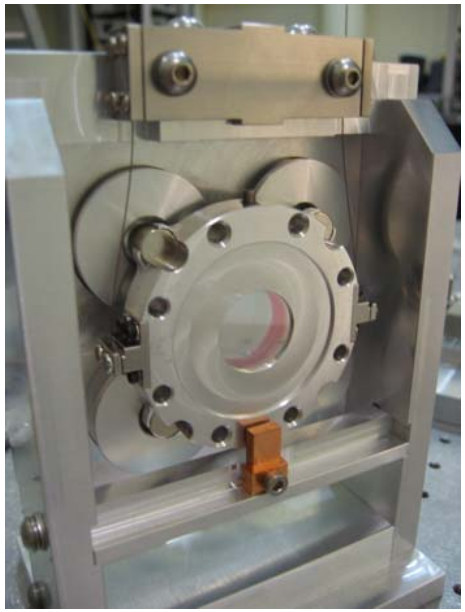
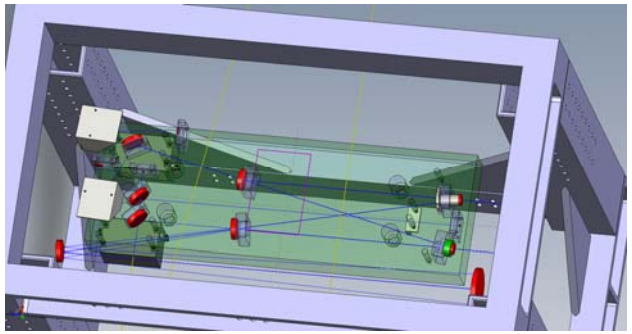
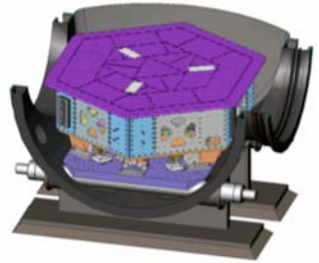
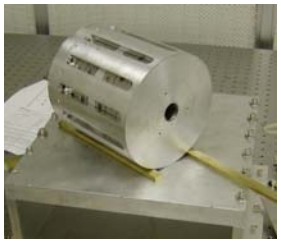
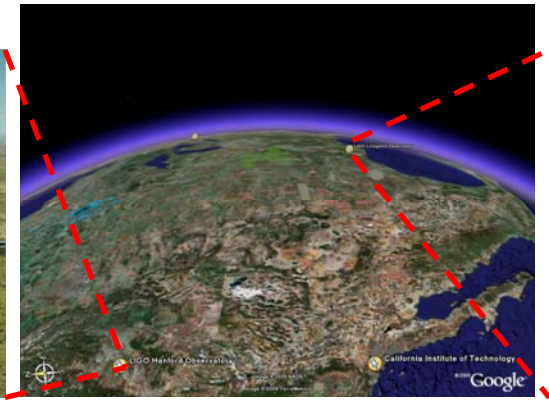
Plans for Enhanced and Advanced LIGO

