

# Advanced LIGO Project Update LIGO Excomm

1 October 2007

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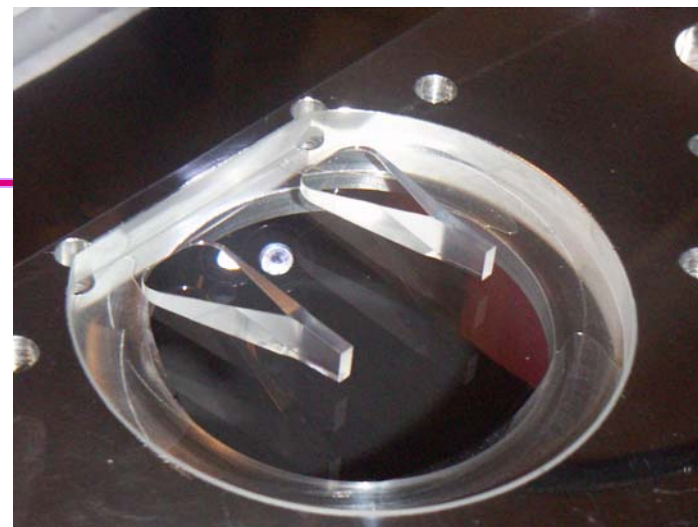
- Last 10 years
- This year
- Next year
- Next 10 years

- Jan 1997: Aspen, first nucleation of LSC WGs; August, 1<sup>st</sup> LSC meeting
- March 1998: Some initial concepts of the upgrade floated, small changes to initial LIGO mechanical infrastructure – not yet the vision of complete instrument change; MoUs between Lab and LSC groups
- May 99: Key technical element: improved suspension thermal noise estimates, at LSC technical summit; Sept 1999: LSC white paper completed, full scope adopted
- March 2000: Project book assembled, upgrade scenario firm, costs estimated; August 2000: Projectification: professional cost/schedule person/tool
- August 2001: Naming of Advanced LIGO; plan for taking R&D activities through final design under Operations funding

- March 2002: discussion in LSC from this point onward is on technical progress, not community building or consensus
- Feb 2003: Proposal submitted; installation planned to start in 2007; June 2003: first NSF review and detailed feedback
- March 2004: Consideration by NSB of proposal; Oct 2004: NSB endorsement of proposal
- 2005: Cost/Schedule/Risk; growing project management structure, discipline; subsystem preliminary design reviews start
- June 2006: Baseline review
  
- The total effort (just) to create the concept, organize, document, and review the Project, from 1997-2007, is estimated to be 39 person-years.
  - » Does not include the technical work!

- Laser:
  - » 35 watt unit – 2/3 of final ‘head’ – delivered to Caltech, preparation for ELI installation
  - » High-power system being built up for complete PSL demonstration
    - Works with high reliability, but ~140 W (requirement: 180)
  - » Infrastructure at Observatories in preparation; thorough review of safety
- Input Optics:
  - » Isolator and modulator in preparation for ELI installation – prototypes tested, production items in assembly Some assembly safety and cleanliness concerns for the FI
  - » Designs well advanced; PDR completed 21 August
- Core Optics:
  - » LASTI optic (full size but not fancy glass) processed – handling 40kg objects is a challenge
  - » Coated by LMA Lyon; successful in many senses, but small blisters, probably due to polish quality and/or annealing
  - » To be integrated with quad suspension; ‘ears’ bonded

