

# Status of GEO

Benno Willke

LSC meeting, Caltech, March 2008

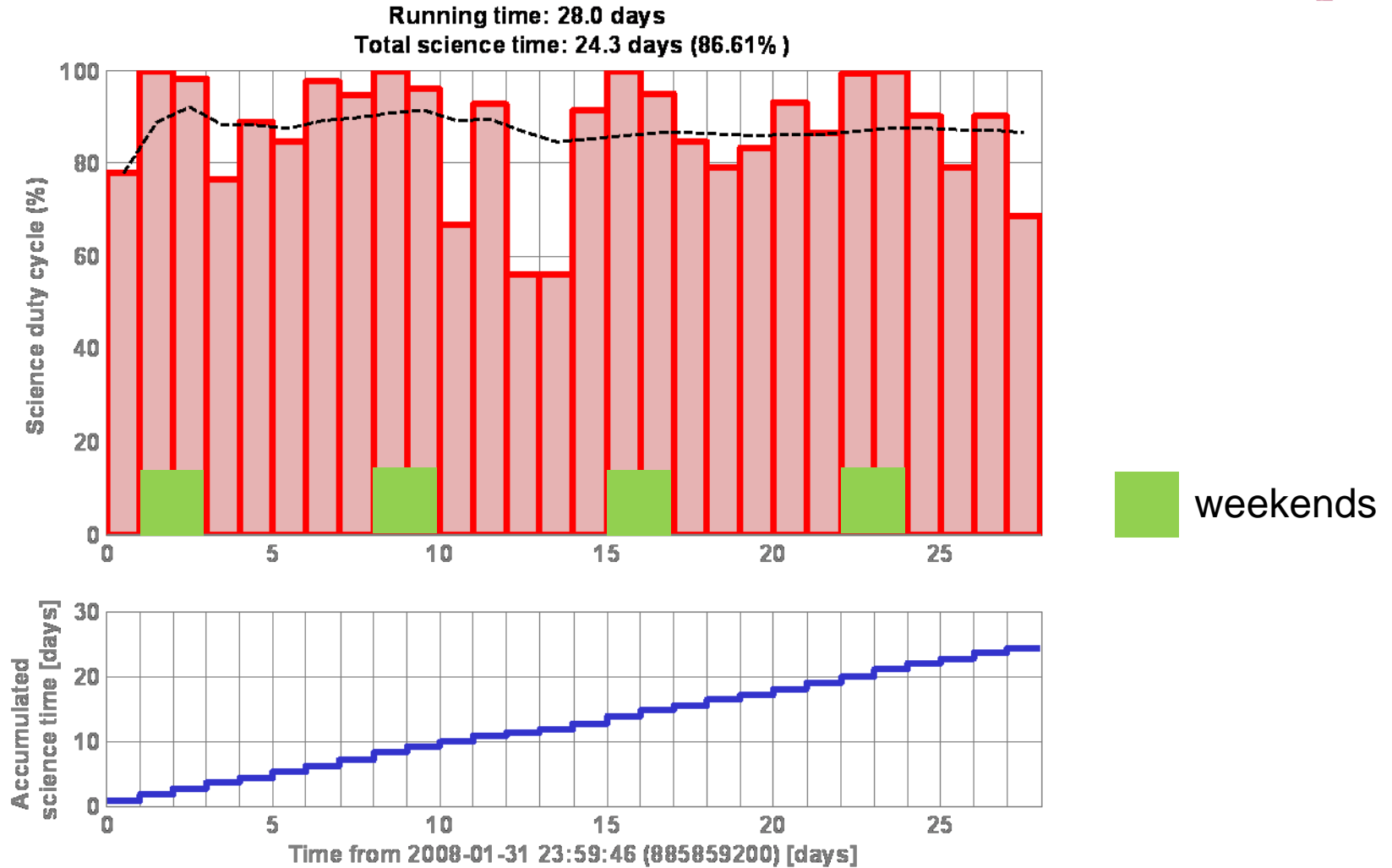
LIGO G080064-00-Z

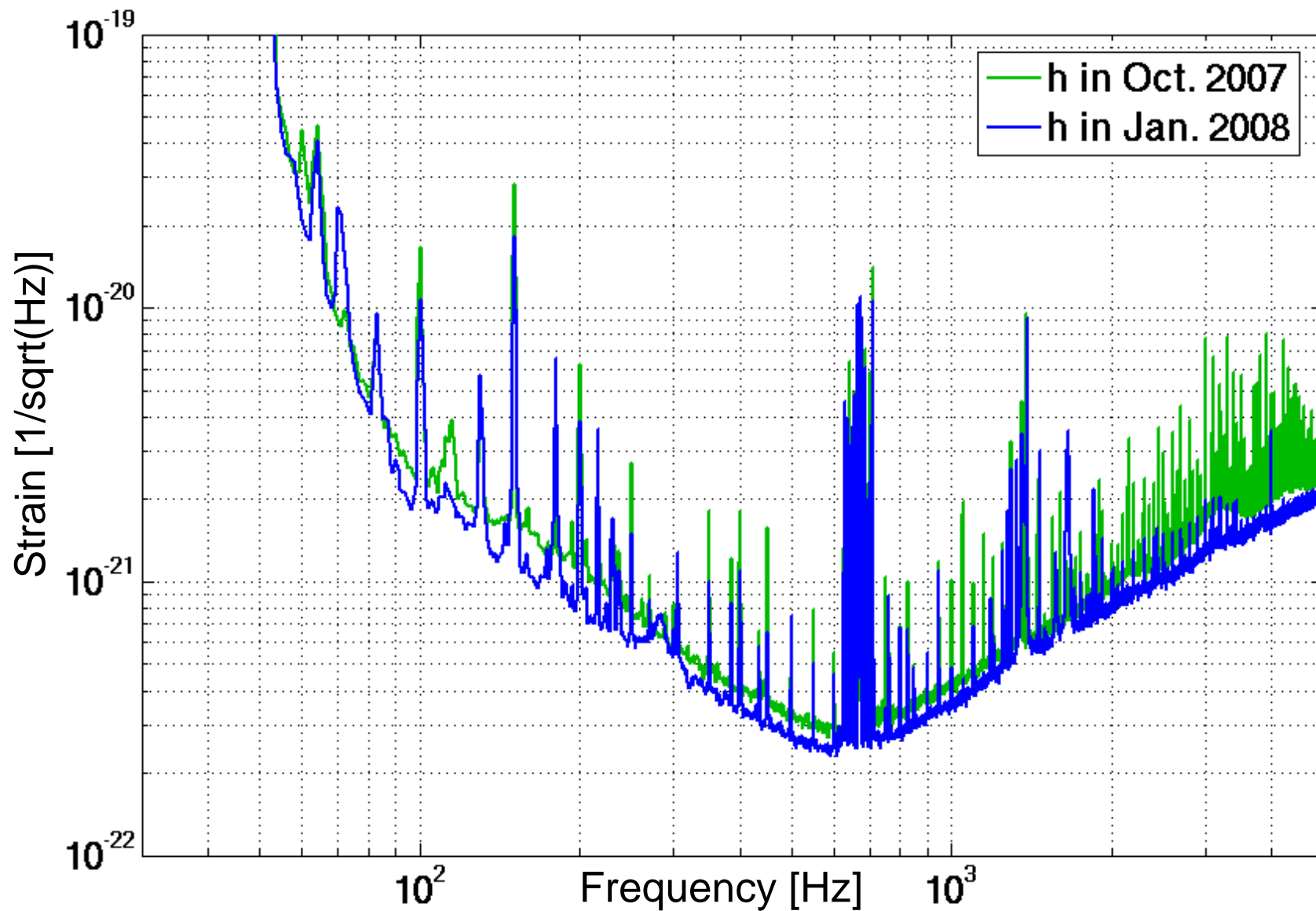




- since the start of the ELIGO installation GEO600 is in Astrowatch mode
- motivation: have at least one detector running in case of a trigger by non-GW detector
  - X-ray flare/faint GRB observed at 2008-01-09 13:32:49 UTC