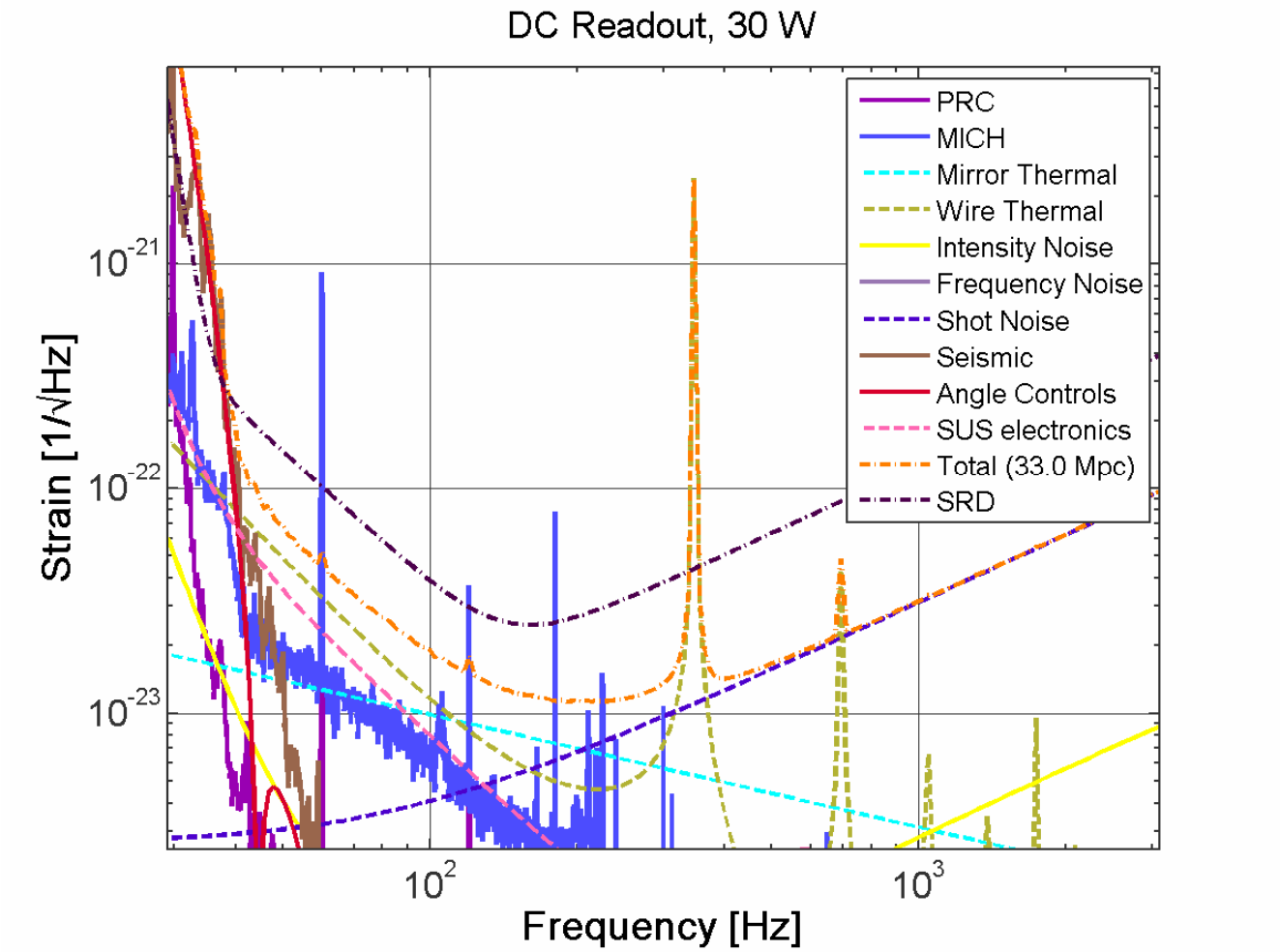






Stefan Ballmer

On behalf of the LSC

Enhanced LIGO Goal



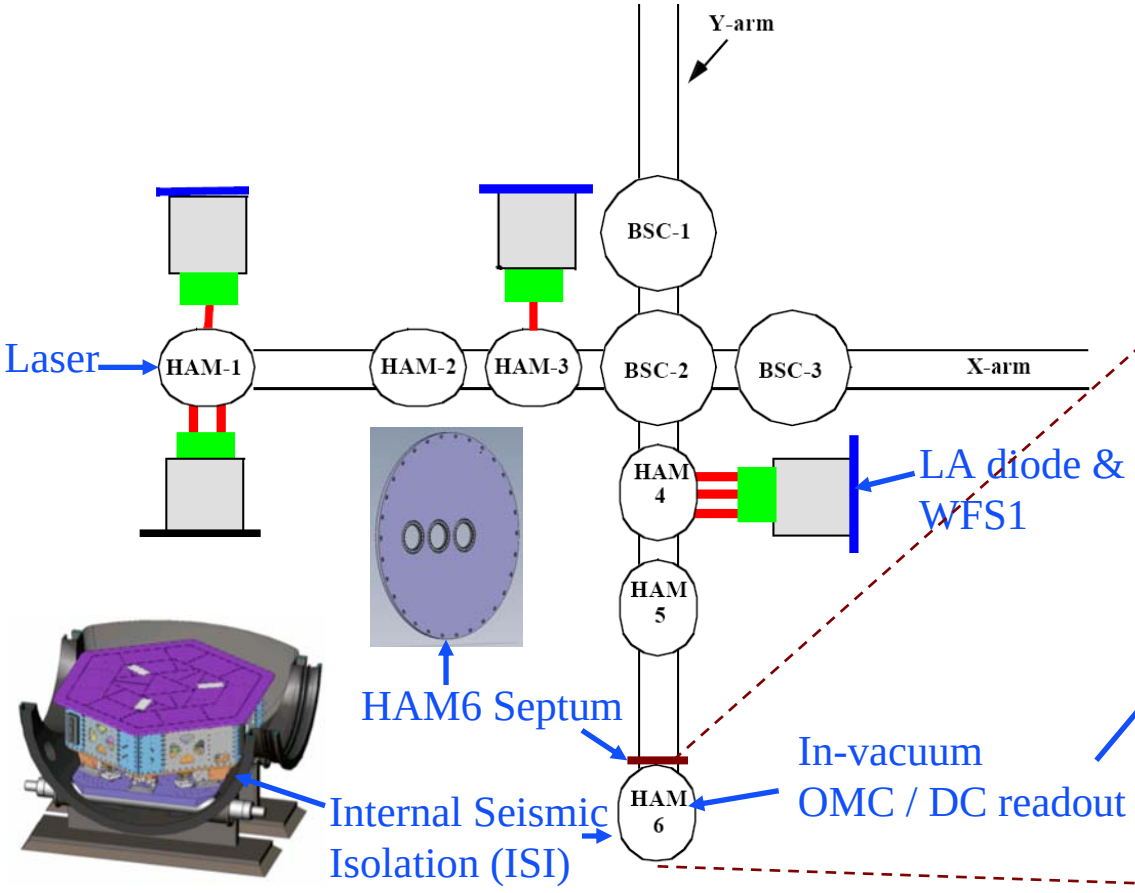
Enhanced LIGO scope

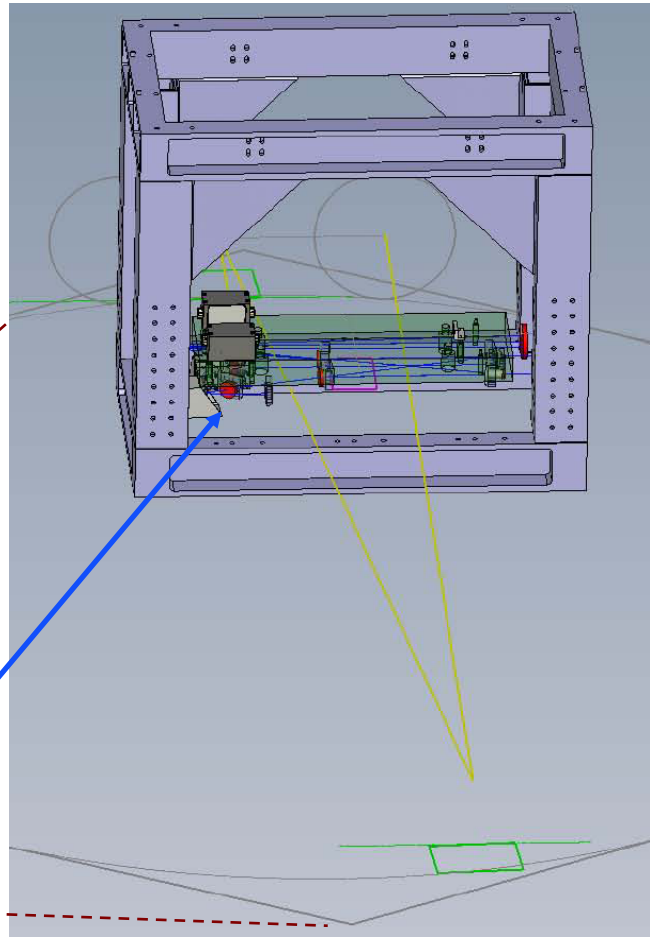
- Switch to DC readout
- Upgrade to 35 Watt Laser
