


Status of GEO600

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for the GEO600 team

Aspen Meeting

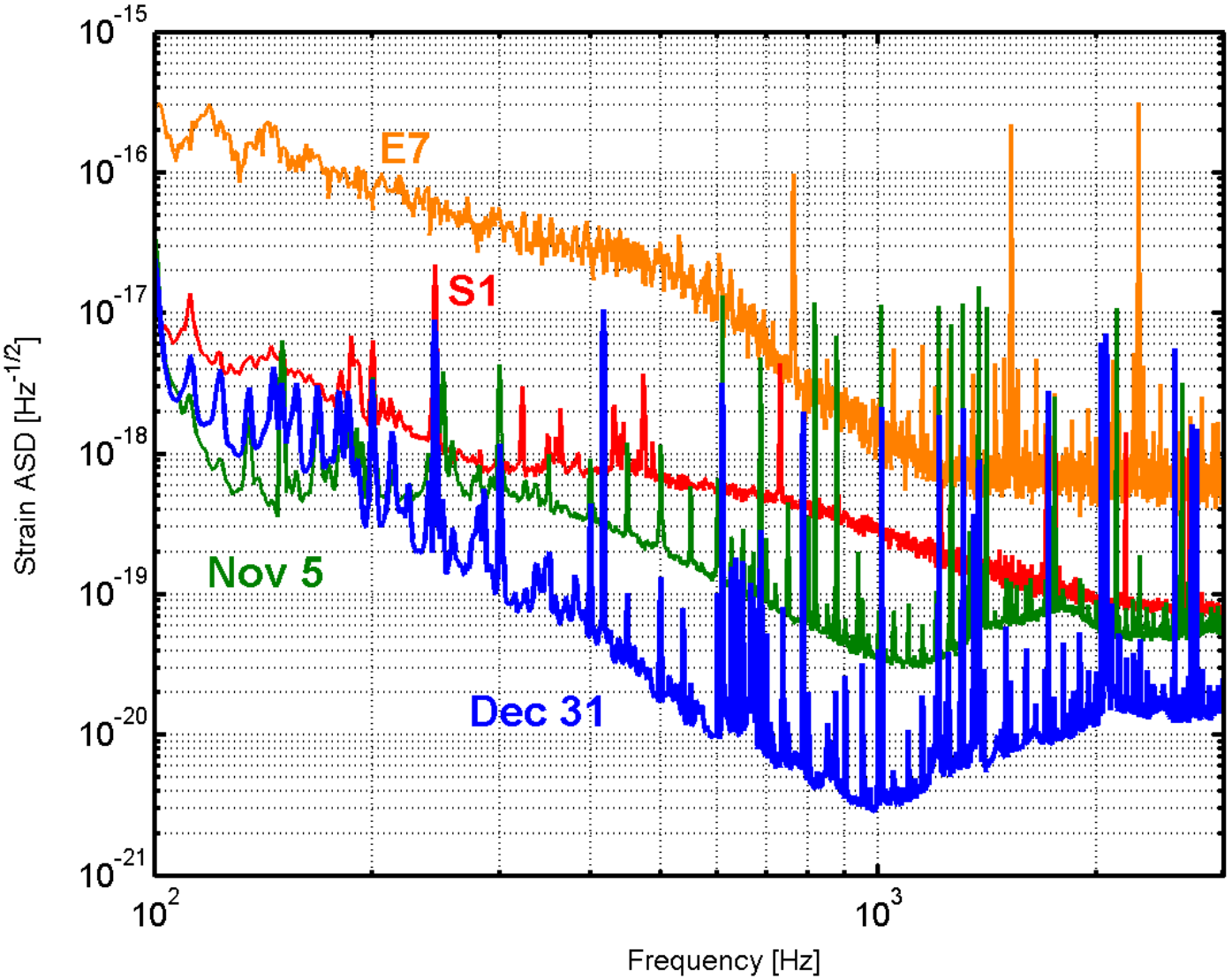
Aspen CO, February 2004

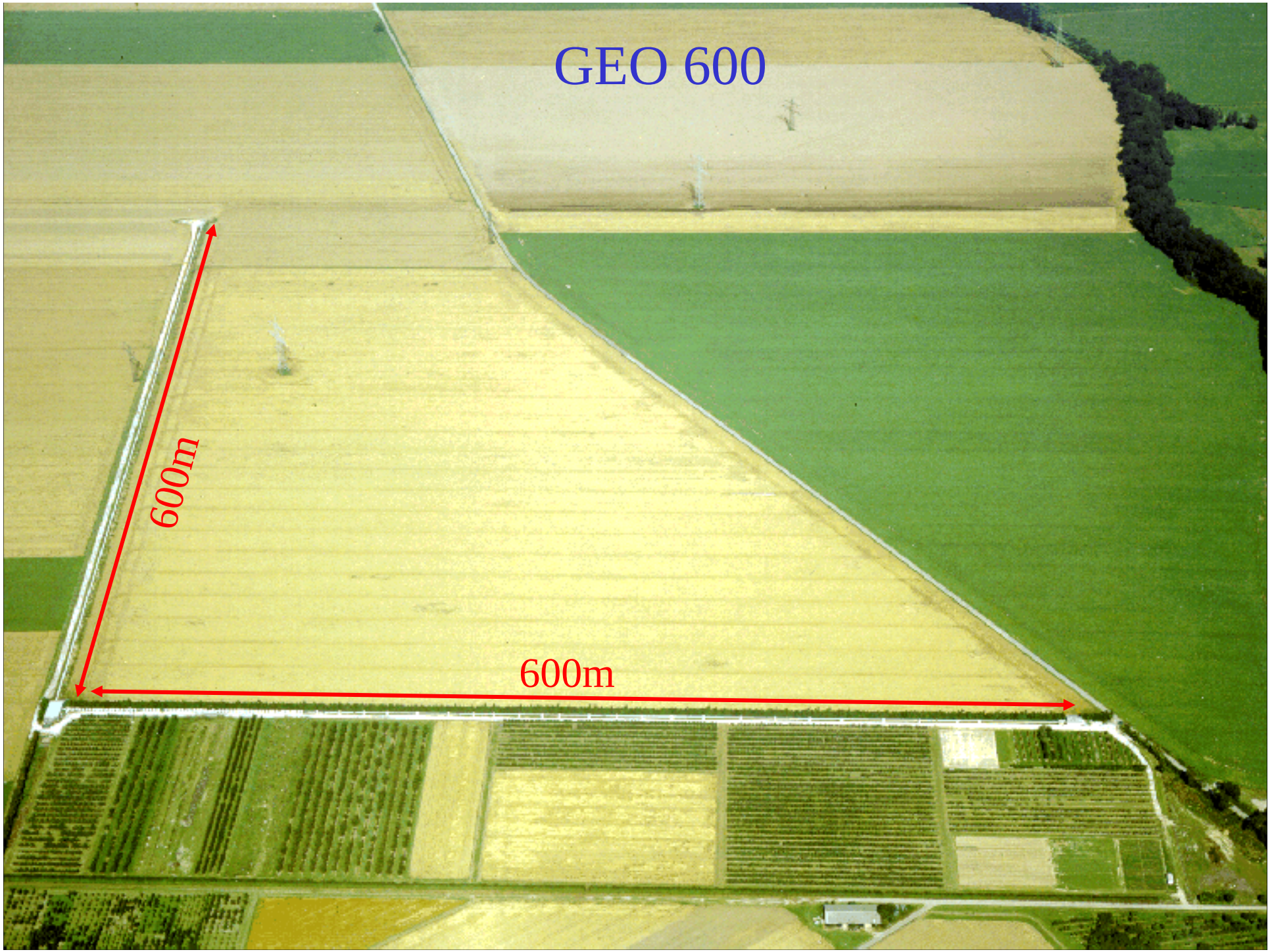
LIGO-G040040-00-Z

GEO600 - Goals

- test and demonstration of new technology
  - corrugated vacuum tubes
  - compact triple pendulum suspensions
  - monolithic last pendulum stages
  - signal recycling
  - mode healing
  - thermal ROC compensation
- search for Gravitational Waves