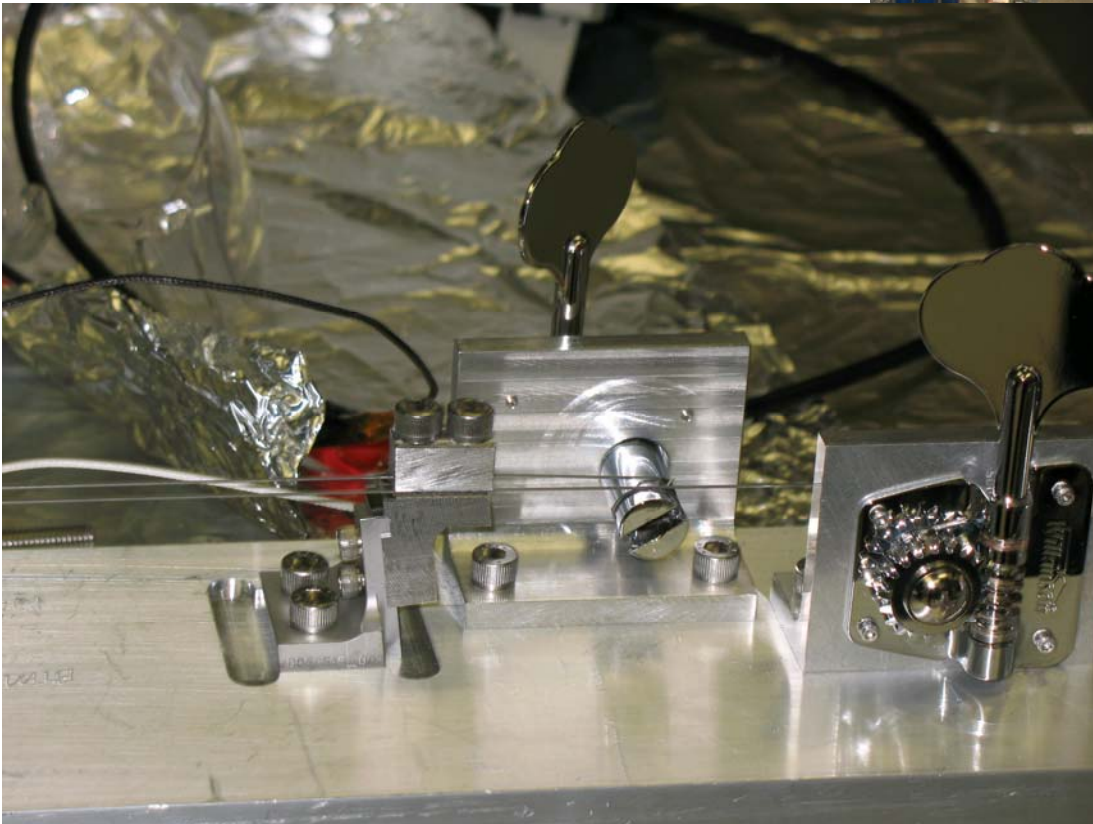