- A few miscellaneous things

DC Readout

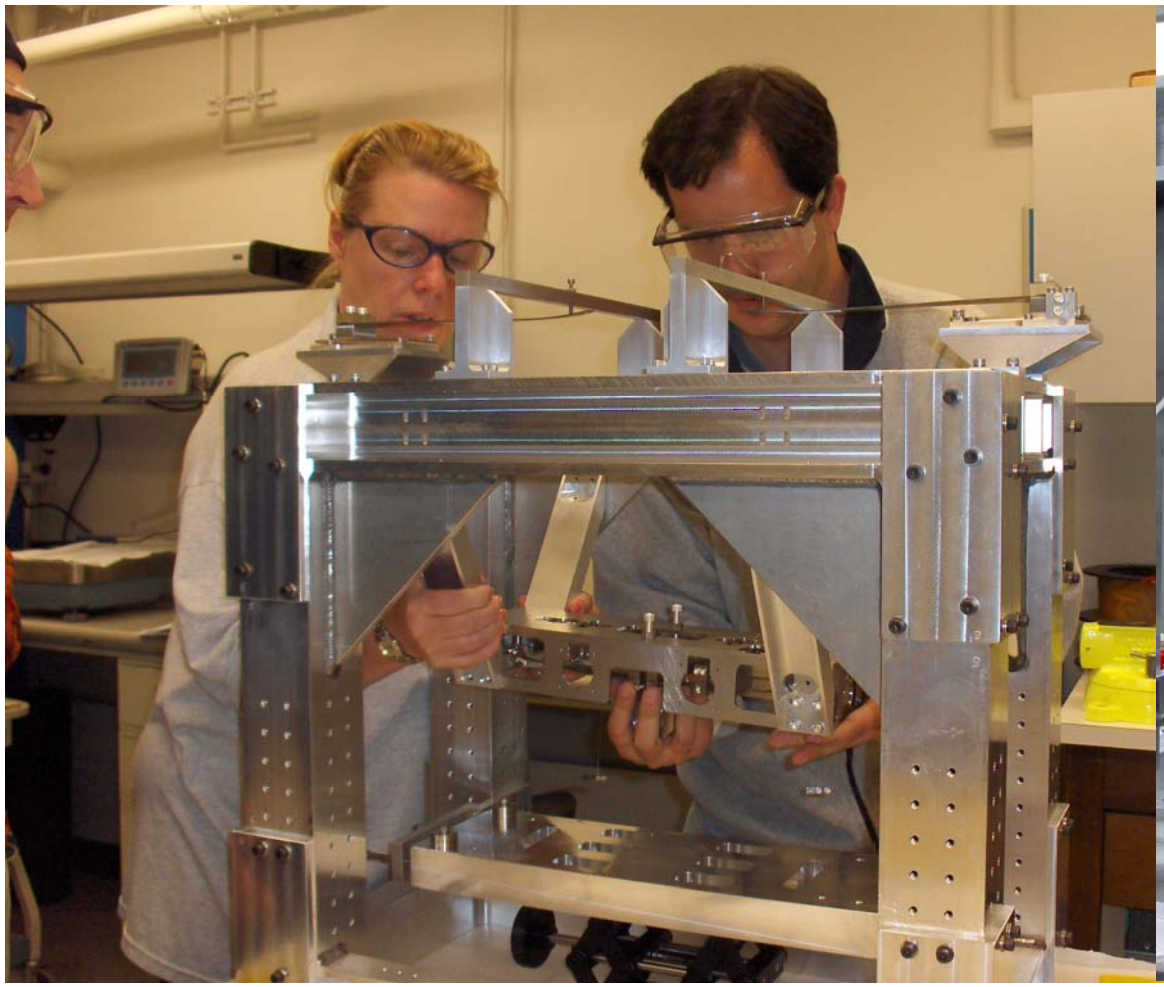
- Switch to DC readout
  - In-vacuum Output Mode Cleaner & Detection bench, on...
  - Seismic isolation platform (ISI) and...
  - Double pendulum suspension
  - HAM6 isolation septum