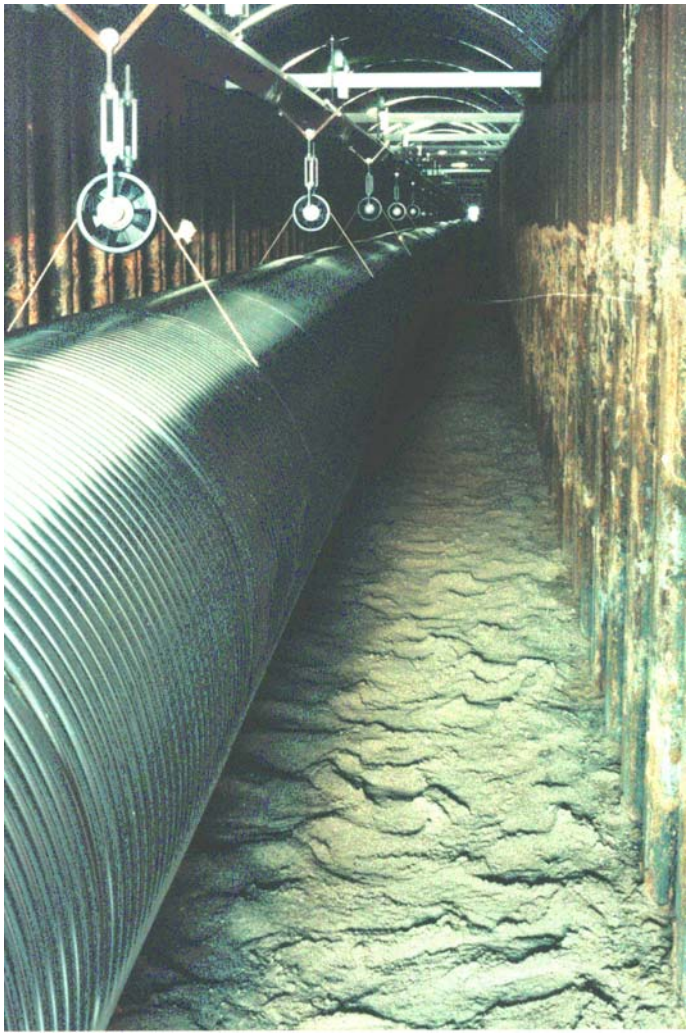
Sensitivity Improvements




GEO 600
600m
600m

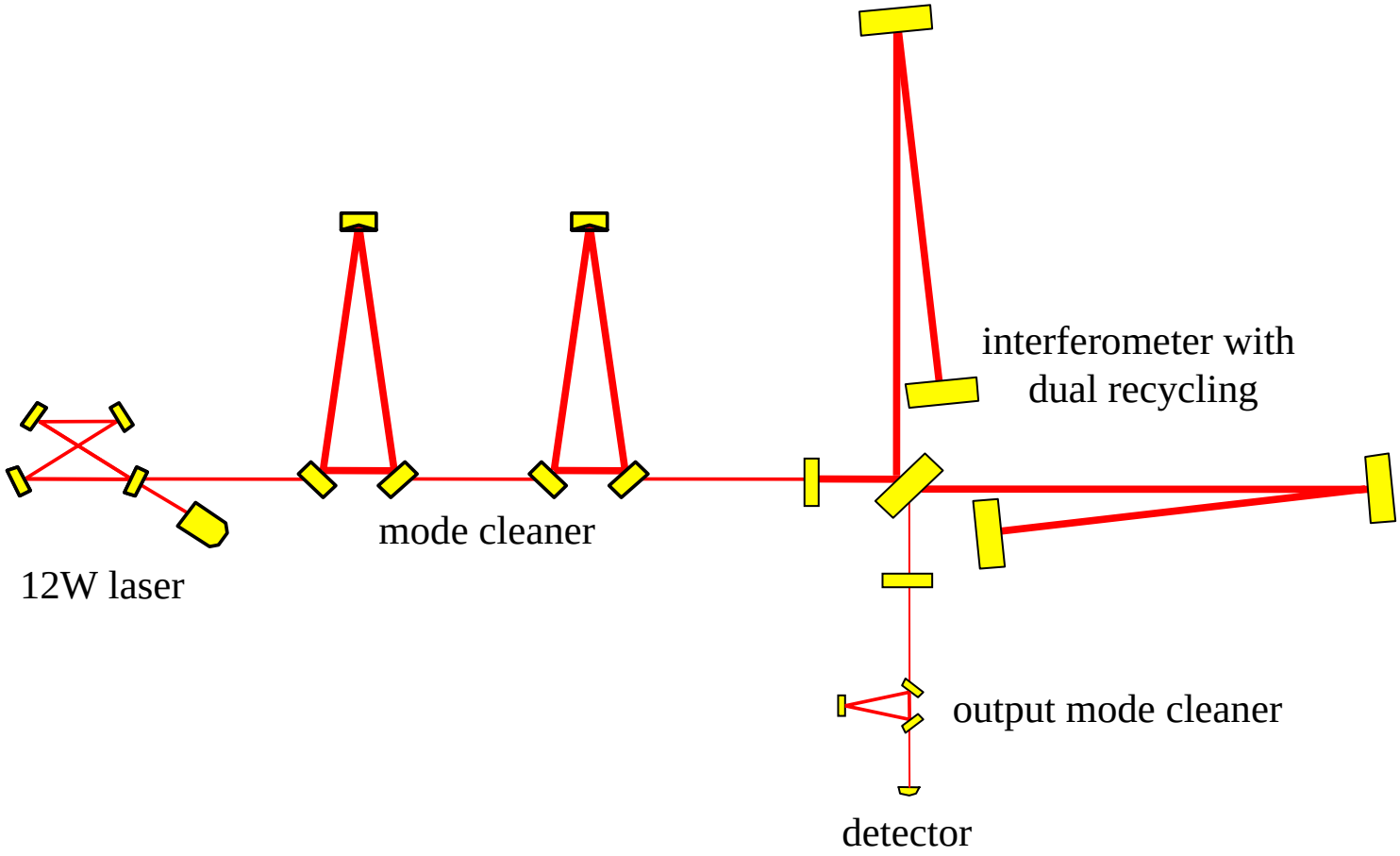
Central Building

Tube / Trench

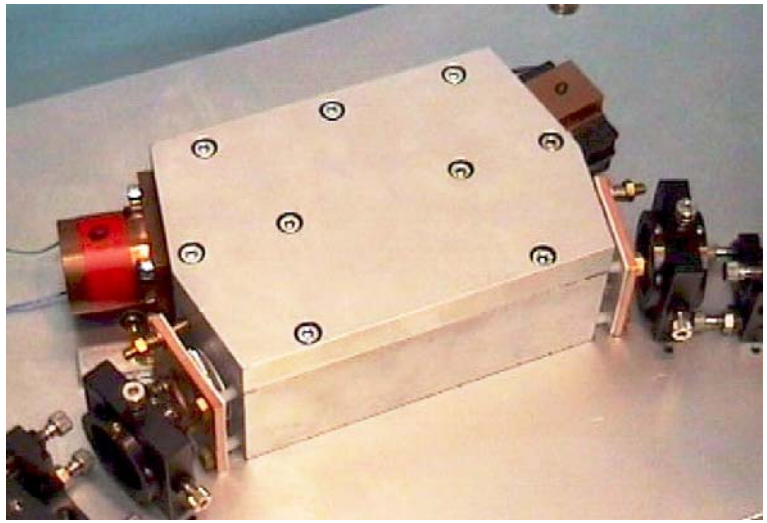


Clean Room / Control Room

Optical Layout



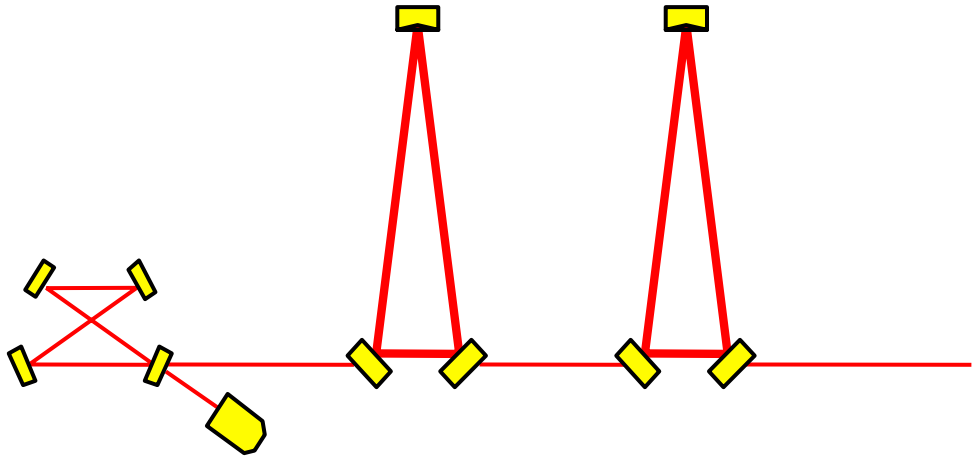
12W Injection-Locked Laser-System



- NPRO (non-planar ring oscillator) master laser, output power: 800mW
- slave laser optical components mounted on rigid resonator-spacer (Invar)
- 12W output power (< 5% in higher TEM modes)
- injection-locking stable over days

Modecleaner

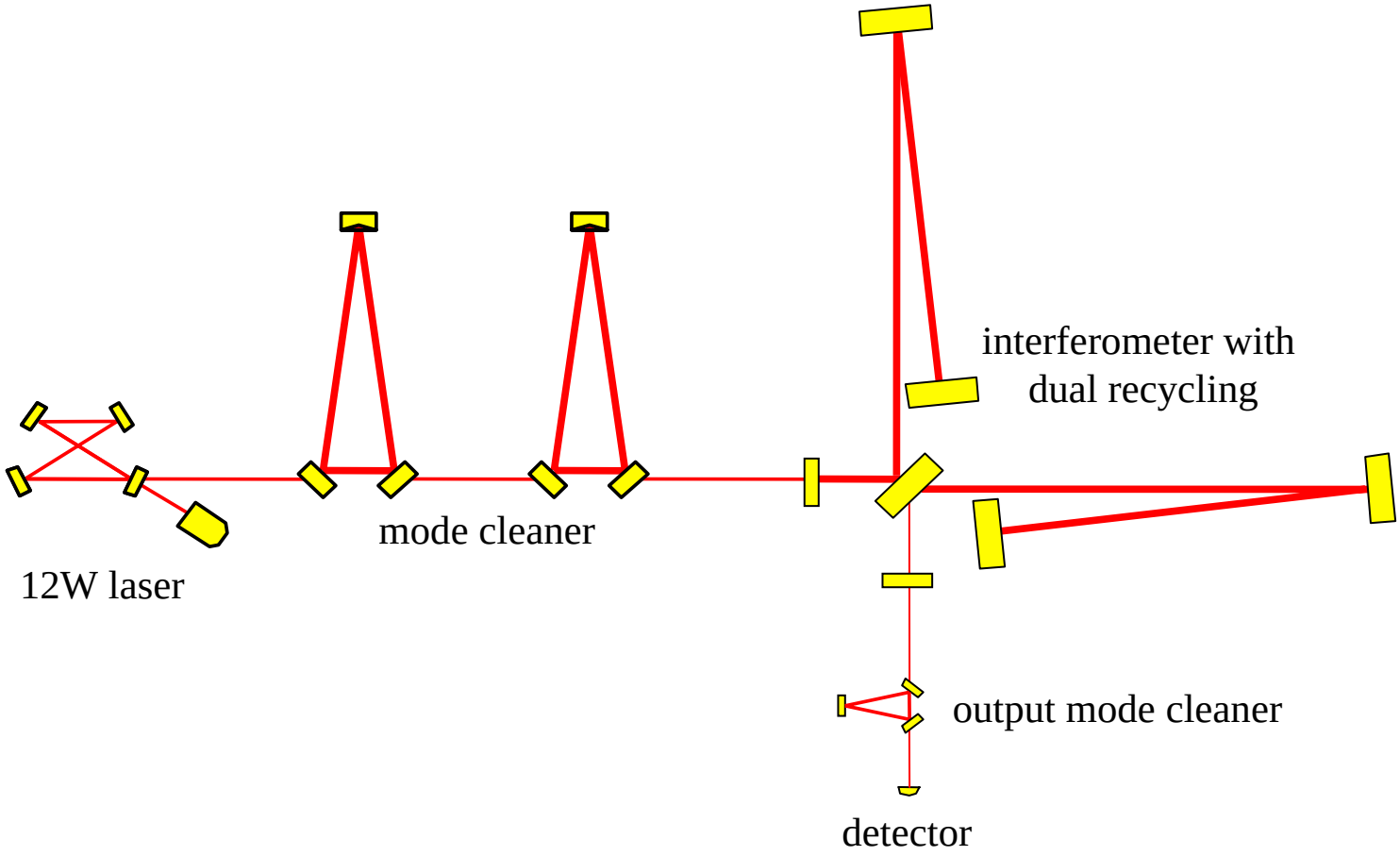
Troughput	80%	72%
Finesse	2700	1900
Visibility	91%	92%



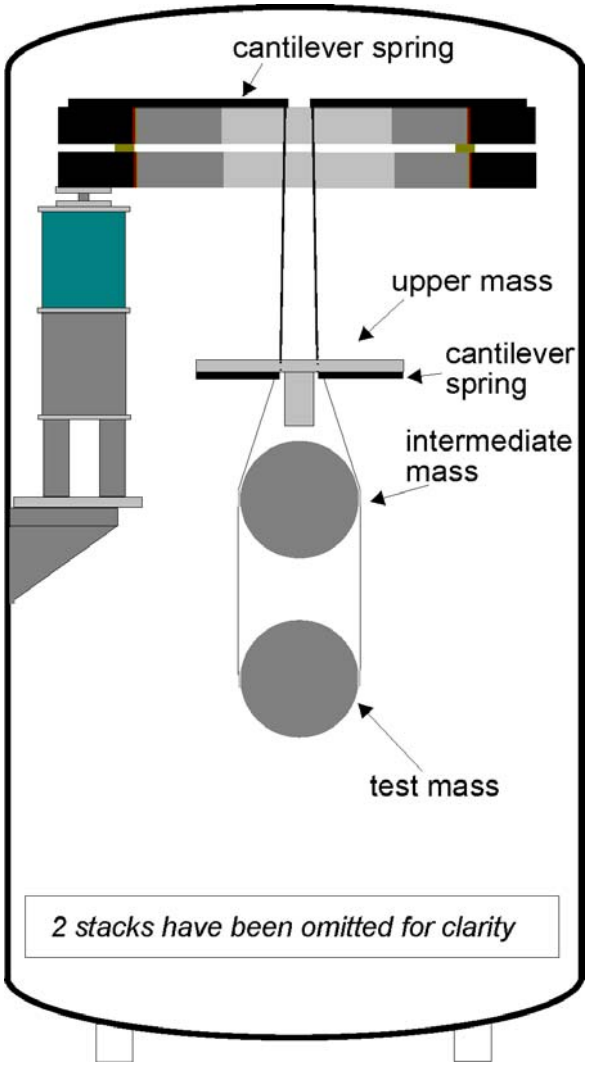
12W Laser Mode Cleaner

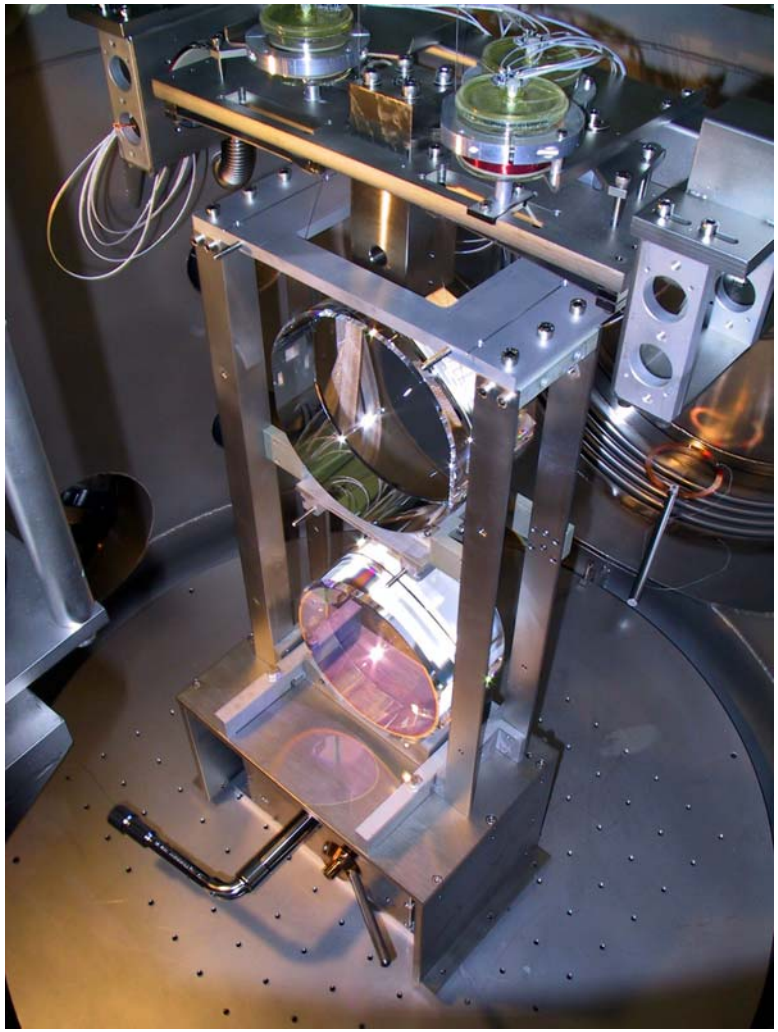
- Triangular 8m ring cavities
- autoalignment system
- automatic lock acquisition
- in operation since Dec. 2000
- not manually realigned for about 1 year