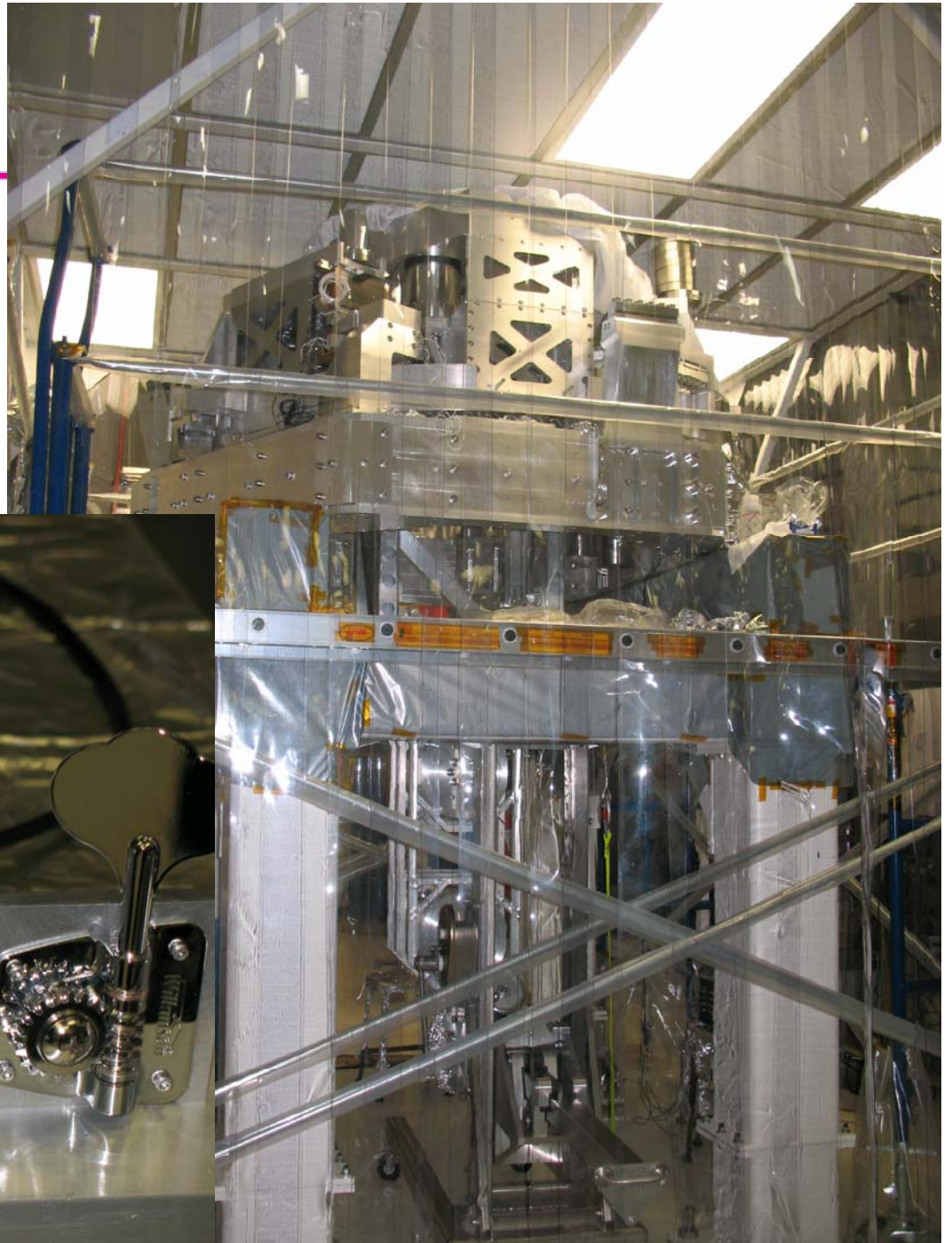
- UK/US team