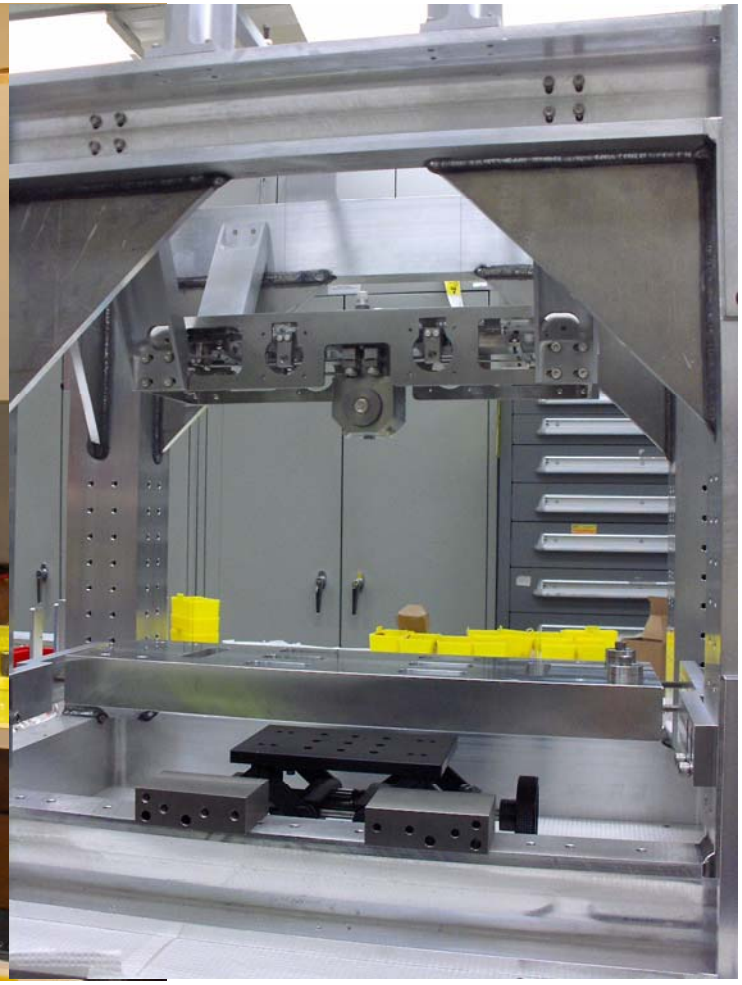
Layout
HAM6 Septum / ISI / OMC



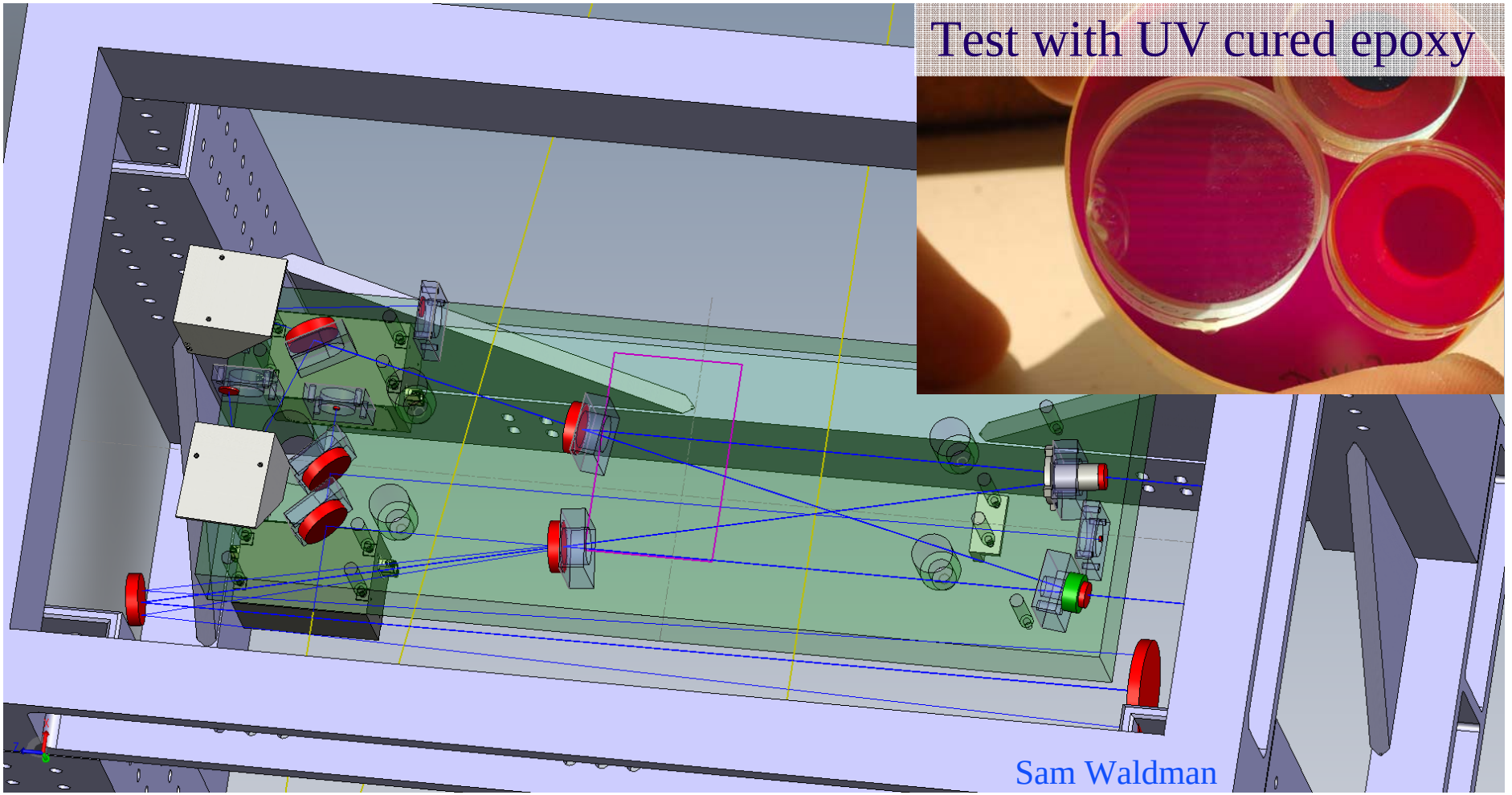


OMC suspension



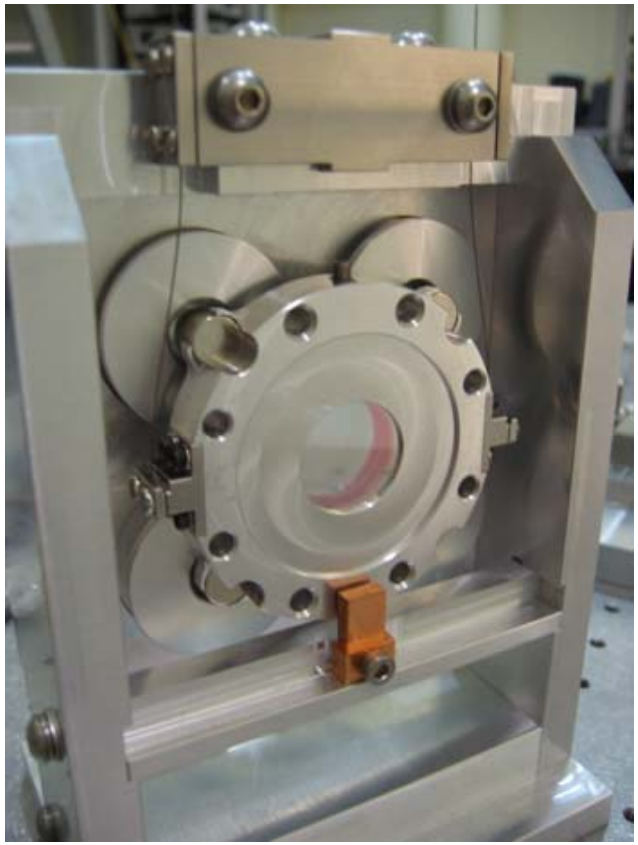


Output Mode Cleaner (OMC)



Tip-tilt mirrors

- Suspension for 2” steering optics
- 14.5 mrad range
