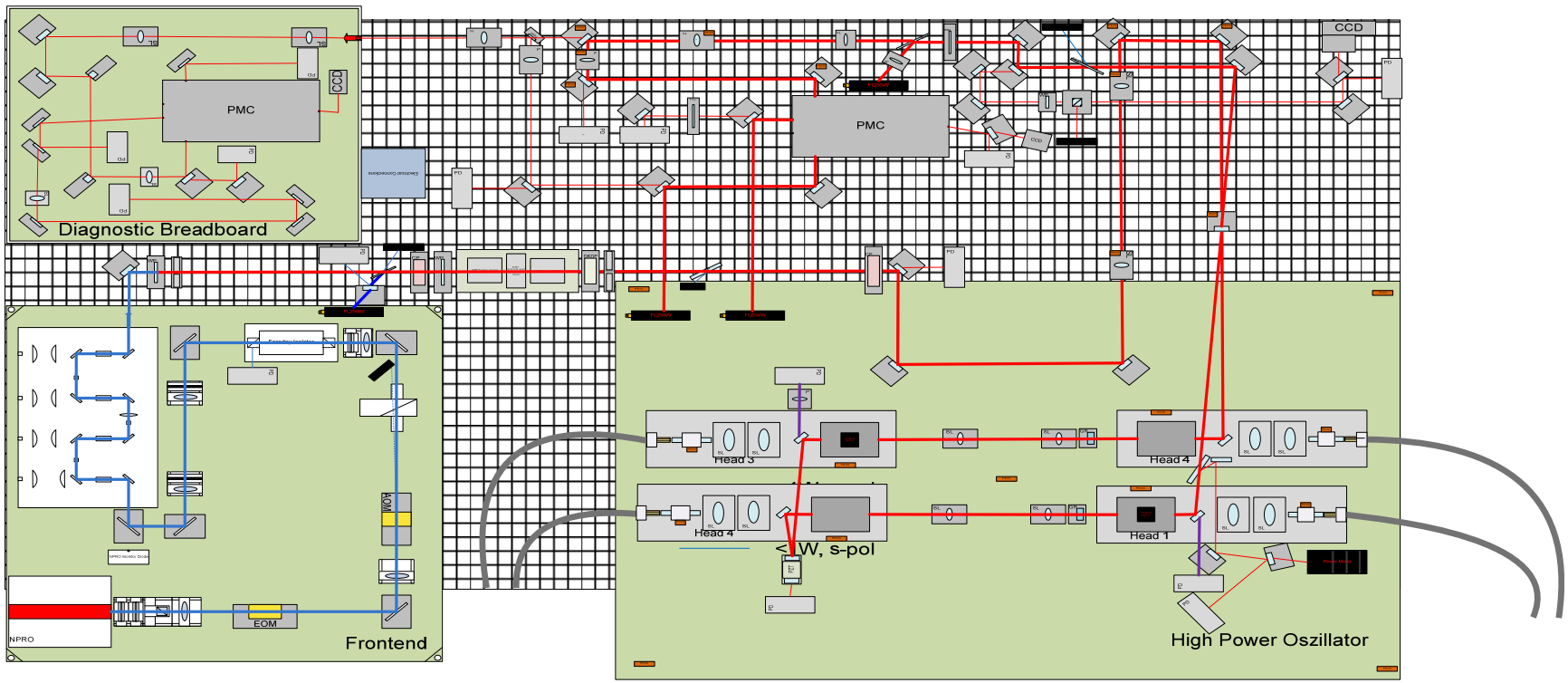


Suspensions

- Output Mode Cleaner
  - » LLO working, so far looks good
  - » LHO just finished, installed (due to blade fabrication problems)
  - » Will need rework for AdL, but basically verifies design
- Triple Suspensions
  - » Revolution due to selection of stable recycling cavities
  - » ModeMatchingTelescope mirrors now interferometrically sensed
  - » Revision of requirements; looks just feasible, PDR in preparation
- Quadruple suspensions
  - » Metal Quad suspended in BSC, providing accurate load
  - » Fused Silica fiber final suspension the next step
  - » Fibers (now round) can be repeatably and satisfactorily produced
  - » Working on welding – change to round fibers requires work
  - » Parts for the actual AdL suspensions in fabrication in the UK!

