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H1 Squeezer Experiment Update

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ANU, AEI, MIT, CIT and LHO
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Wiki: http://baikal.mit.edu/sqwiki/H1Squeezer

Email list: http://mm.ligo.caltech.edu/mailman/listinfo/squeezer

G0900098-v2

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Motivation

- High power operation in future detectors
  - Biggest remaining technical risk (after DC readout)
  - Squeezing allows for lower laser power
- Squeezer technology now ready
  - 7 dB of squeezing down to 10 Hz
  - Has been demonstrated on a bench and on interferometers (40M)

Missing: Low frequency noise demonstration

- Planned Experiments
  - GEO600: prototype for long baseline interferometers
  - Hanford H1: low noise at low frequency

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Goal of the H1 Squeezer Experiment

- Demonstrate squeezing at low frequency with a high sensitive long baseline interferometer
  - Demonstrate 3 dB of squeezing at frequencies where we are shot noise limited
  - Do not introduce noise at other frequencies!
- (Build a squeezer which could be readily turned into an advanced LIGO upgrade
  - Fully engineered optical breadboard
  - Use LIGO type electronics and controls
  - Prepare for long-term reliability investigations)
- Be ready for a test on H1 after S6

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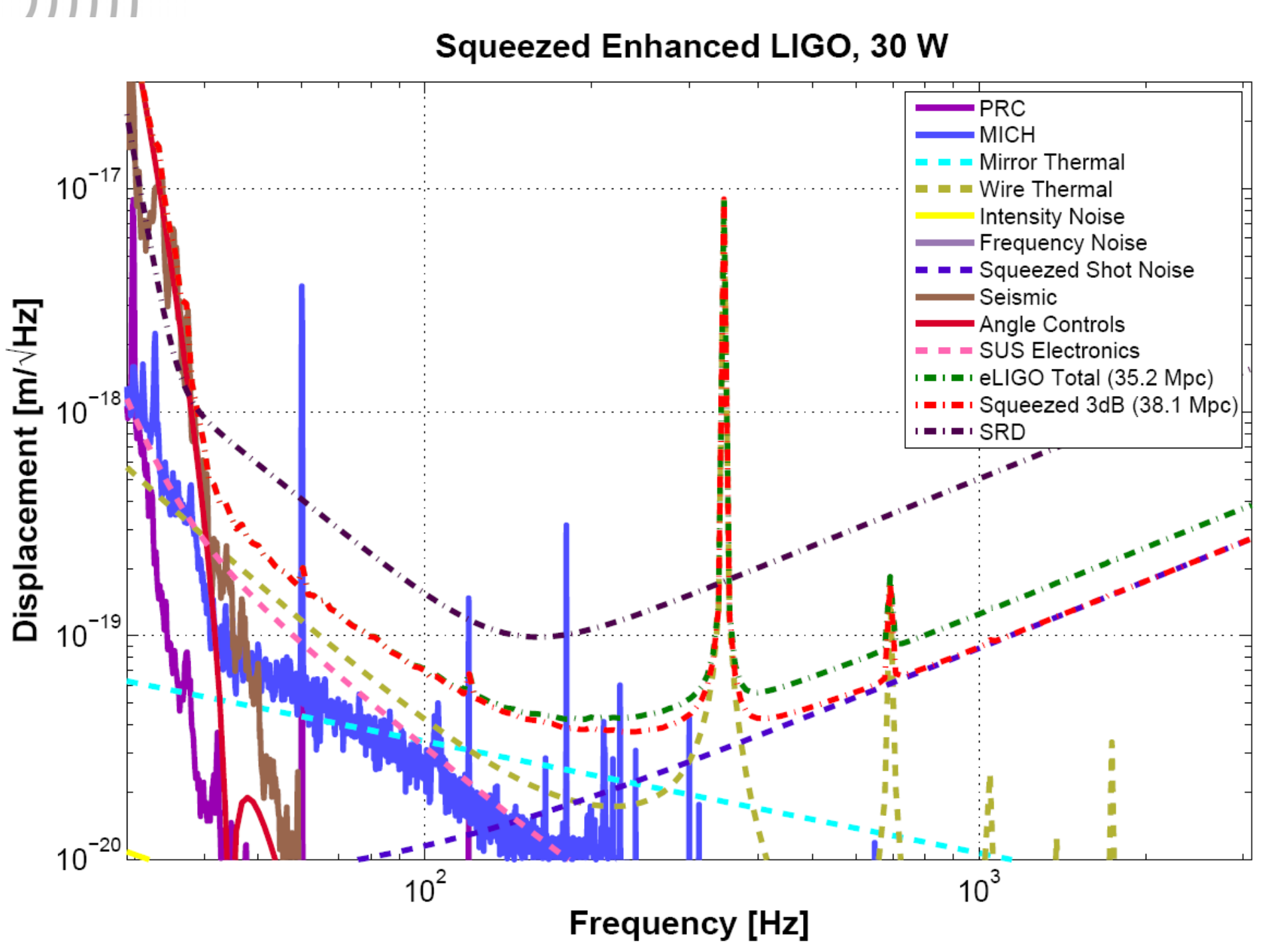
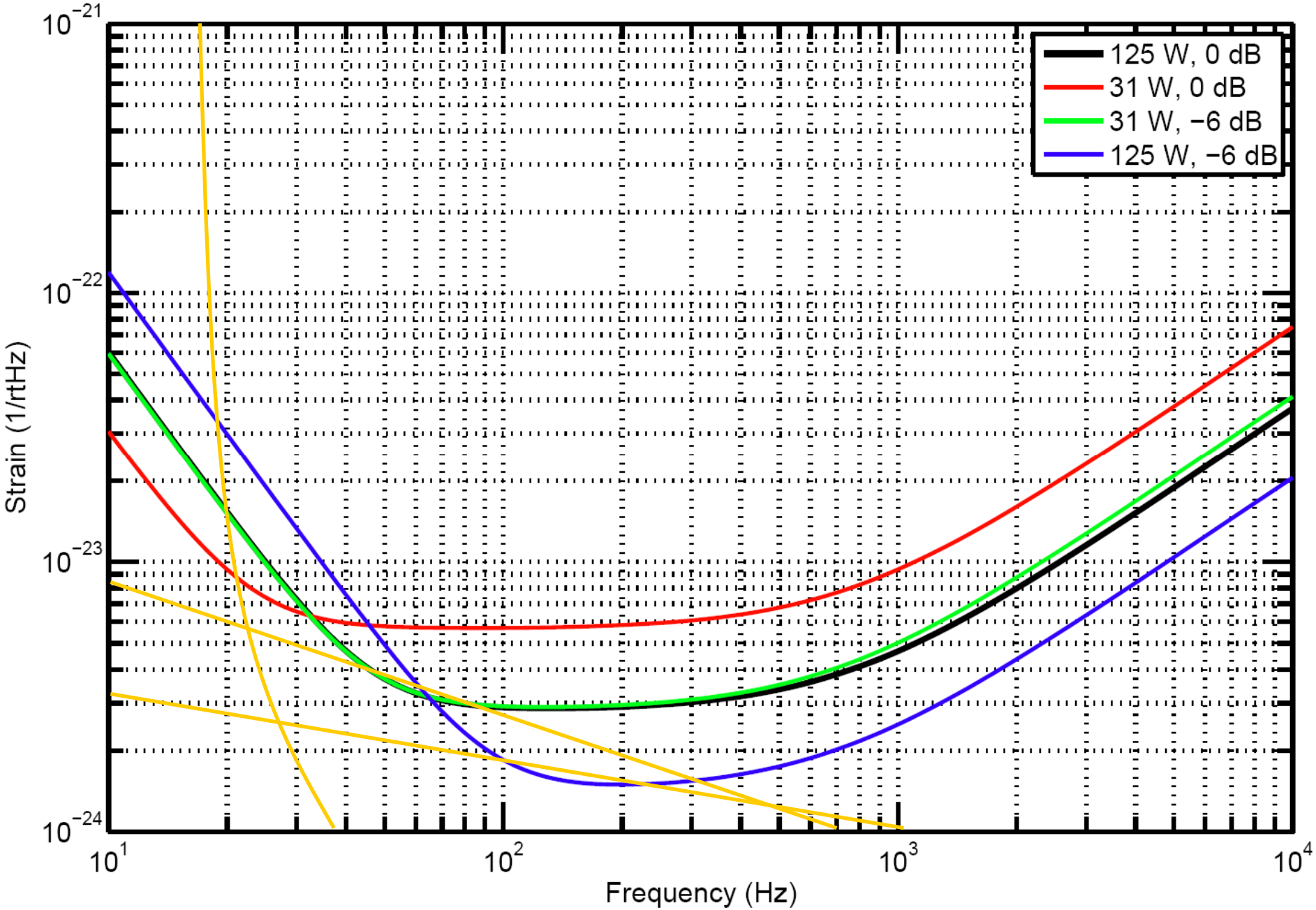
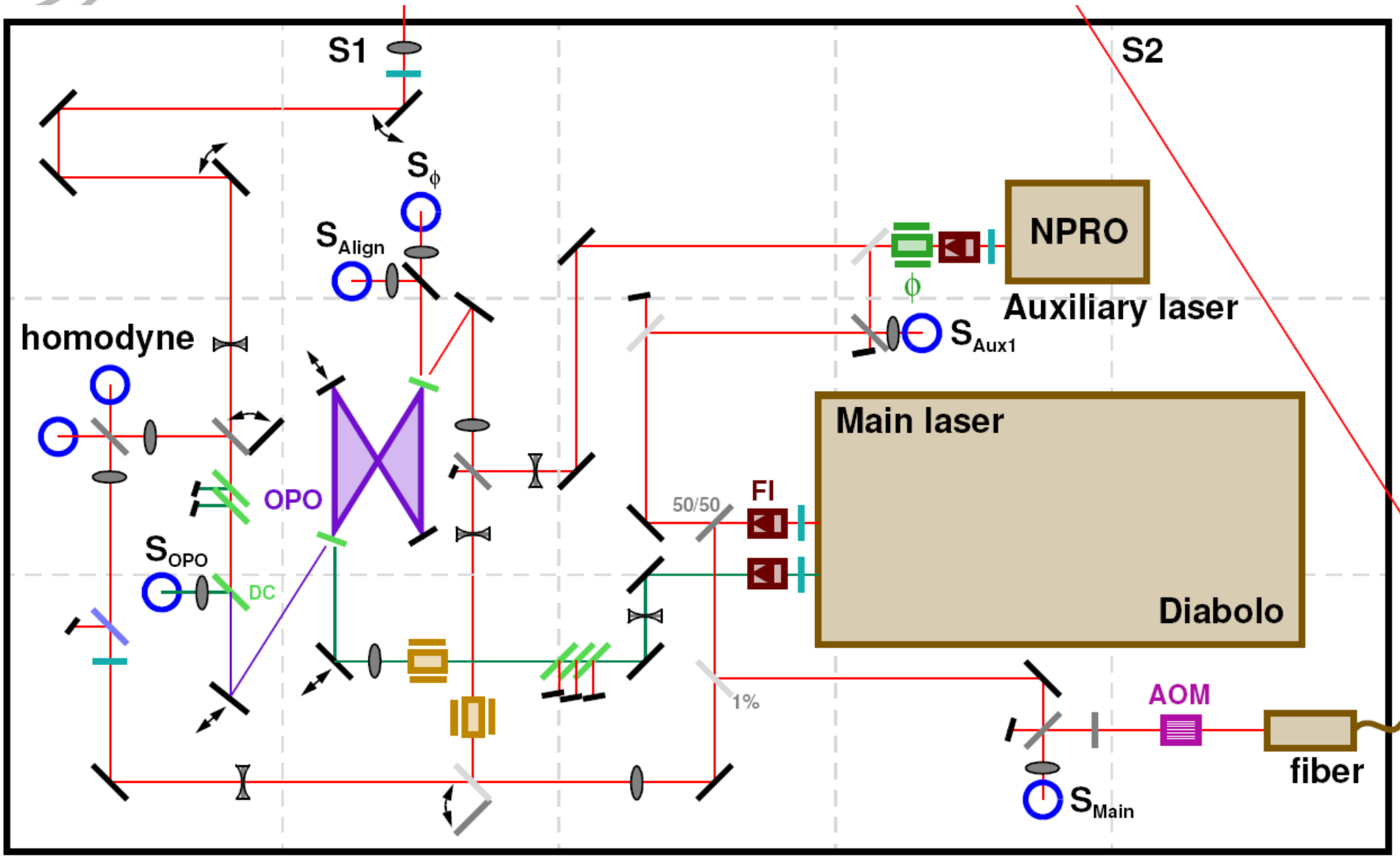
H1 Squeezer Time Line