Optical Layout

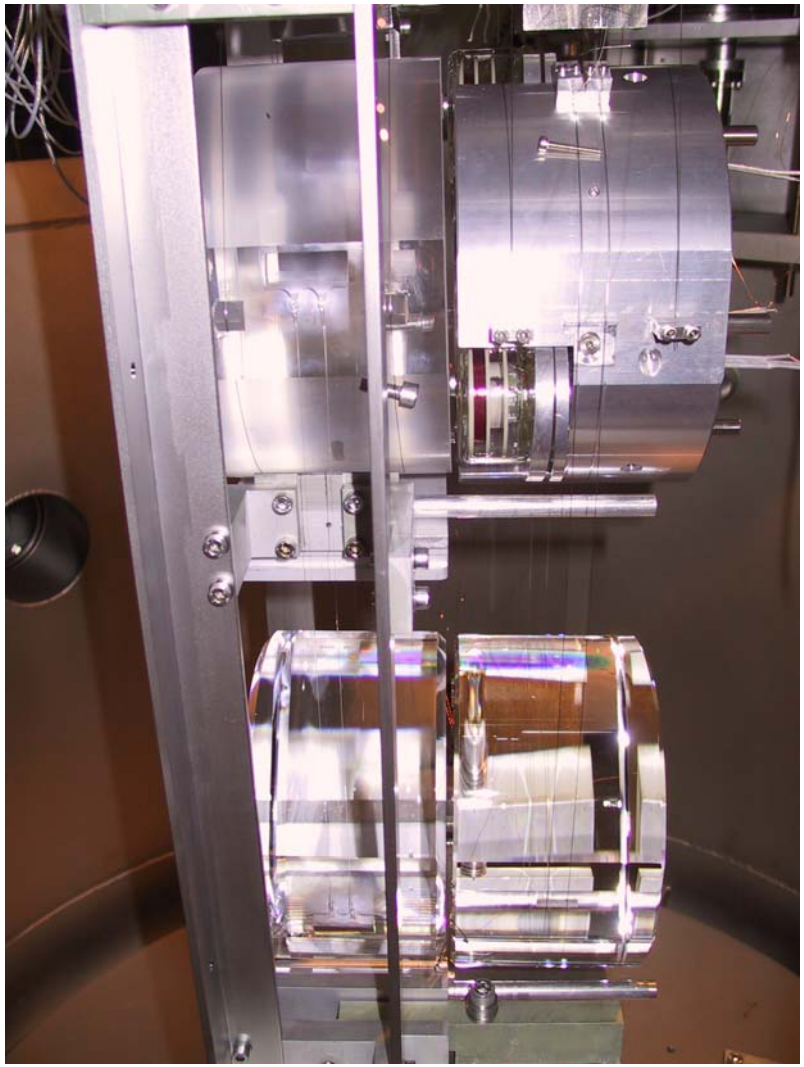


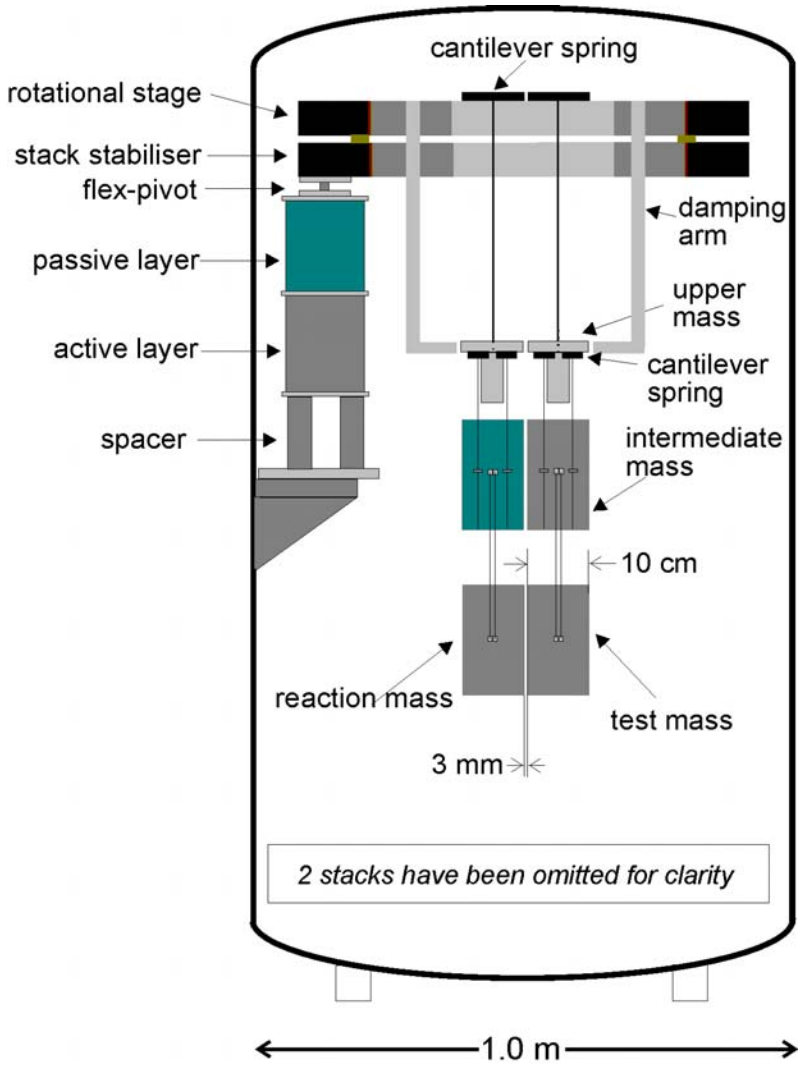
Triple Pendulum Suspension



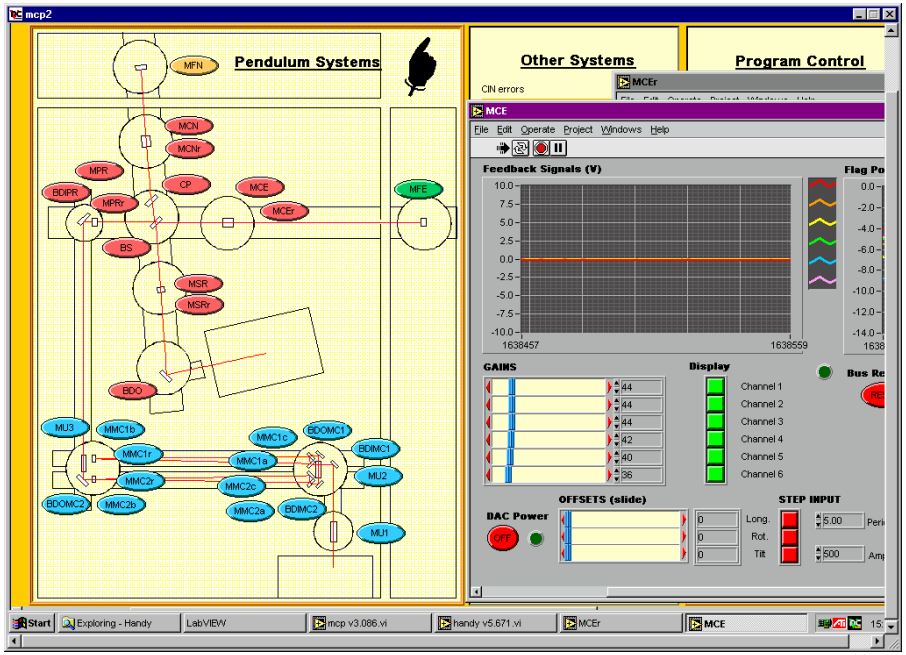


Reaction Pendulum





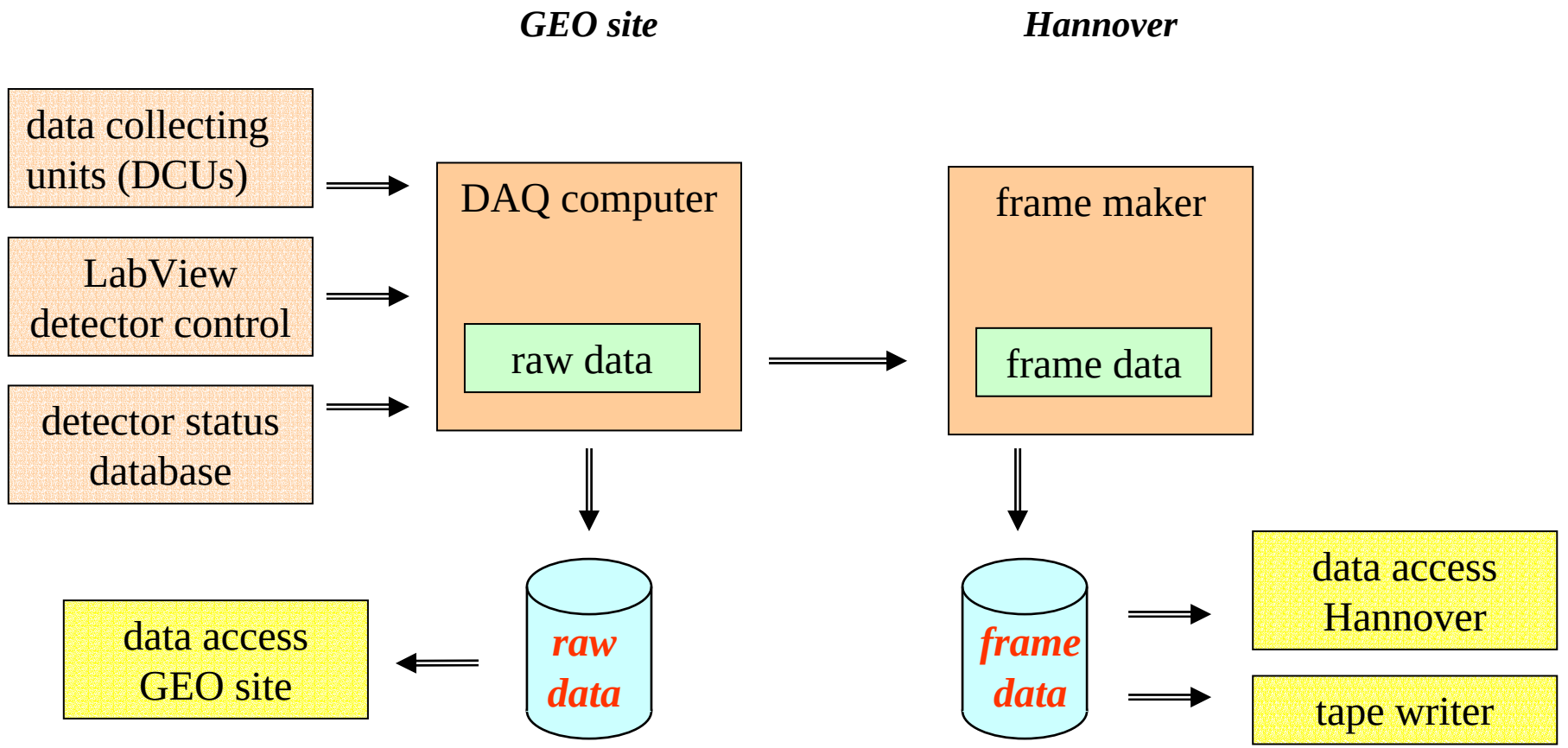
System Control & Data Acquisition



- LabView guided analog control systems (~200 loops, ~1000 channels)
- Micro Controler guides time critical lock acquisition
- digital feed-forward loops to reduce seimic noise and long-tilt coupling

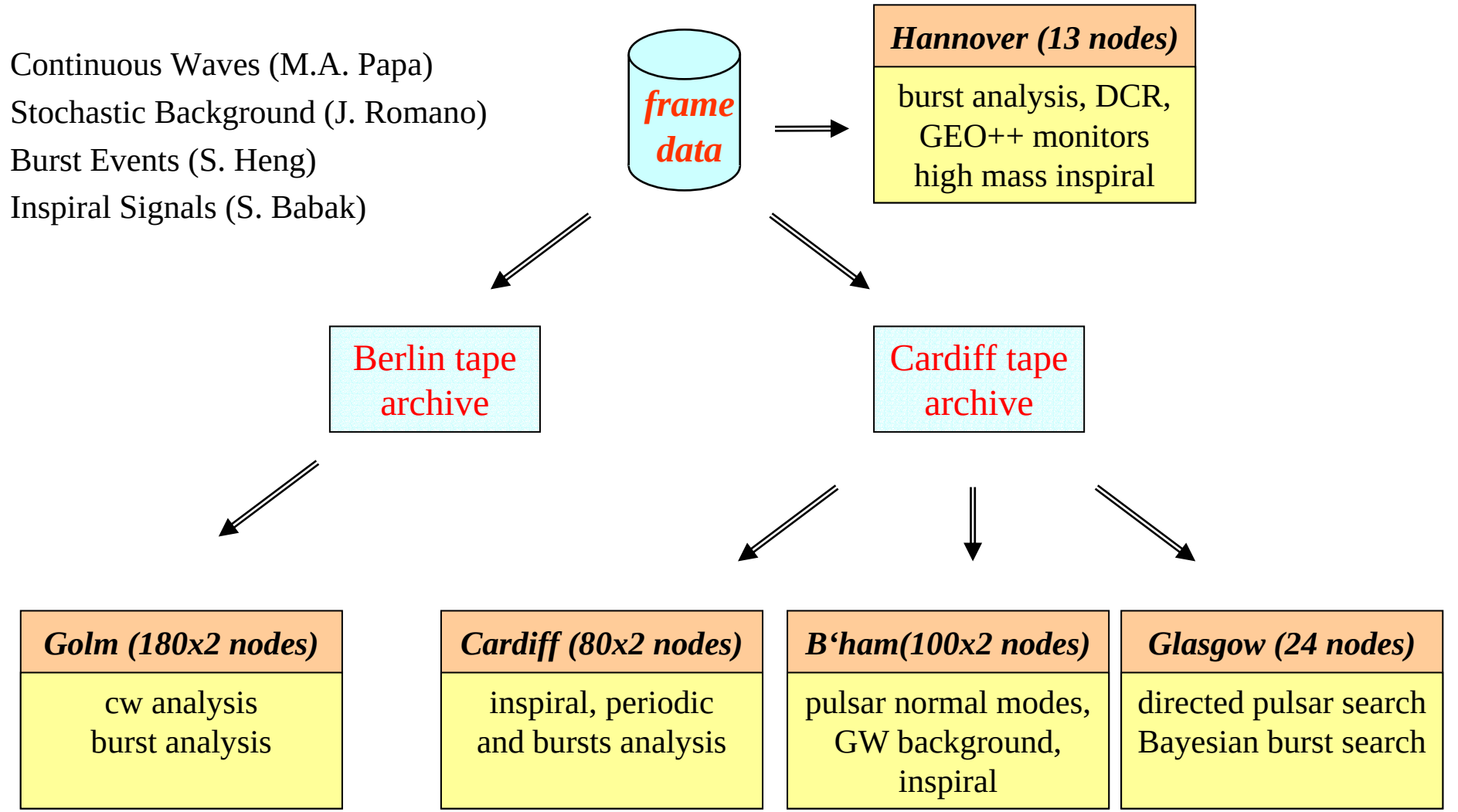
- VxWorks/Tornado based DAQ
- Up to 64 channels 16384Hz, 16bit
  64 channels 512Hz
- LabView system acquires
  ~ 1000 channels @ ~10Hz