- Dither at ~1kHz, 6.8urad range



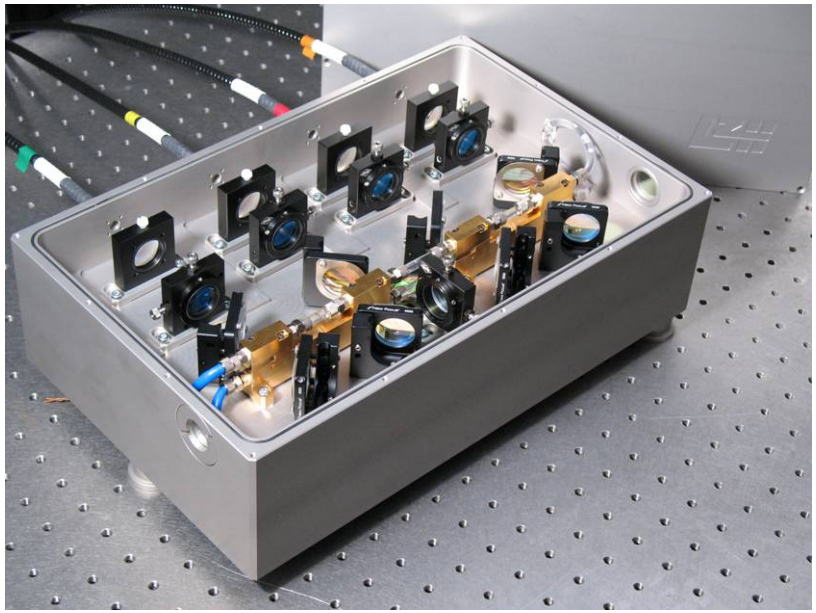
Bram Slagmolen

Laser Power

- Upgrade to 35 Watt Laser
  - Laser provided by AEI/LZH
  - New high-power IO Faraday isolator
  - Drag-whip optics (reduce absorption)
  - Upgrade Thermal compensation system