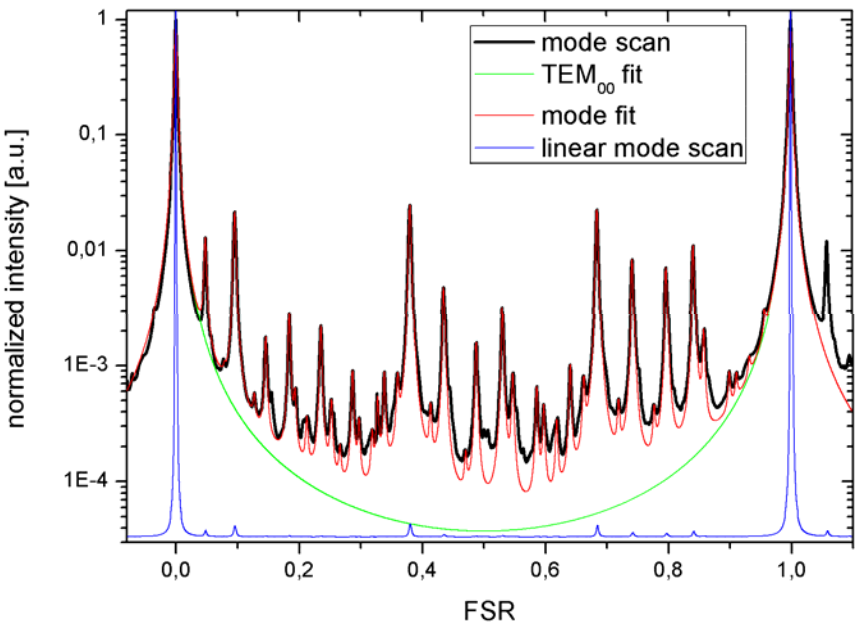
Pre-Stabilized Laser

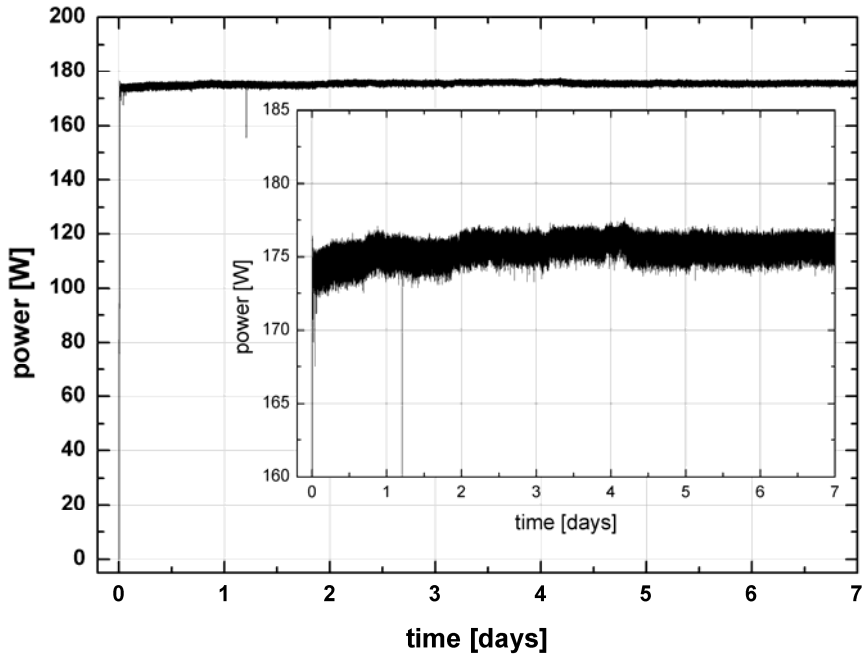
- Optical layout for 200W laser prototype



Pre-stabilized Laser

- Performed complete characterization run on 180W AdL laser functional prototype with diagnostic breadboard
- Additional diagnostic is being installed to understand loss locks during cold start-up and to trace down main source for the free running RIN
- PDR documents ready, PDR probably at LSC/Virgo meeting in Amsterdam





Core Optics, related issues

- Vendors (Heraeus, Corning) chosen for both Input and End test masses
- Orders placed (or almost!) with both, but fabrication underway
- Demonstration polish by Tinsely (ASML heavy lifting) moving along
- Working on Parametric Instabilities
  - » FEA modeling of the substrate to get frequencies, mode forms
  - » Modeling and testing of spot dampers on optic
  - » Looking forward to measuring Qs of optic as suspended from fibers
- Modeling of optical system
  - » Static IFO simulation being exploited
  - » Studying diffraction losses esp. in recycling cavity – trade studies on beam diameter
- Charging of test mass
  - » Document summing where we are about finished
  - » UV looks like it is not a mirror-safe solution for discharge…
  - » Stanford has possible conductive implanting approach – TBD!