Data Acquisition System

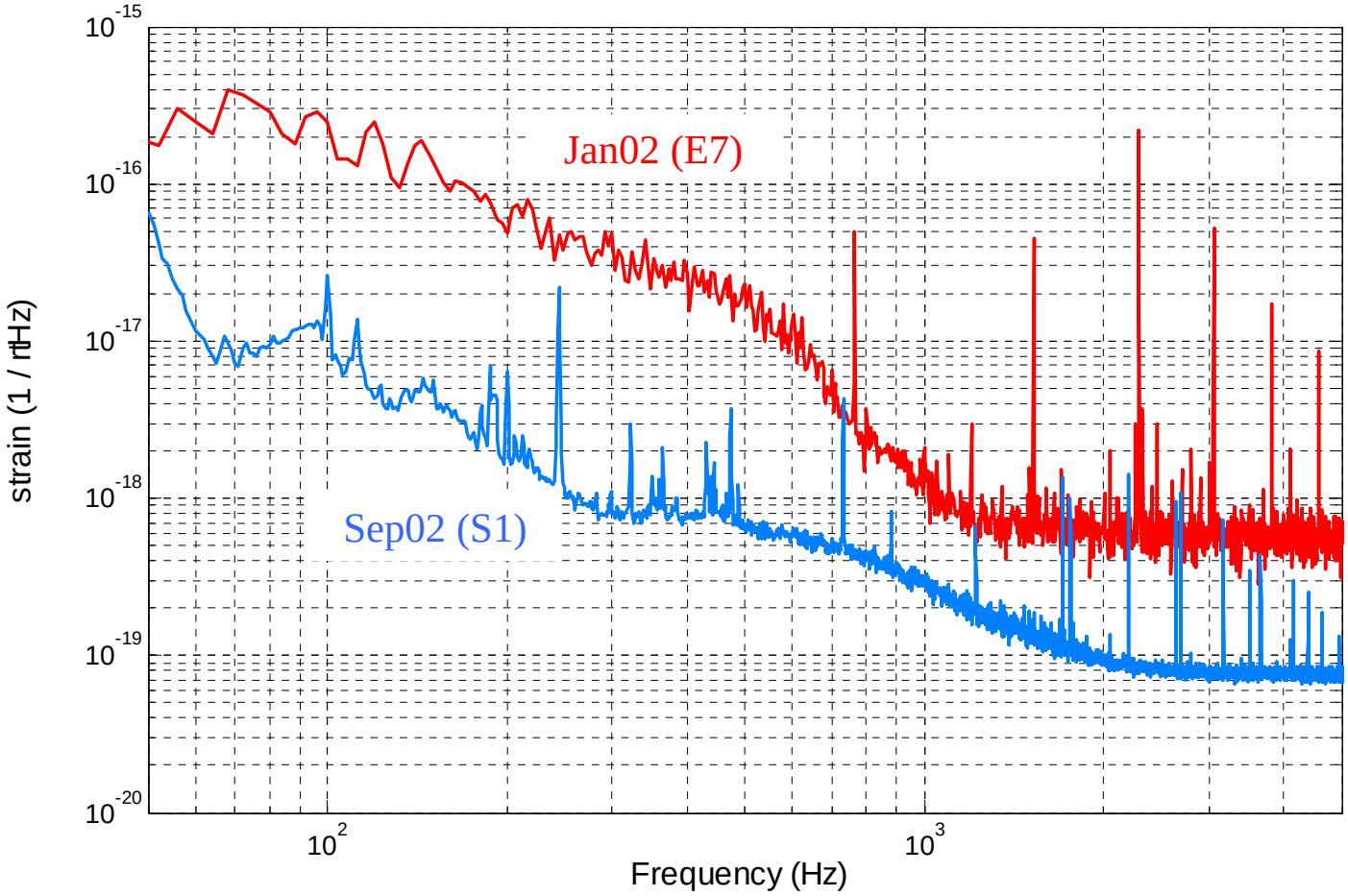


Data Analysis Network

Continuous Waves (M.A. Papa)
Stochastic Background (J. Romano)
Burst Events (S. Heng)
Inspiral Signals (S. Babak)

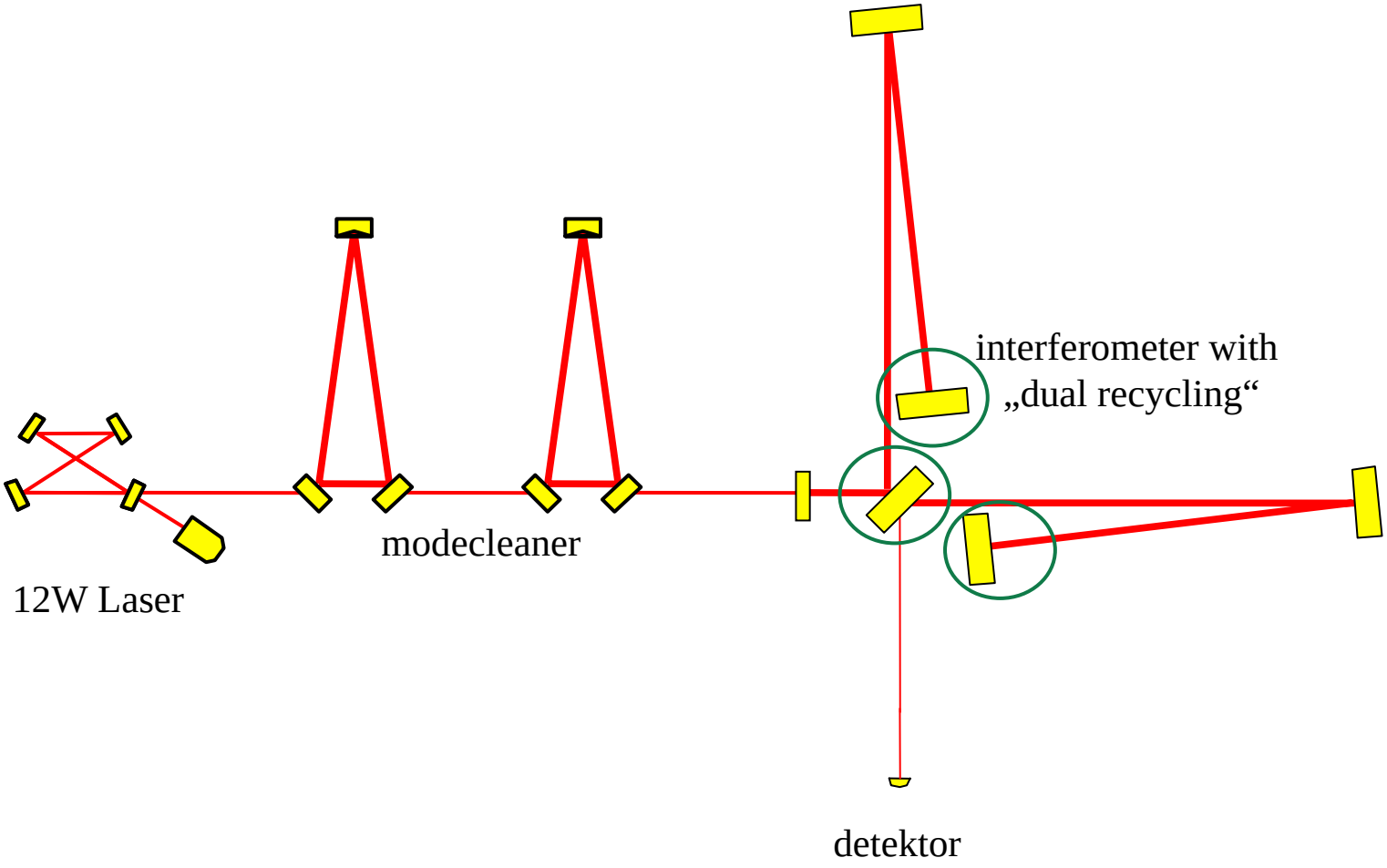


Sensitivity E7 / S1



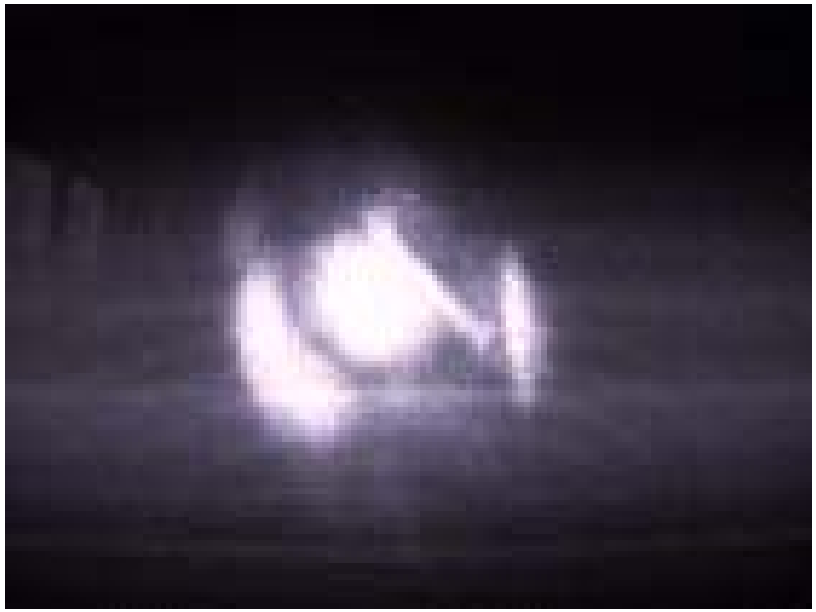
duty cycle:	75% (E7)	98% (S1)
longest lock:	> 3h 40min	> 121h