- Core Optic Coatings:
  - » Have 'acceptable' coatings from thermal noise standpoint; working on somewhat better optimized coatings, TNI test in preparation or underway
  - » Have excess scatter in initial LIGO coatings, still trying to understand that
  - » Mostly just want to industrialize the current coatings so far as AdL is concerned (but R&D to go beyond this)
- Core Optic concerns:
  - » Few qualified coaters, but adequate for Adv. LIGO
  - » Two polishing pathfinding contractors deliver results this fall -- bids for 3rd polishing pathfinder due early Oct
  - » Expensive to pursue prototyping, and production costs may also be higher than planned
- Charging
  - » Better understanding of parameters in models via measurements
  - » Possibility of either UV light, or charged particles, to manage

# LIGO **advanced**ligo Suspensions: Quad on SEI ISI

- Wires currently being installed on temporary metal masses
- Any bassists in the audience?



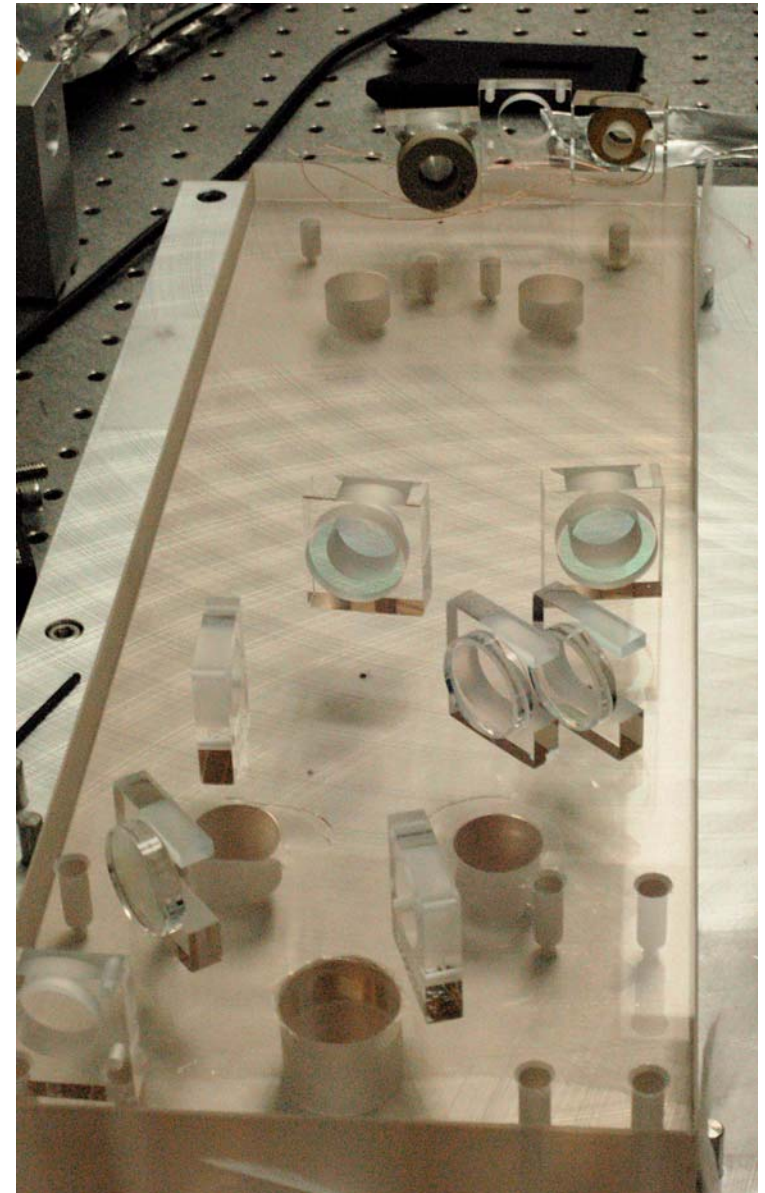
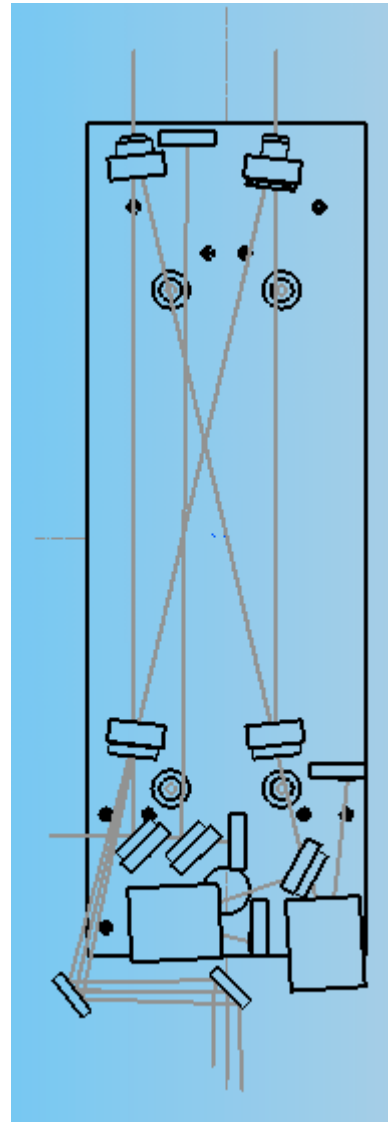
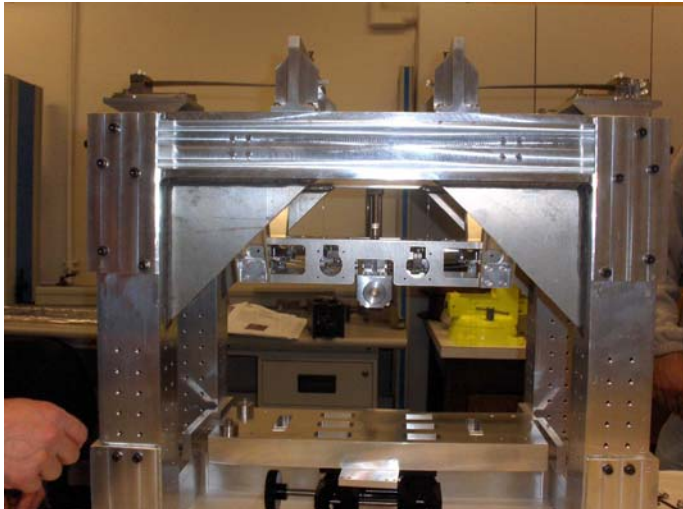