35 Watt amplifier

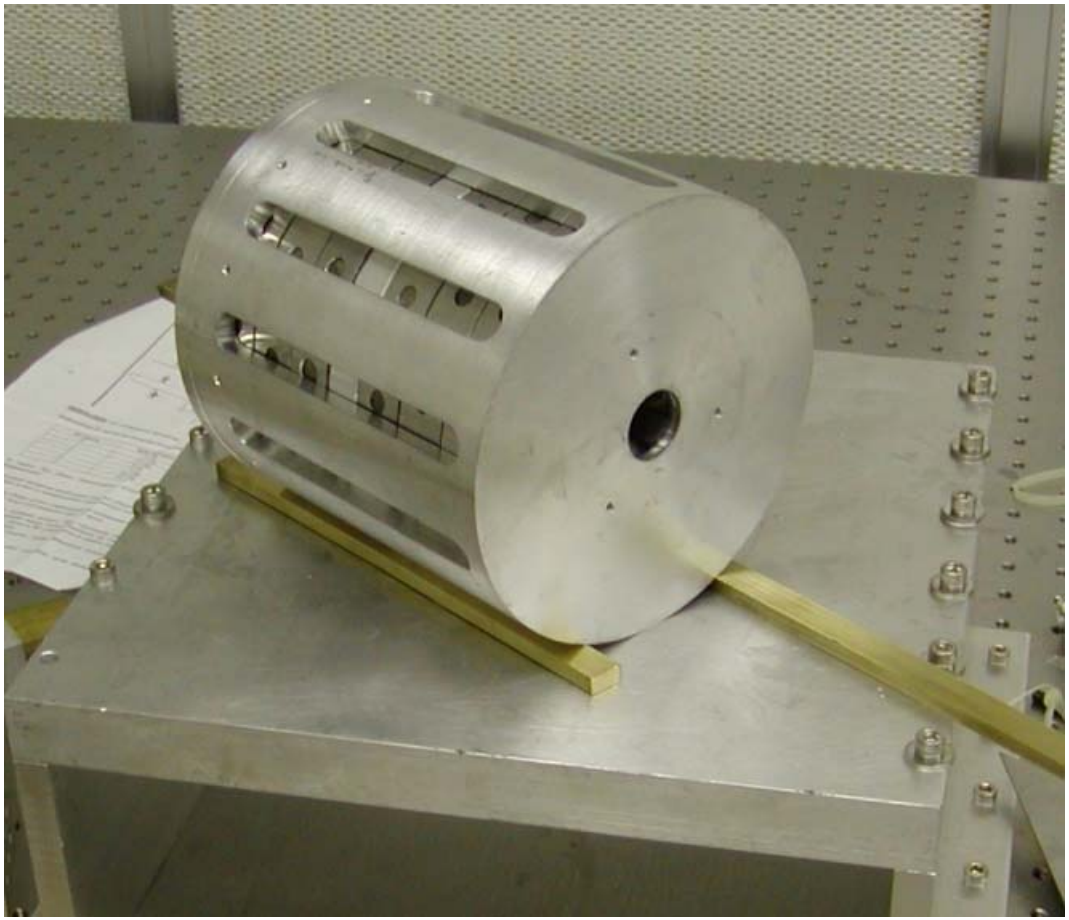
- AdvLIGO medium power stage
- Operational at AEI/LZH
- Integration/Tests with LIGO electronics ongoing
- Will be shipped to Caltech in June for further characterization



35 Watt amplifier prototype

Faraday Isolator

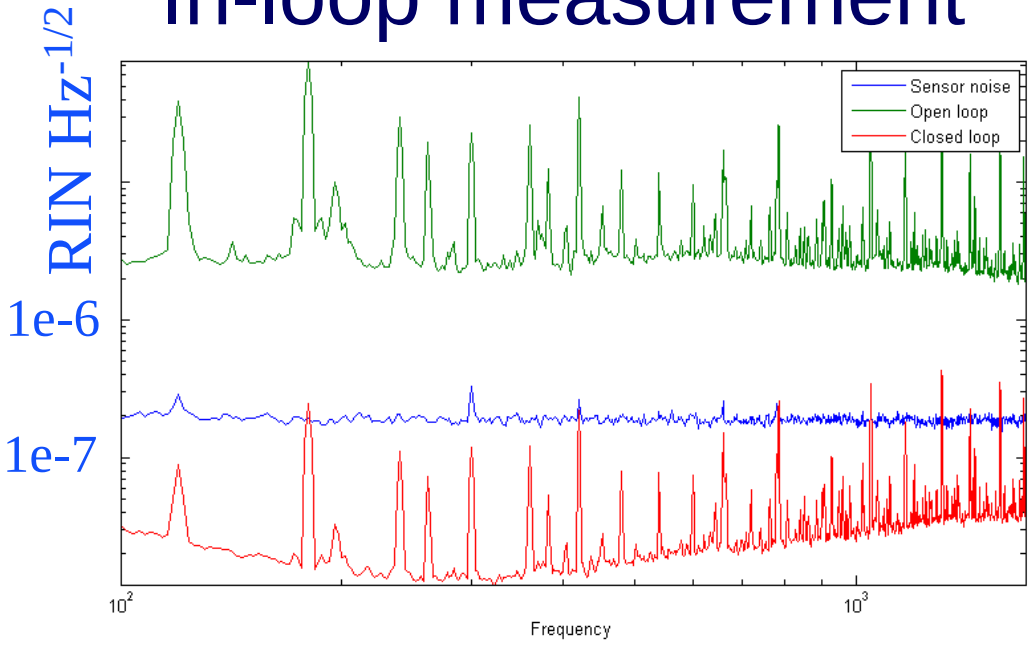
- Needs to handle 100W without significant beam deflection
- >40dB of isolation demonstrated