Mirror Installation Fall 2002

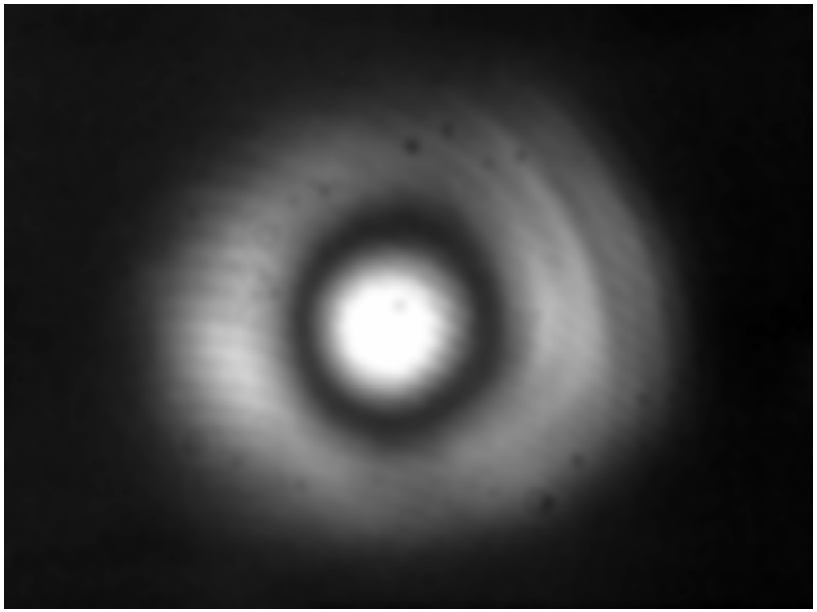


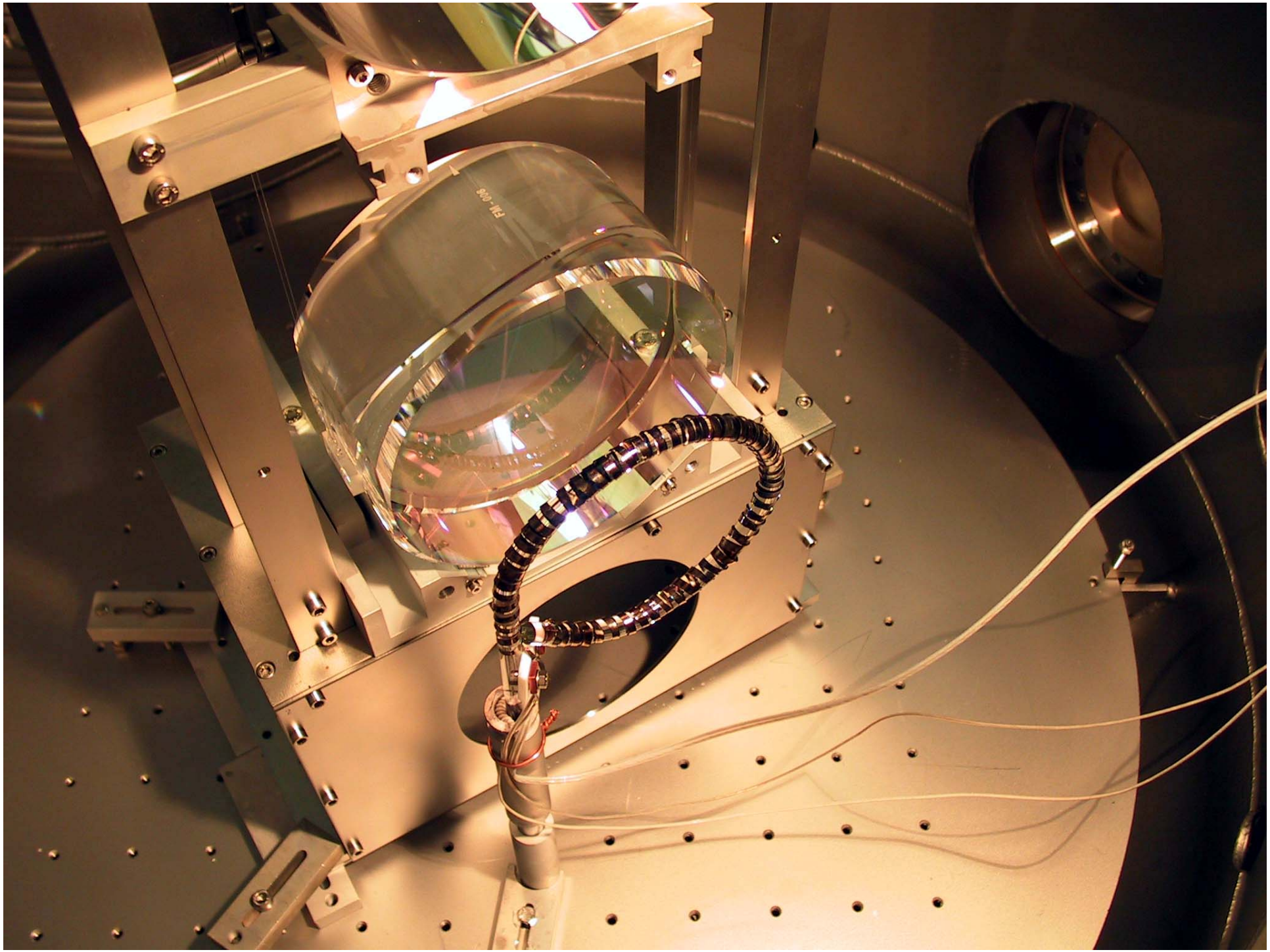
Contrast Defect

output port
test mirrors

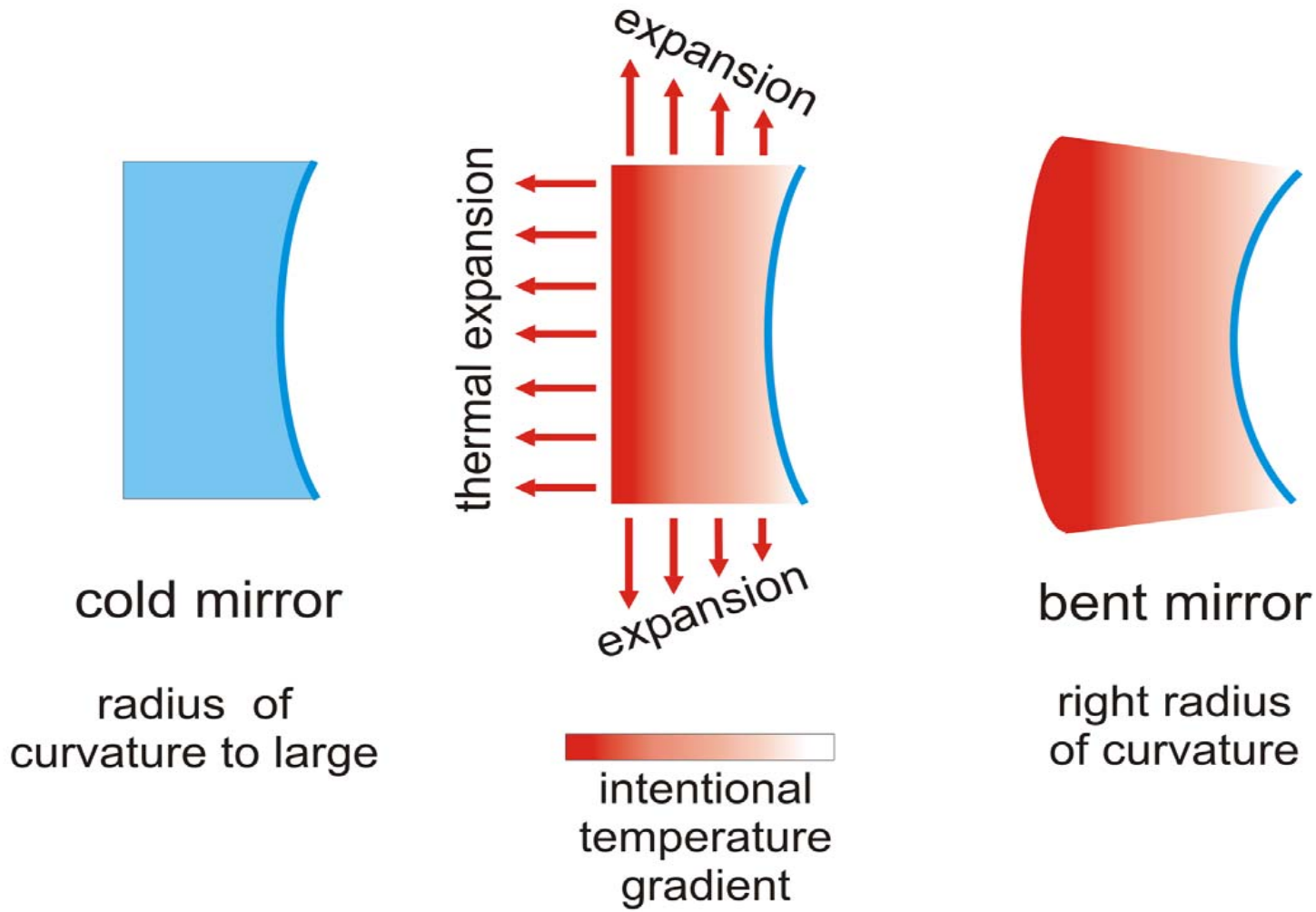


output port
“high-quality” mirror

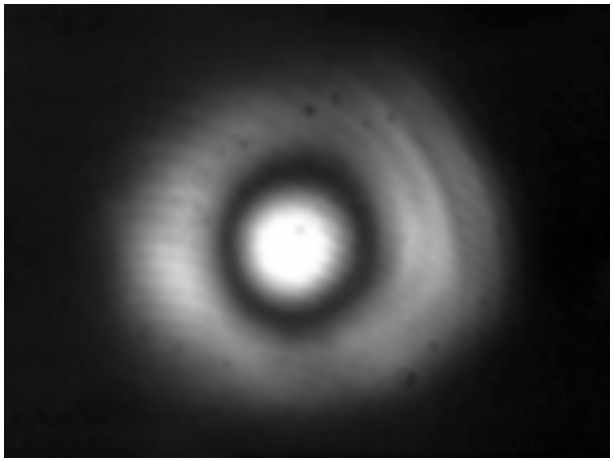
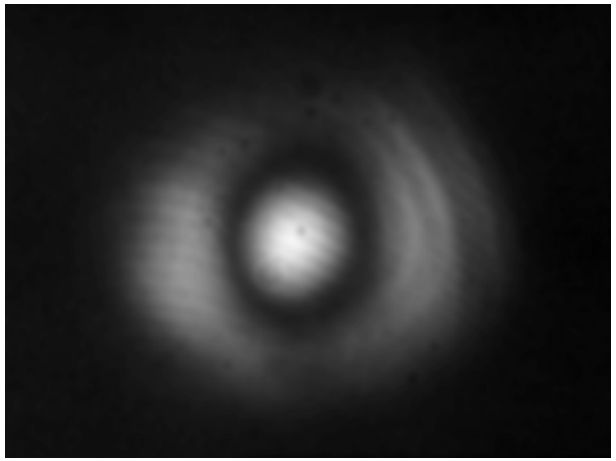
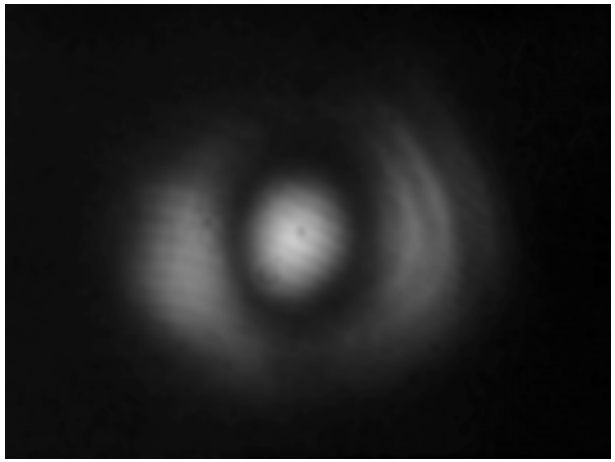
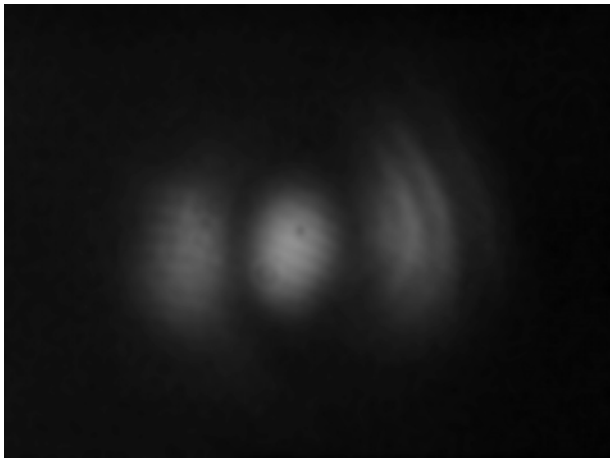