- Fixed start date for H1 experiment: 2/15/2011
- Fixed end date for H1 experiment: 10/3/2011

Better be ready!


Squeezed Enhanced LIGO, 30 W
PRC
MICH
Mirror Thermal
Wire Thermal
Intensity Noise
Frequency Noise
Squeezed Shot Noise
Seismic
Angle Controls
SUS Electronics
eLIGO Total (35.2 Mpc)
Squeezed 3dB (38.1 Mpc)
SRD
Displacement [m/√Hz]
Frequency [Hz]
10^-17
10^-18
10^-19
10^-20
10^2
10^3


125 W, 0 dB
31 W, 0 dB
31 W, −6 dB
125 W, −6 dB
Strain (1/rtHz)
Frequency (Hz)
10^−21
10^−22
10^−23
10^−24
10^1
10^2
10^3
10^4


S1
S2
S_ϕ
S_{Align}
homodyne
OPO
S_{OPO}
DC
NPRO
Auxiliary laser
S_{Aux1}
Main laser
Diabolo
50/50
FI
1%
AOM
fiber
S_{Main}

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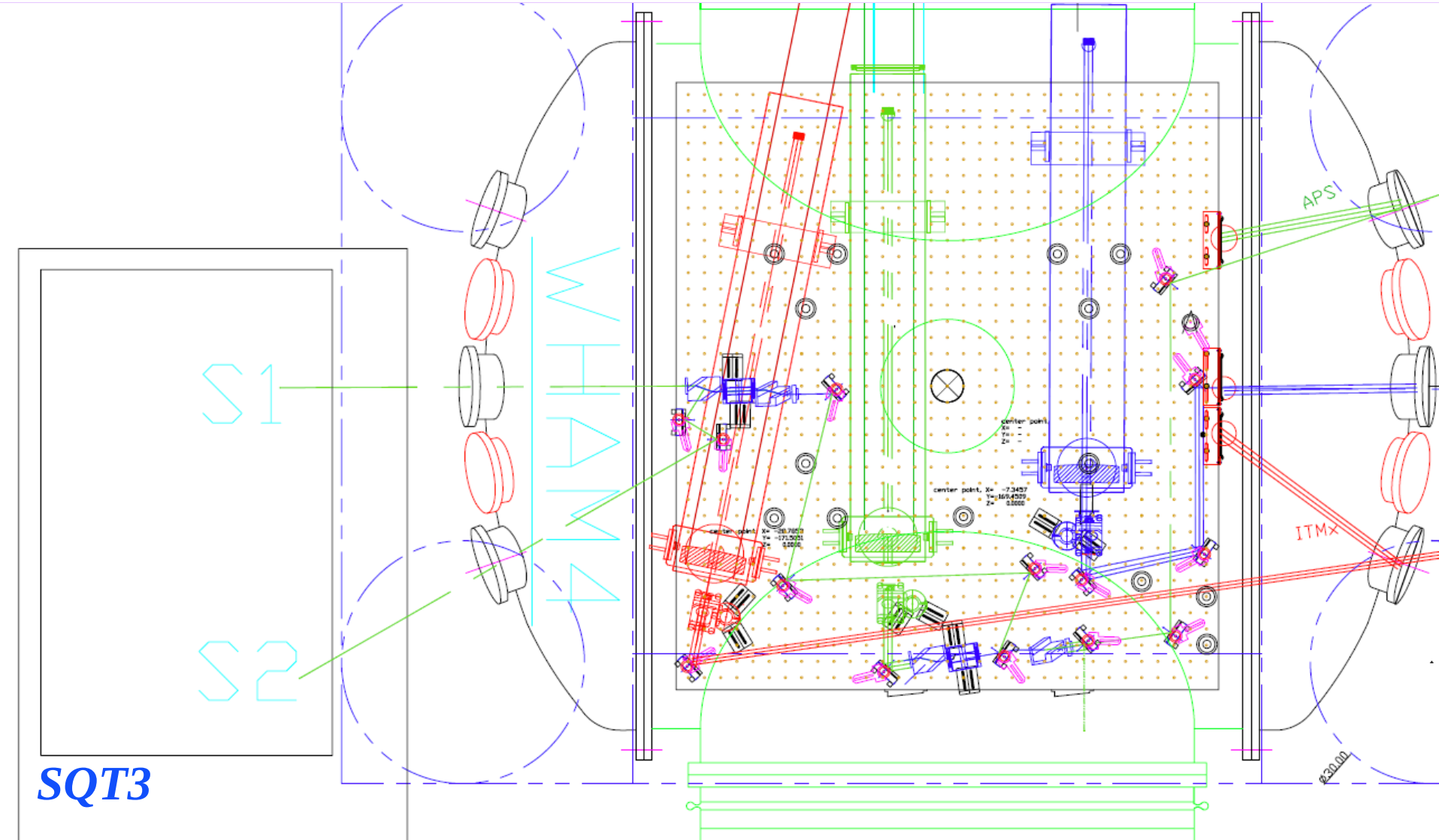
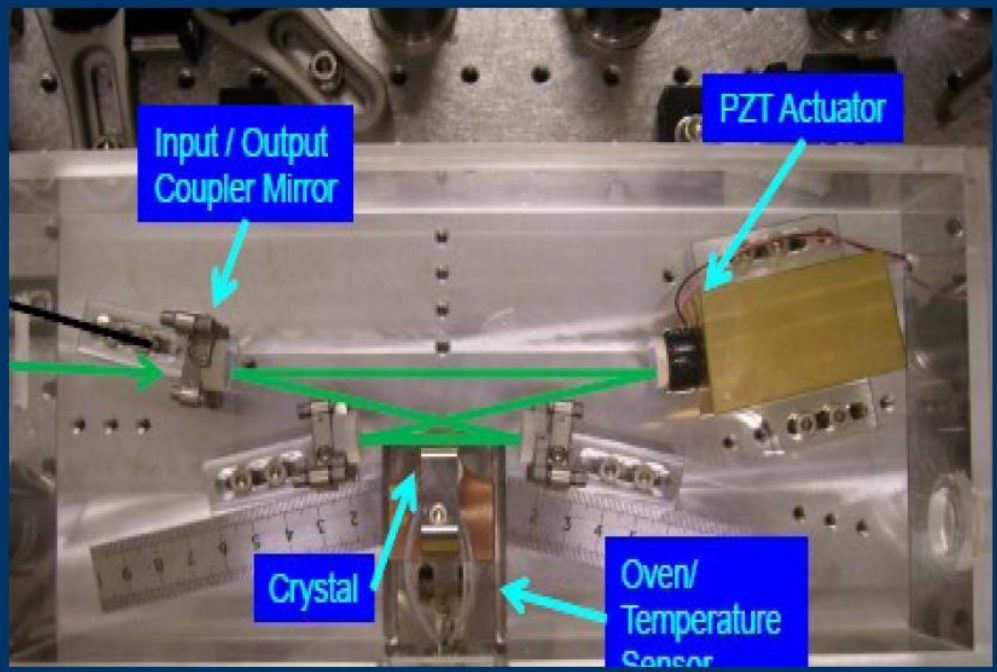