Thermal Compensation System Intensity stabilization

- CO2 laser upgrade to 35 Watt
- Requires Intensity stabilization

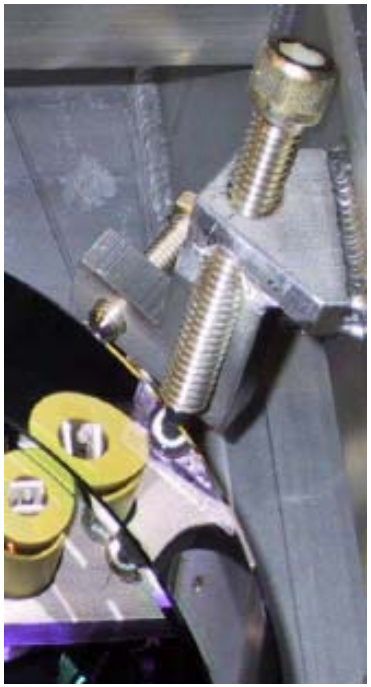
In-loop measurement

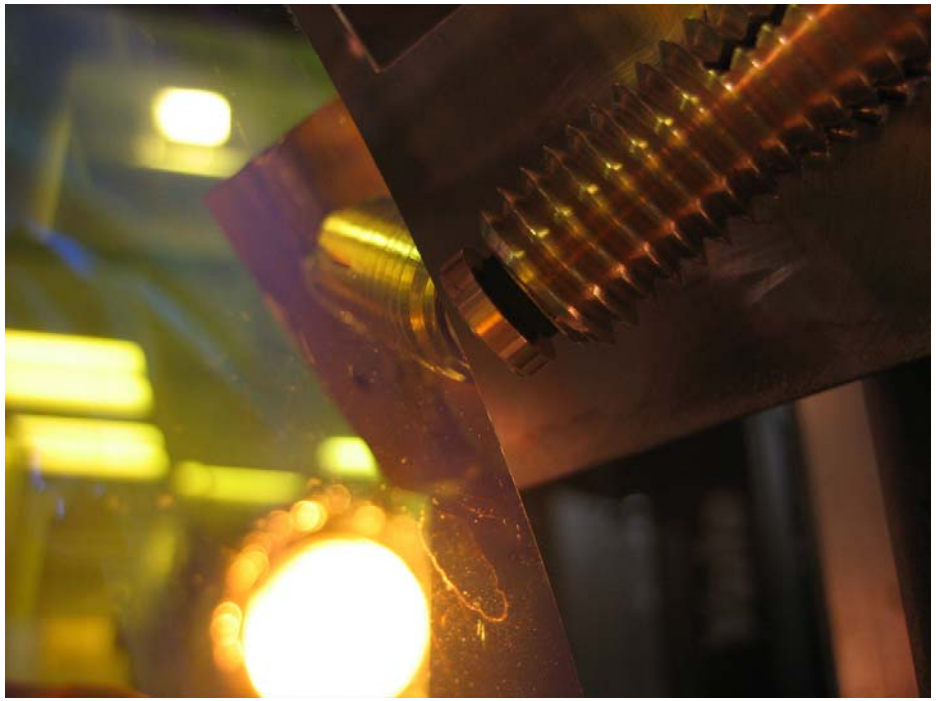


Tobin Fricke

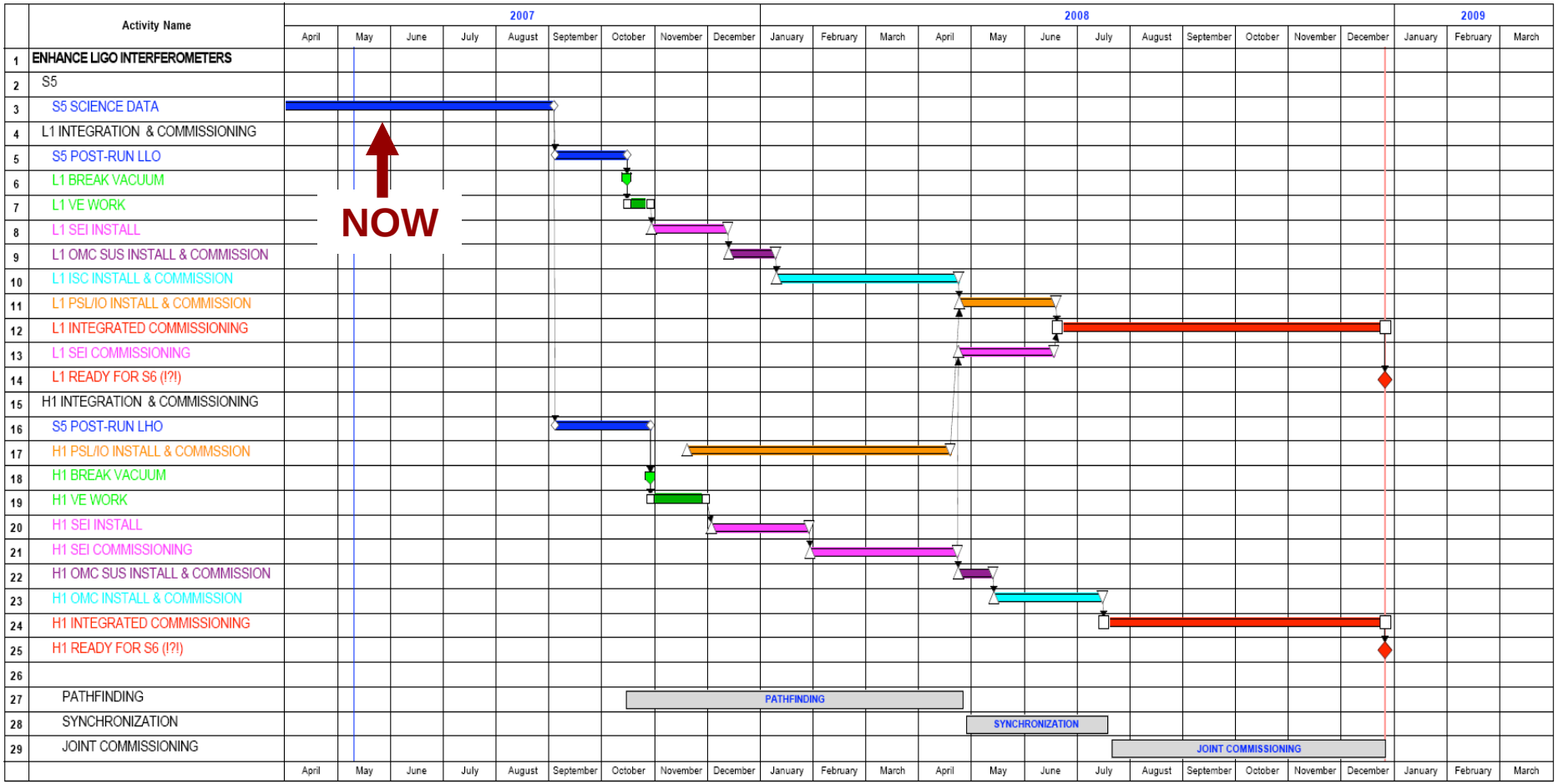
Miscellaneous

- Retrofit large optics earthquake stops (fused silica tip)





Installation Timeline

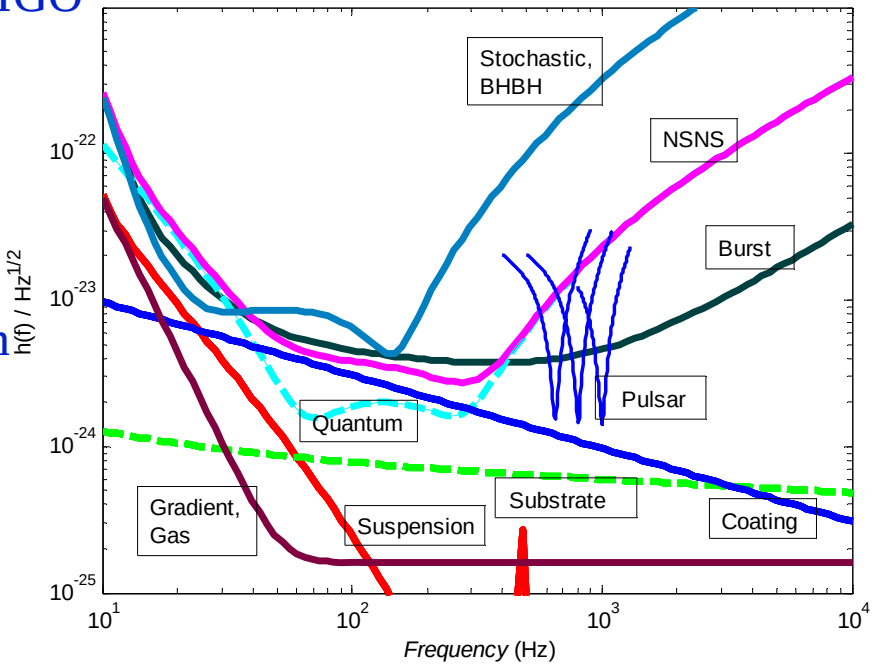


...S6...

- ...see some Gravitational Waves ?

Advanced LIGO

- If you have just tuned in...
  - Second generation of detectors in LIGO
  - ~Factor 10 in amplitude sensitivity
  - ~Factor 4 lower frequency 'wall'
- Quantum Limited at most frequencies
  - Recombined Fabry-Perot Michelson
  - ~20x higher input power
  - Signal recycling → tunable
- Gravitational gradient, thermal noise limits
  - 40 kg fused silica masses
  - Fused silica suspension
  - Aggressive seismic isolation



AdvLIGO News

- Summary up to March by David Shoemaker at Baton Rouge LIGO-VIRGO meeting:
  - http://www.ligo.caltech.edu/docs/G/G070066-00/

Since March

- Seismic Isolation down-select:
  - HAM-ISI (stiff, active) vs HAM-SAS (low Eigen-freq., mostly passive)
  - AdvLIGO will use HAM-ISI, because:
    - Schedule pressure, HAM-ISI is more mature
    - Expected interaction between soft system and multiple suspension

advancedligo

AdvLIGO and Enhanced LIGO

- Most aspects of Enhanced LIGO involve AdvLIGO technology:
  - Output Mode Cleaner (OMC)
  - OMC suspension
  - Internal Seismic Isolation (ISI)
  - 35Watt Laser is AdvLIGO Medium Power Stage
  - High Power Faraday
  - High Power Thermal Compensation system
- Provides early test bed
  - Reduces AdvLIGO risk
  - Reduces the amount of new hardware for AdvLIGO installation
    - i.e. reduces AdvLIGO commissioning time

advancedligo

Advanced LIGO Summary

- Good progress on designs and prototype tests
- Lots of hardware already provided for Enhanced LIGO

- Advanced LIGO is on the President's FY2008 budget
  - US Congress will address US federal budget for FY2008 in the next few month

- **Advanced LIGO has an ever-better chance of seeing October 2007 funding!**