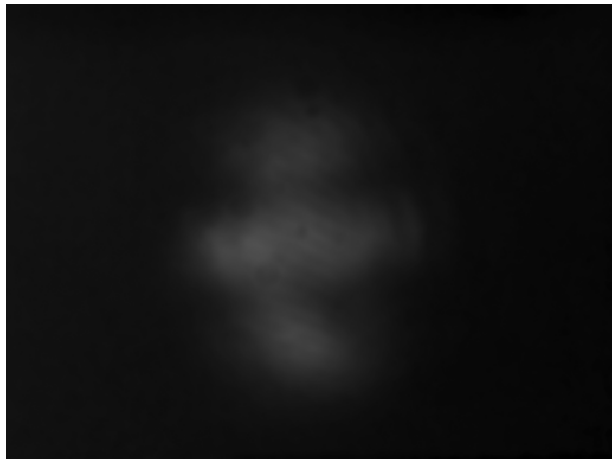


Thermal Compensation – Model

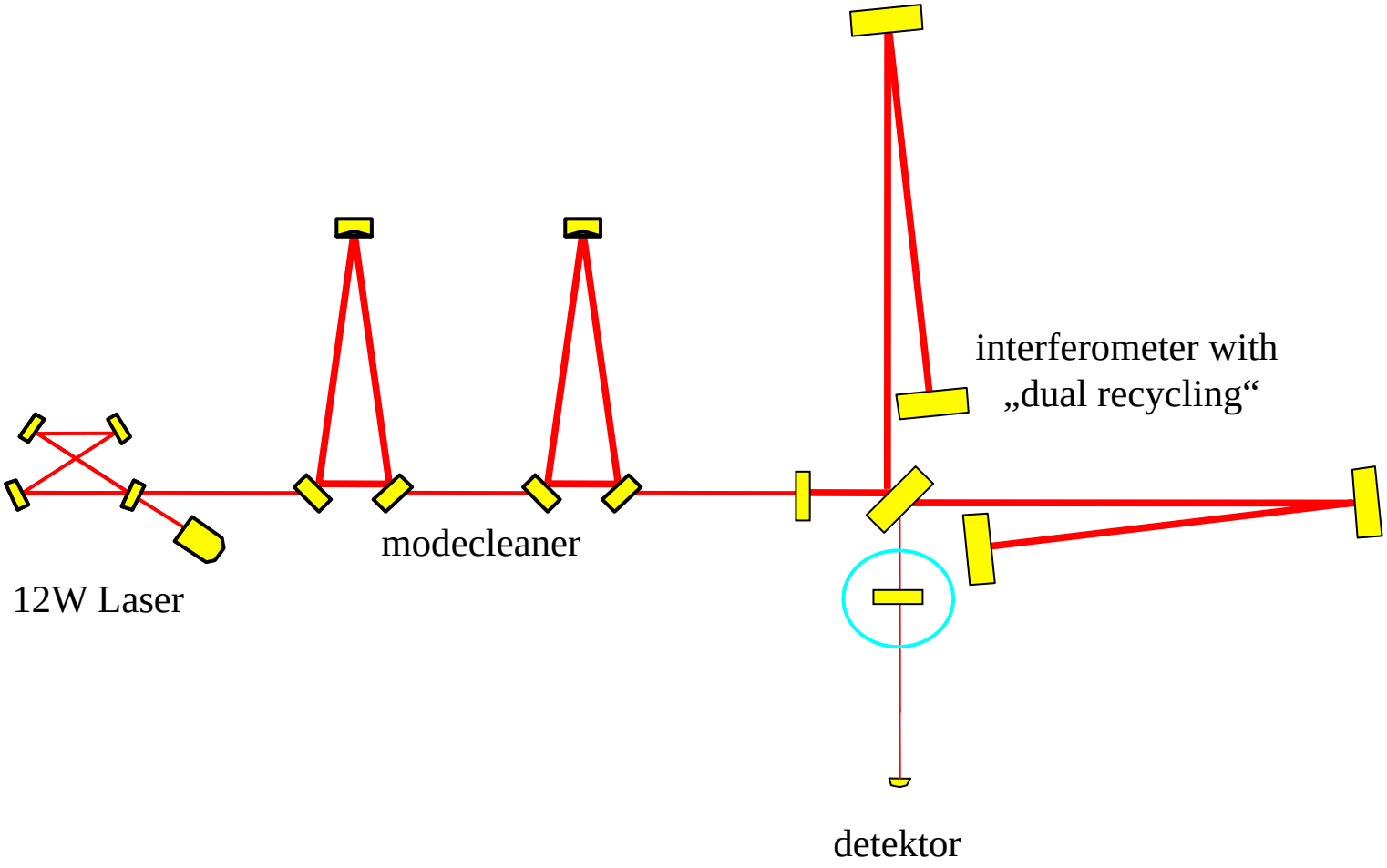


Thermal Compensation - Experiment

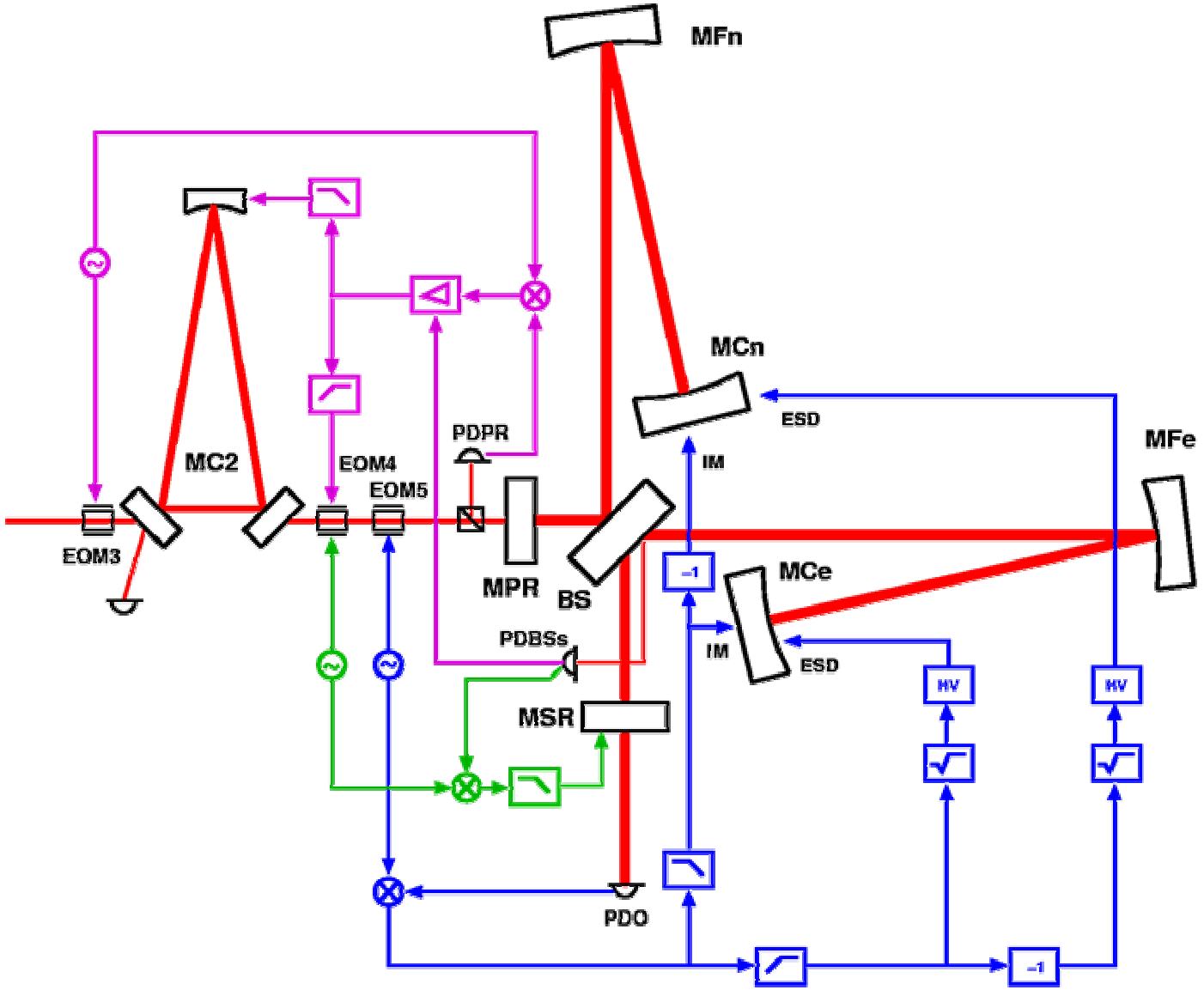







Mirror Installation Fall 2002



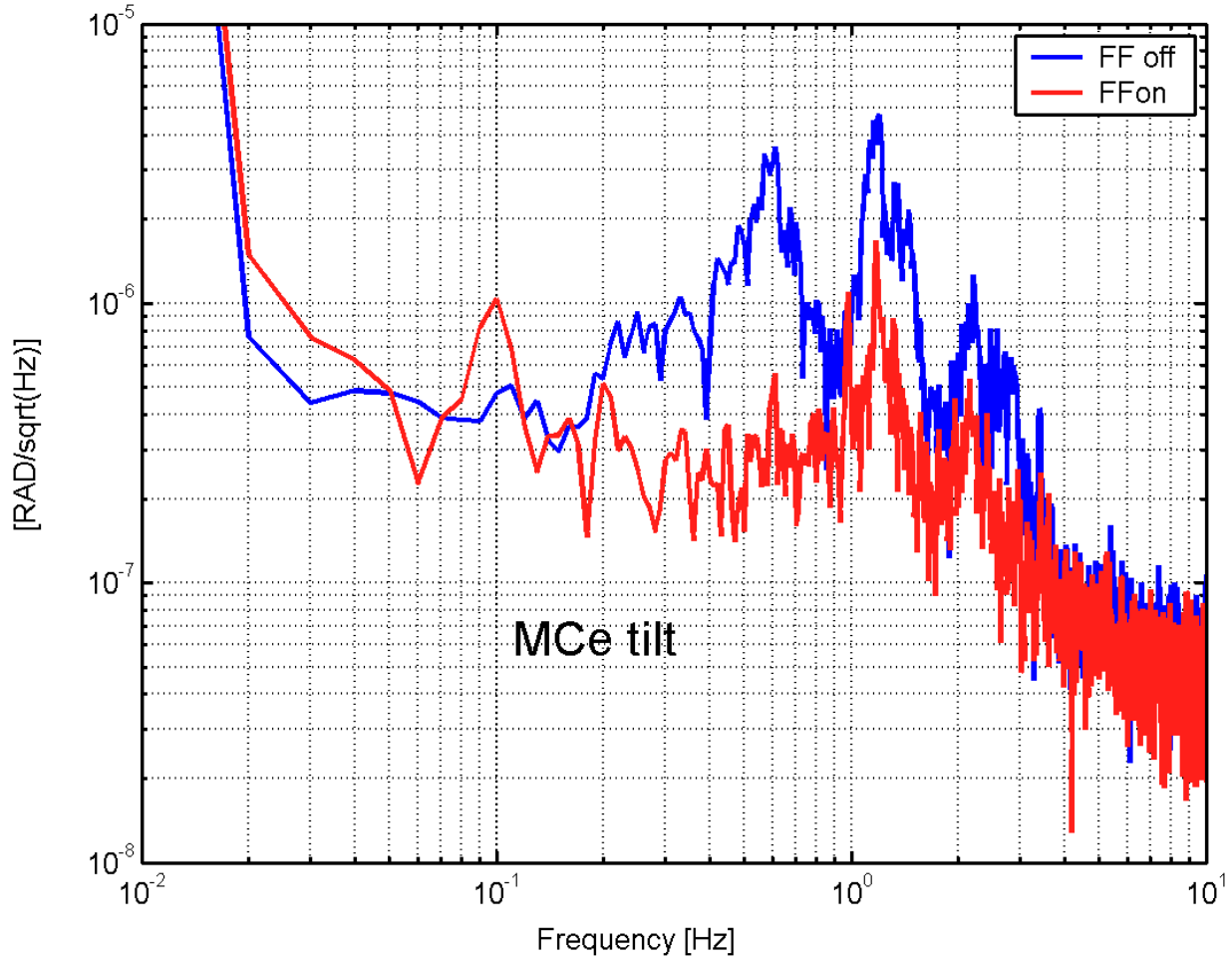
Dual Recycling Length Control

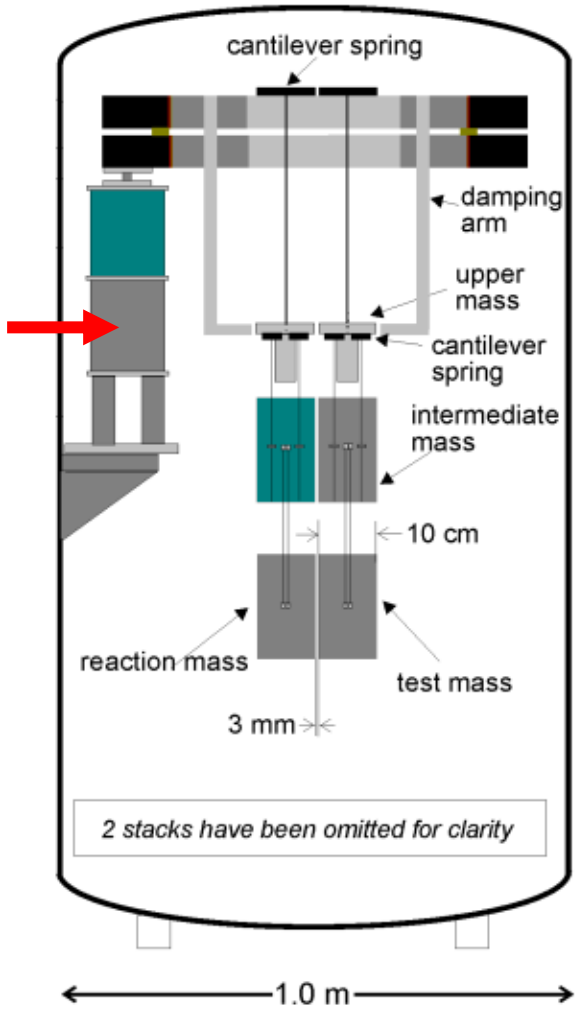


Problems with SR lock acquistion

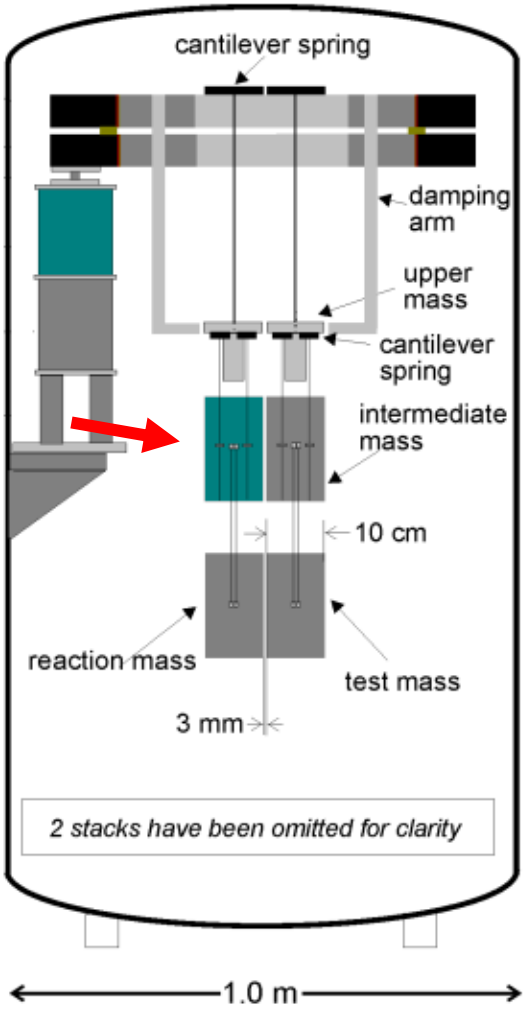
- PR and SR error signal vary strongly with MI tuning at final SR operation point
- first lock IFO in largely detuned state
- rare successful lock acquisitions
- only short lock durations due to large tilt motion of main mirrors
- traced problem back to longitudinal to tilt coupling of the main suspensions