- Test Mass Suspensions:
  - » 2<sup>nd</sup> generation quad suspension in assembly now; will integrate glass optics, fibers later in winter; attached to SEI – tooling acceptable, lessons learned
  - » UK generally good on mechanical front, but have Al welding issues, procurement issues for glass penultimate & reaction masses, receiving late interface information from ISC on a Seismic Platform Interferometer (SPI)
  - » UK understaffed in electronics and late in electronic deliveries -- concerns regarding quality/compatibility of the electronics to be tested at LASTI soon
- HAM Suspensions:
  - » Output Mode Cleaner 1<sup>st</sup> prototype for ELI, second in production; some Al welding issues
  - » Recycling Mirror suspension: basic mechanical design complete -- now detailing and will begin prototype fabrication in a couple of months
- Test Mass Seismic Isolation:
  - » Some relatively minor (though important) assembly lessons learned
  - » Reliability of in-vacuum sensing to be assessed, and addressed if needed
  - » After actuator/sensor tests, dynamics characterization and active control testing
- Ham Seismic Isolation:
  - » Two fabricated, one being assembled 'dirty' this week, other being shipped directly for cleaning; both to ELI soon

- Auxiliary Optics:
  - » Most elements in requirements/conceptual design process
  - » Thermal Compensation System (TCS) – DRR/CDR done, stability requirements for Hartmann sensor appear stringent -- concepts being evaluated
  - » Stray Light Control (SLC) – DRR/PDR underway now -- baffle designs advancing
- CDS
  - » Racks/electronics in the LVEA or not a pending decision, as is the potential for water cooled electronics
  - » Too much work to do – extensive mechanical prototyping leads to extensive CDS support
- ISC/SYS:
  - » Review and decision to continue, curtail or eliminate further custom low noise ADC and DAC design (in support of ISC) in November
  - » DC readout designed for ELI
  - » Big question: marginally stable (initial LIGO style) or stable recycling cavities? Layout, COC tolerance and TCS consequences being evaluated. Plan is to make decision by/at SYS PDR in November
  - » Output Mode Cleaner designed, prototype assembled, light in/out; UV/heat cured epoxy bonding of fused silica optics to fused silica bench has been developed

Optics hang under the table

- To be mounted on a two-stage suspension
- In optical testing



- November: Advanced LIGO Review at time of Lab Annual review
  - » To streamline funding, but another short review probably needed, once NSF is funded
  - » Some risk of continuing resolution, project frozen until 2009...but if successful:
- March-ish: Project Start
  - » Core Optics, HEPI at LLO, Site infrastructure early activities
- Continuing development throughout 2008 under Ops, a little in 2009 – (Most) All subsystems to Final Design before Project takes over
- DHS thinks challenges are...
  - » Getting mirrors polished and coated to requirements
  - » Getting our distributed FTEs to work at an efficiency approaching the plan

- ELI goes together, detects GWs, and shows that parts of AdL work really well together
- Late late 2010 (assuming March 2007 start) we open up and switch to AdL
- mid 2013 we accept the first IFO, accept the 3<sup>rd</sup> in very late 2013 or more likely 2014
- 2015 we detect lots of GWs
- 2017....we celebrate a year run with Advanced LIGO?