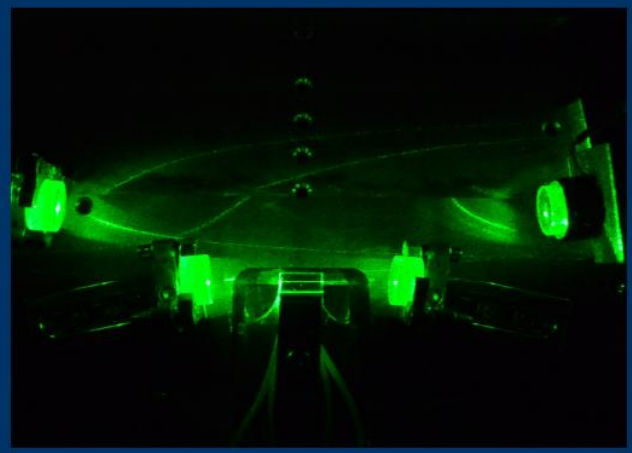
HAM4 Layout



New Cavity from ANU group





- ANU machine shop just finished machining more of these bases, including 2 with 4” beam height
- Barely stable cavity- g is almost 1

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Recent Progress

- Technical review was on 8/19/08
  - Most action items have been addressed (L080140-00/L080130-00)
- Budget/schedule review was on 1/15/09
  - Looked at costs saving by using existing equipment from H2
  - Report available at M0900042-v1
- Use LIGO I laser to pump a AEI designed SHG
- Laser system assembly at MIT
- First 50k$ allocated to build SHG & laser locking
  - Building of SHG started at MIT
  - Electronics is in development (borrow from initial & adv. LIGO)
  - No slack left in schedule