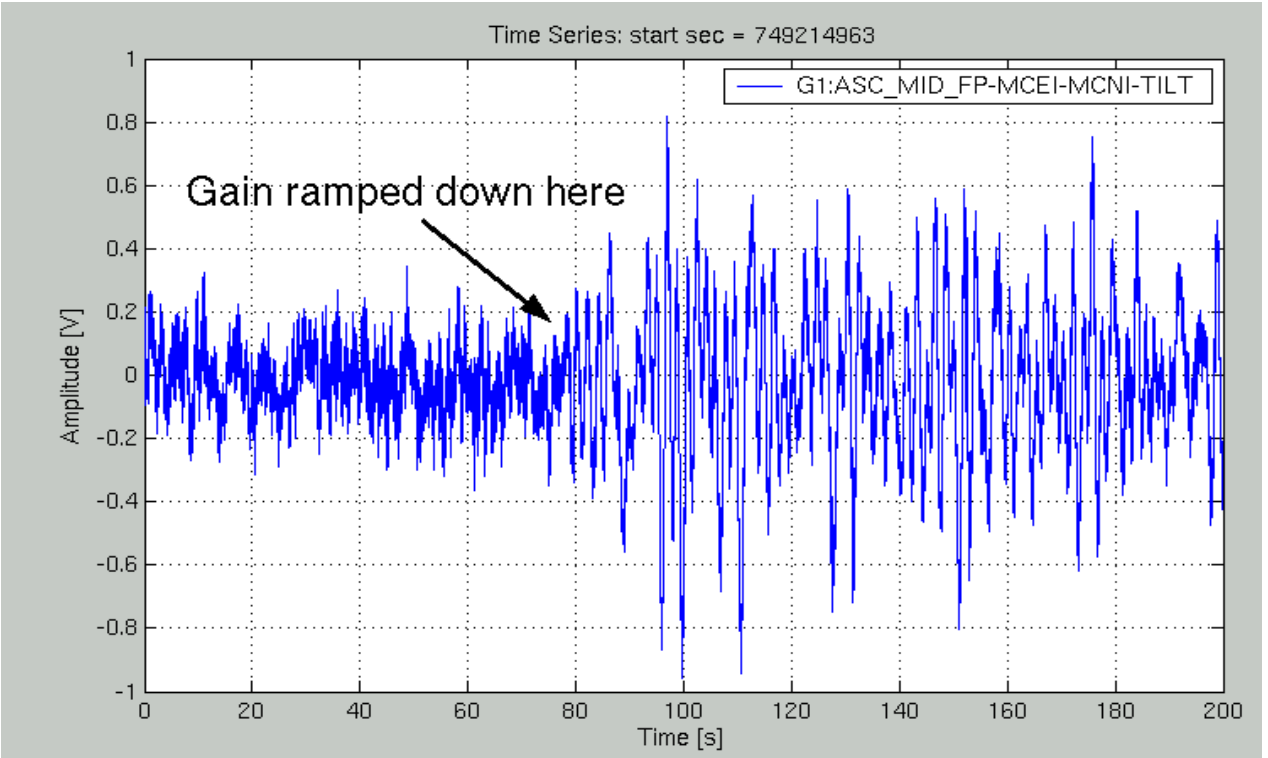
Feed-Forward Seismic Noise Reduction



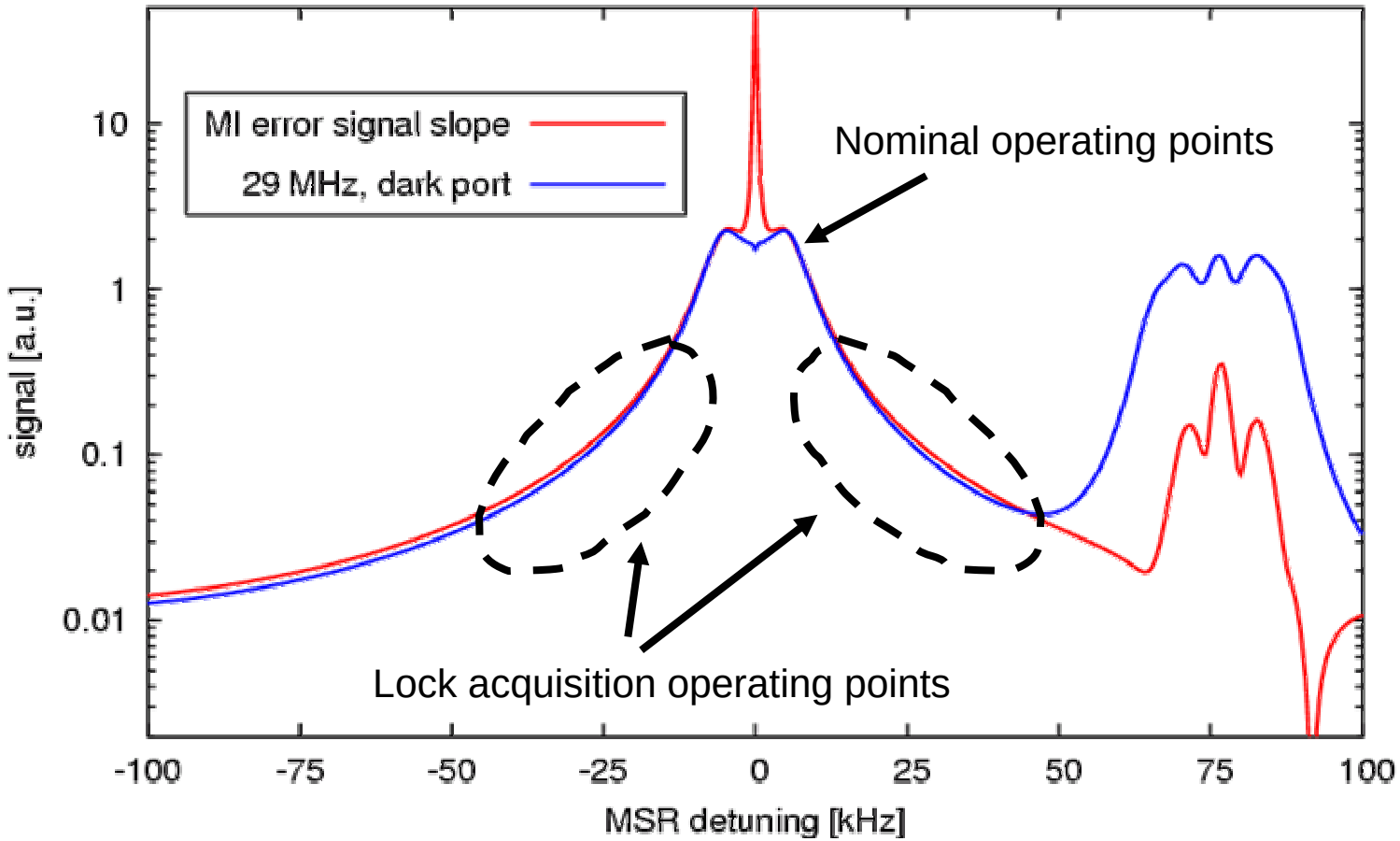


Reduction of Long.-Tilt Coupling

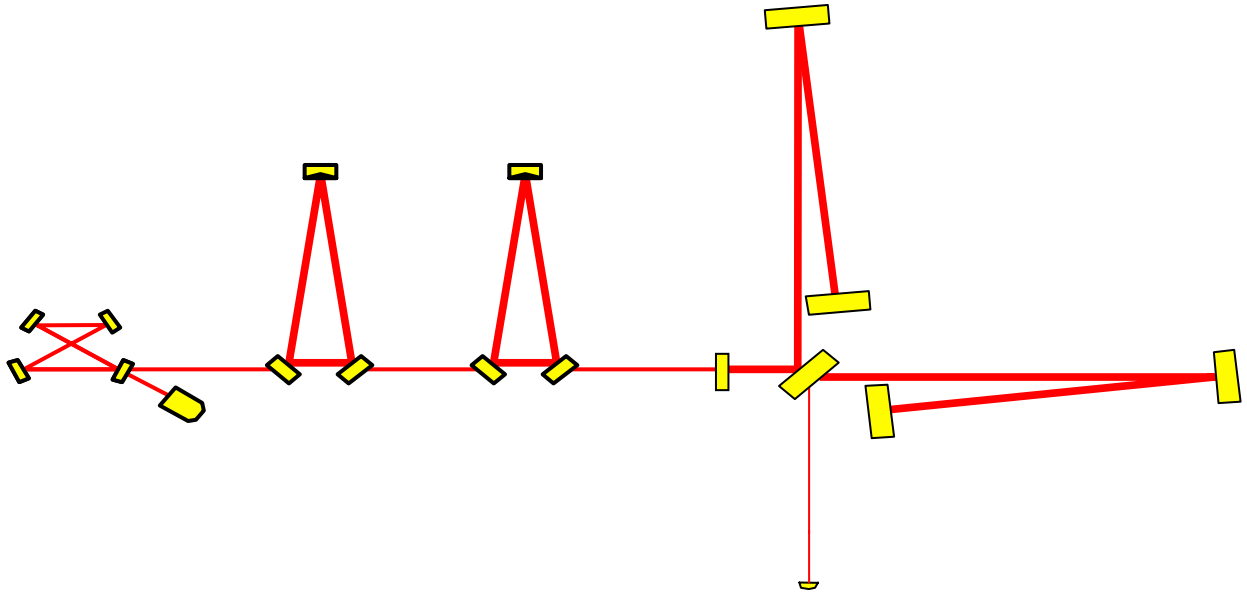




SR Pre-Lock and MI Gain Control

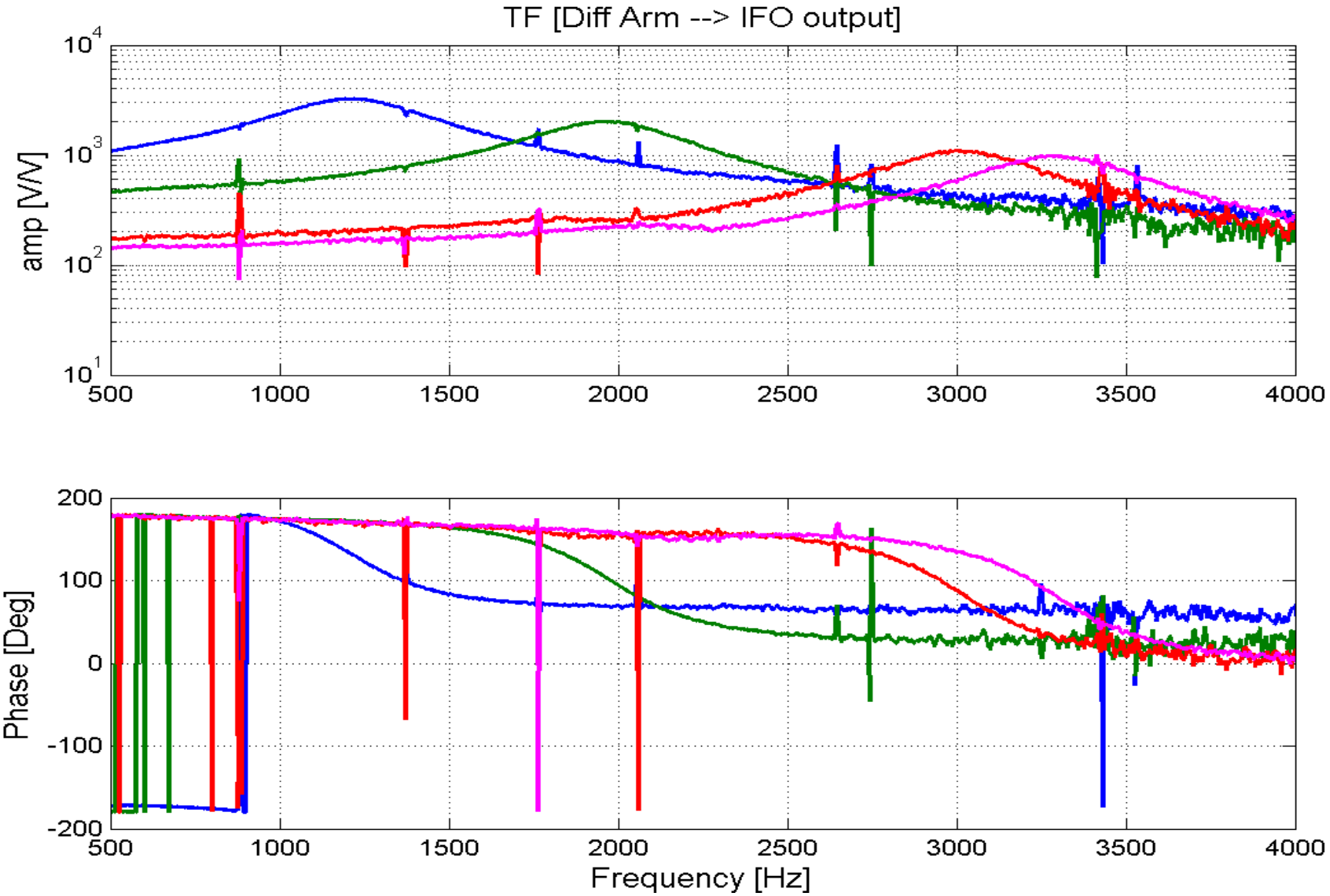


Dual Recycling Lock Acquisition

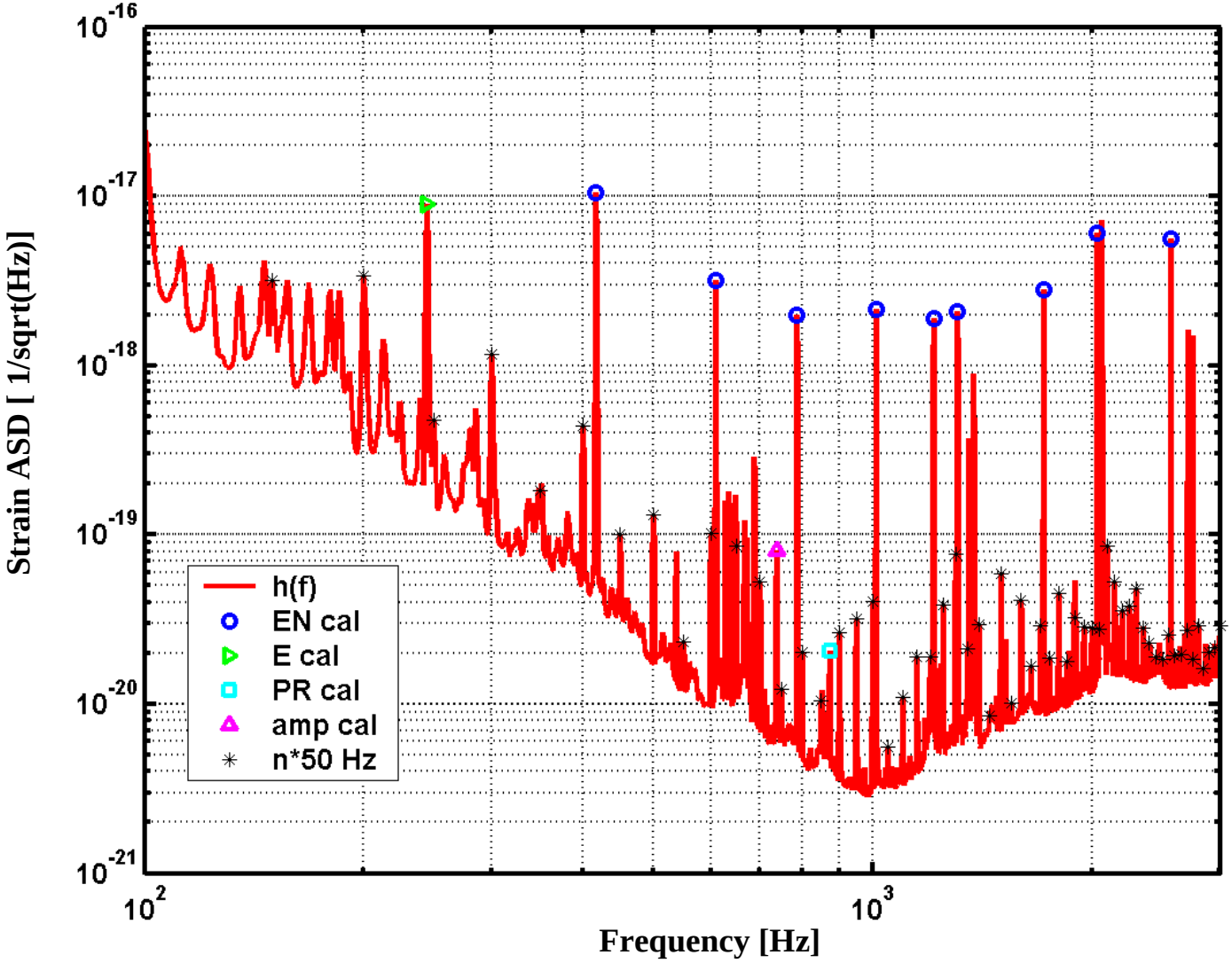


- lock PR length if MI is close to dark fringe
- lock MI and normalize MI gain to power in PR cavity
- lock SR to 2f signal in largely detuned state (where PR and MI lock is robust)
- switch on PR and MI fast automatic alignment
- start down tuning to operation point and switch to main SR error signal on zero crossing