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Auxiliary Optics

- eLIGO baffling design/fabrication completed – installation too?
- eLIGO ThermalCompensationSystem mostly installed (with some last minute changes in mirror substrates to accommodate the CO2 power!)
- TCS Gold coating to manage emissivity of test mass probably to be applied to a cylindrical shield rather than the test mass
- General ray-tracing and layout of interferometer thanks to expertise in this domain

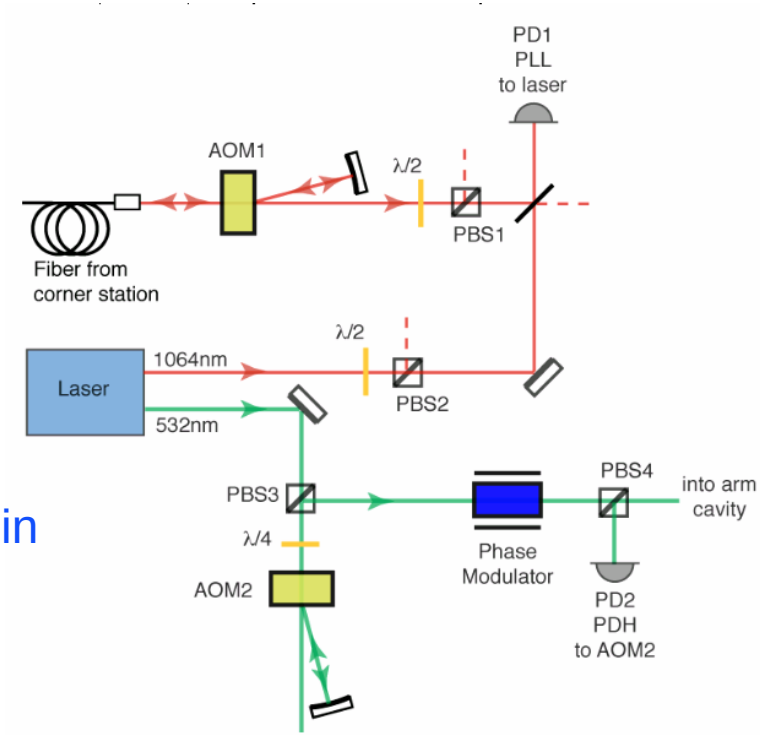
Input Optics

- Studying the optical efficiency of the eLIGO LLO input optics, matching – still a bit mysterious
- Modeling of the AdL IO and ability to match
- Detailed design on AdL IO optics

- **…and: IO subcontract approved! Advanced LIGO Project procurements can start!**