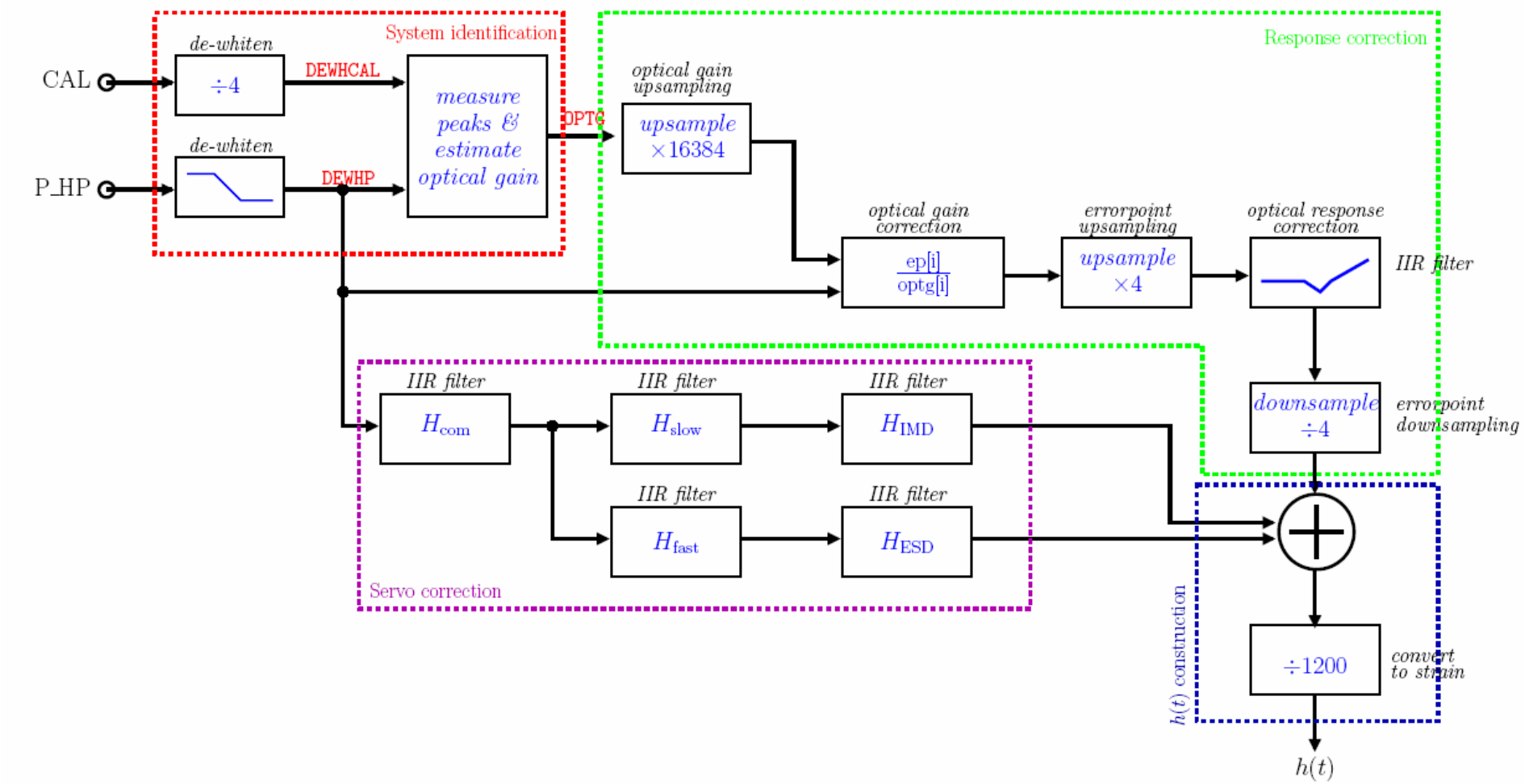
Tunable Optical Gain



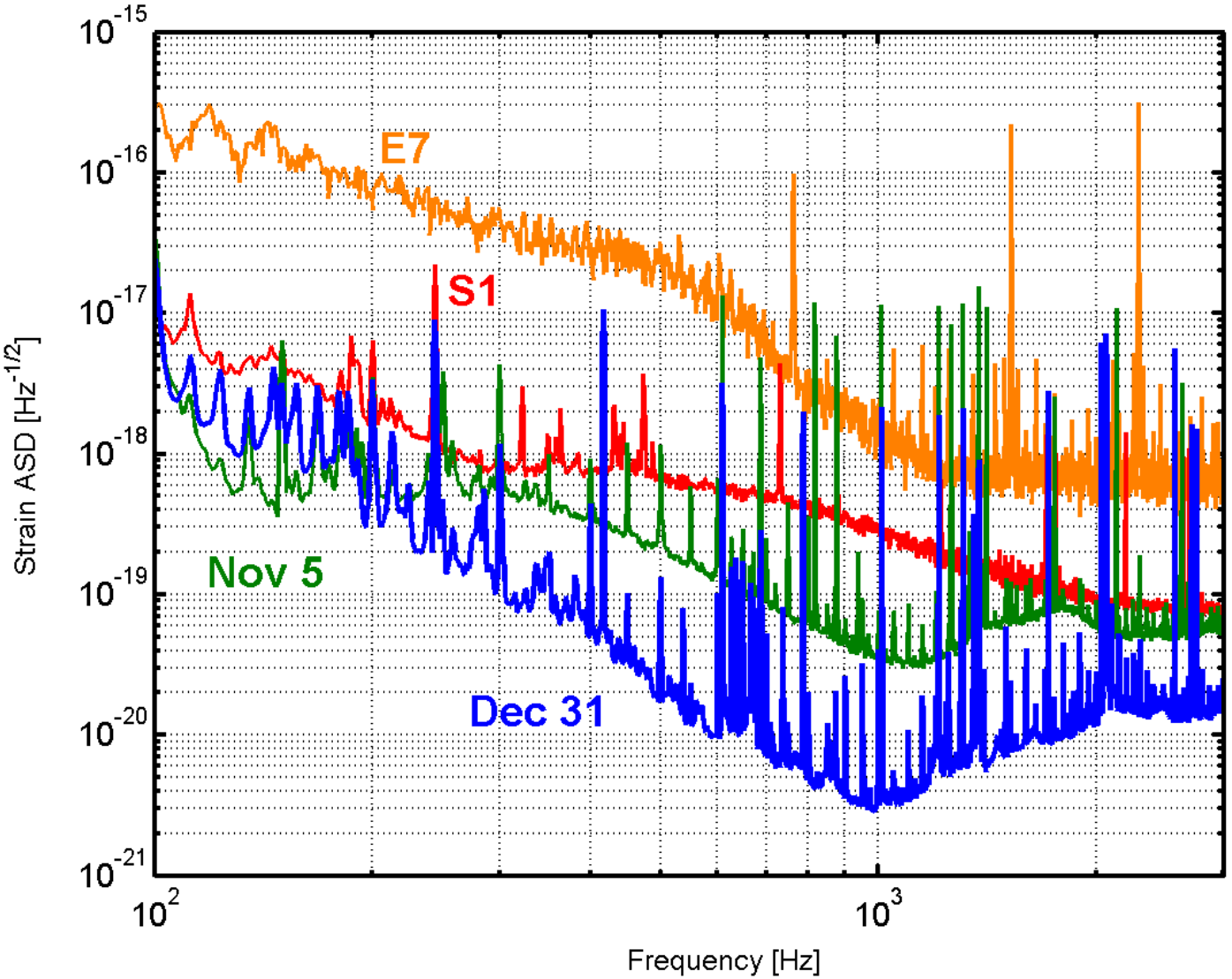
Calibration Peaks



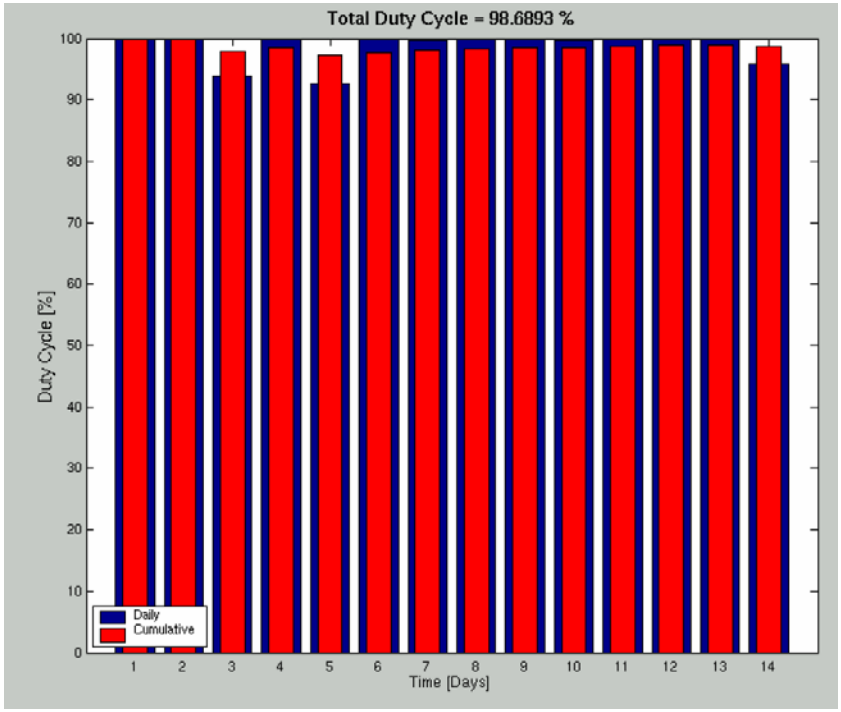
DR Michelson Calibration



Sensitivity Improvements



GEO600 - Participation in S3



S3 part I (7 days)
Nov 5th – Nov 12th

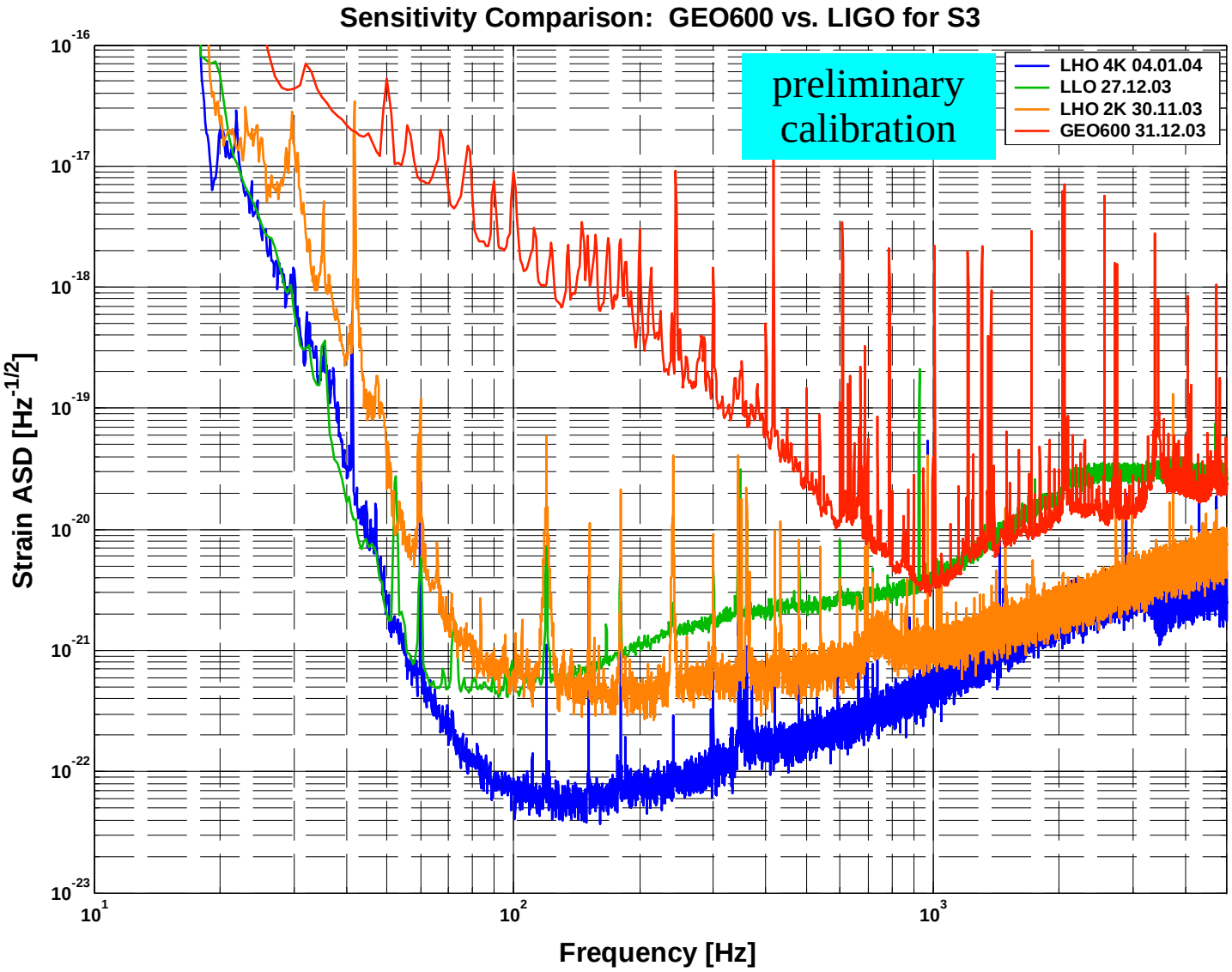
duty cycle > 95%
longest lock > 27h

S3 part II (14 days)
Dez 30th - Jan 13th

duty cycle > 98%
longest lock > 95h

followed by 2 days for burst and inspiral injections

LIGO – GEO Sensitivity During S3



Summary & Outlock

- GEO600 successfully demonstrated dual-recycling on large baseline detector including calibration
- sensitivity and duty cycle allow to make significant contribution to S3 analysis
- next steps:
  - increase injected power
  - improve noise models and increase sensitivity
  - keep detector in-lock with calibration lines present for as much time as possible

thanks to ….

and the Glasgow team