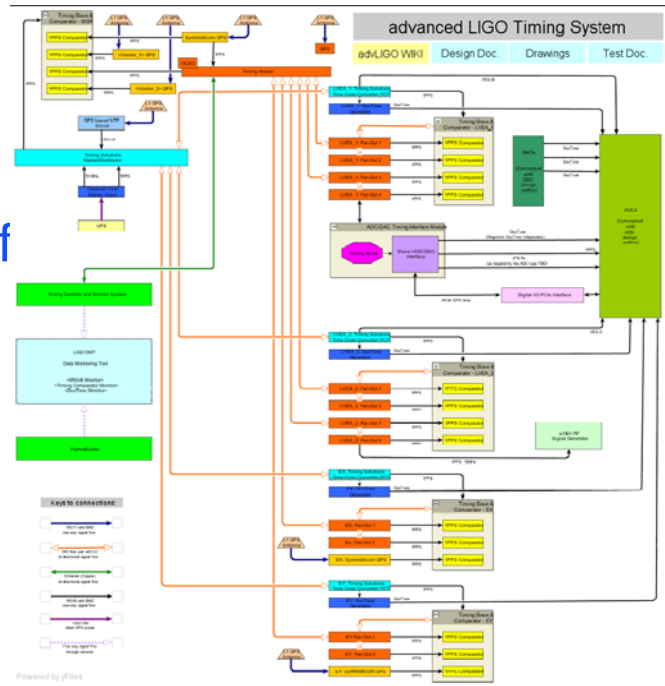
Interferometer Sensing and Control

- DC Readout as realized in eLIGO
  - » Setup of second OutputModeCleaner bench, in commissioning now
  - » Knocking down noise sources
  - » Understanding dither locking side effects
- Pre-lock length stabilization:
  - » focusing on use of a second frequency in arms to form low-finesse cavity
  - » Injection through end mirrors; trial layouts in development
- Optical levers
  - » Tests of current system, weaknesses
  - » Notions for improved piers, optics



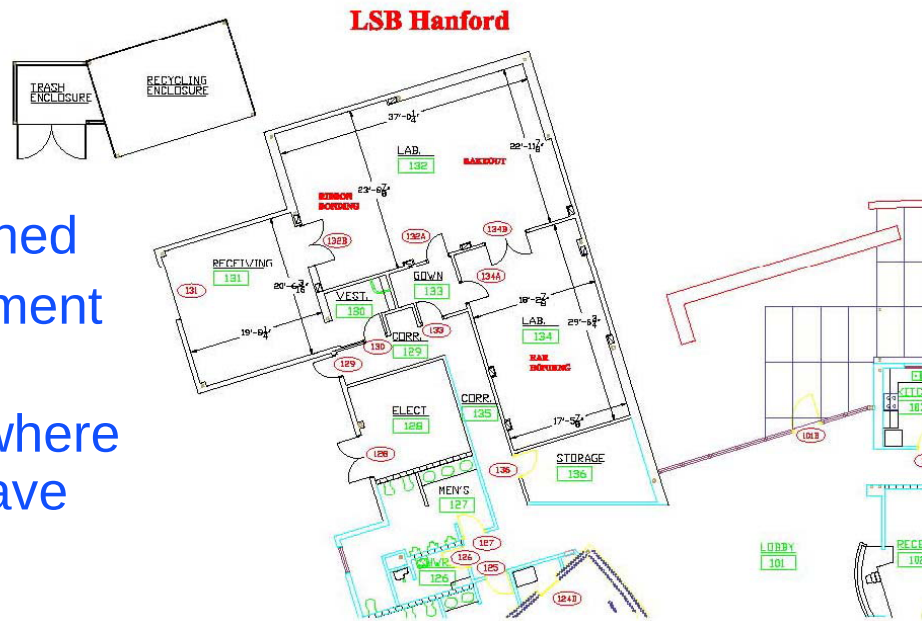
Control and Data systems

- DAQ Preliminary Design Review underway
  - » Overall architecture
  - » Software framework, realtime coding
  - » Candidate hardware approaches for e.g., communications
- LSC input for control room software an element of this design
  - » Balance between what would be nice and what we can actually accomplish
- Timing in development
  - » Preliminary Design Review about wrapped up
  - » Hardware testing underway, looks promising



Facility Modifications an Preparations

- Procurement Readiness review completed
  - » Significant participation by subsystems, systems to form the plan
  - » Changes in baseline – cleaning incorporated into subsystem
  - » Really put the subsystem on a firm footing
- Getting packages ready for assembly/storage building modifications, maybe some contracts already let?
- Pulling together the Inventory Tracking System
  - » Homegrown
  - » Specifications are being established
  - » Interface with the Prism Procurement system important
  - » Should allow everyone to know where their pieces are and what they have experienced to date!



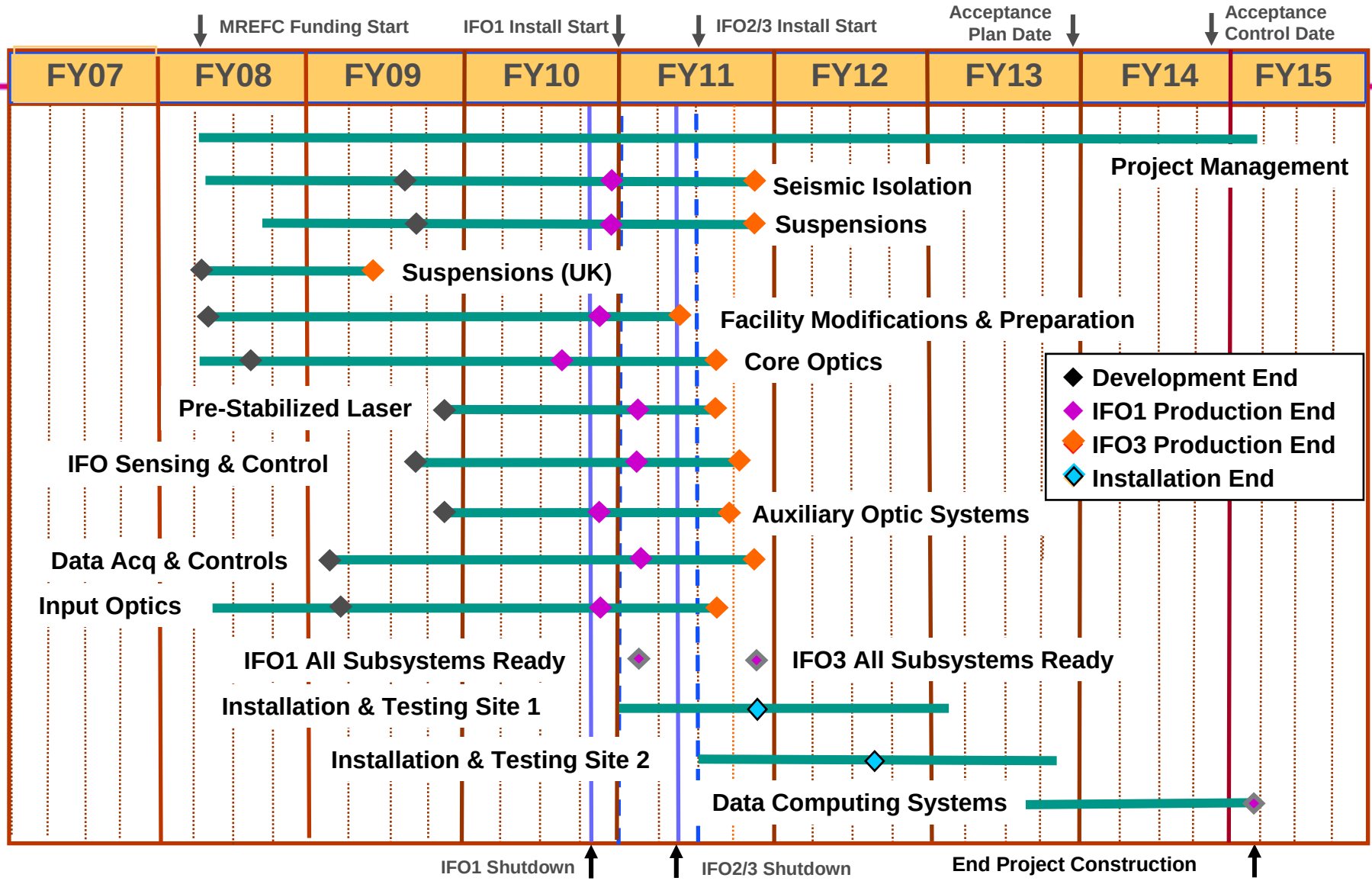
Systems

- Received PDR report, working through recommendations
- Working on a range of subjects to support subsystems
  - » Parametric Instability (PI):
  - » Test Mass barrel, thermal sleeve (shield) gold plating
  - » Inhomogeneous loss modeling of test mass to get at impact of a gold coating
  - » BS gravitational sag (shown to be negligible, happily)
  - » Nickel plating process/specification for maraging steel (with Virgo, GEO)
- Modeling/simulation group contributing widely

- And, slightly off-topic: Review of proposal to undertake a squeezing demonstration underway – definitely interesting for Advanced LIGO.

Advanced LIGO Subsystem Summary

(Showing Development and Project Production Early Milestones)



Closing notes

- Project ramping up with major procurements, parts starting to come in
- Challenge is still to get our reviews completed so that more subsystems can transition to hardware – may be some ‘triage’ in testing and improvements
- AdL (and the Lab) has an NSF review in November (at Caltech) – should not get much in the way of progress, will be fun to show off progress to our review committee!

- Let me know if you see something to improve in the way the Project works.