- trade-off between *coverage* and *improvements* led to the policy:  
*“if duty cycle exceeds 80% some low risk experiments are allowed to improve sensitivity and to reduce glitch rate”*
- duty cycle
  - November: 81.1%
  - December: 81.5%
  - January: 89.1%
  - February: 87.3%

total: 84.7%

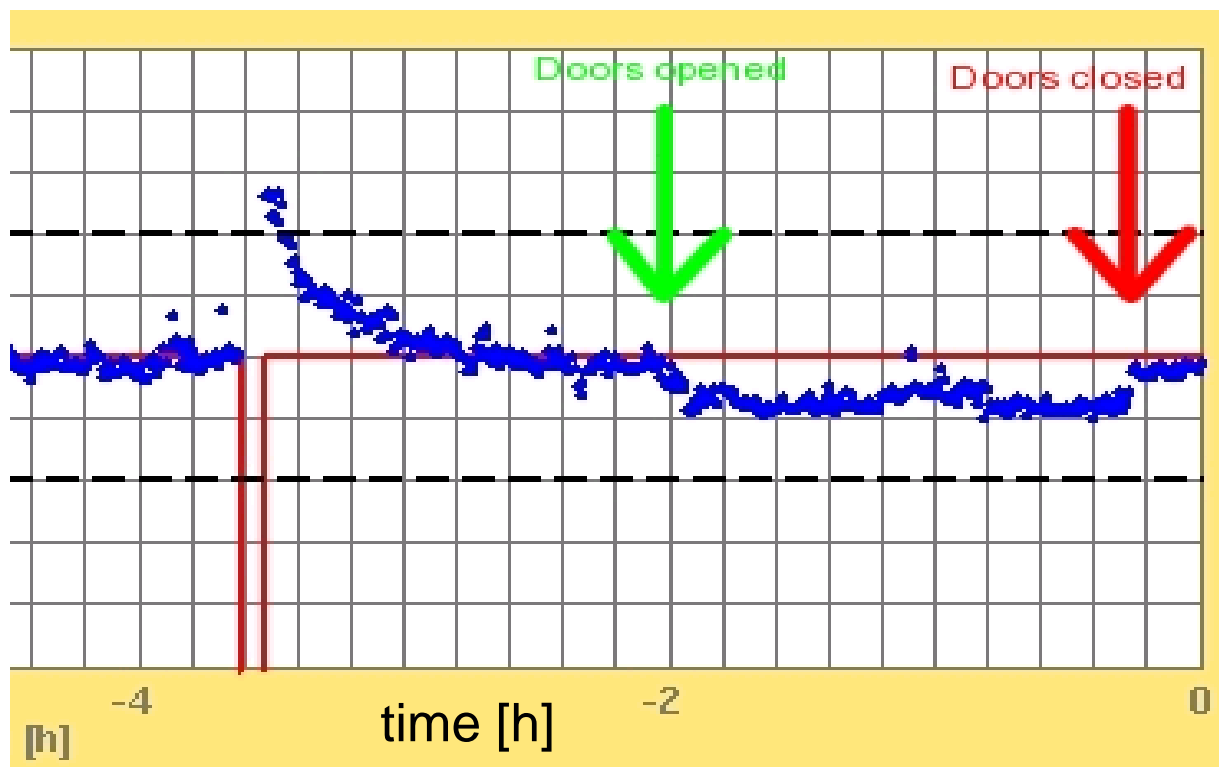


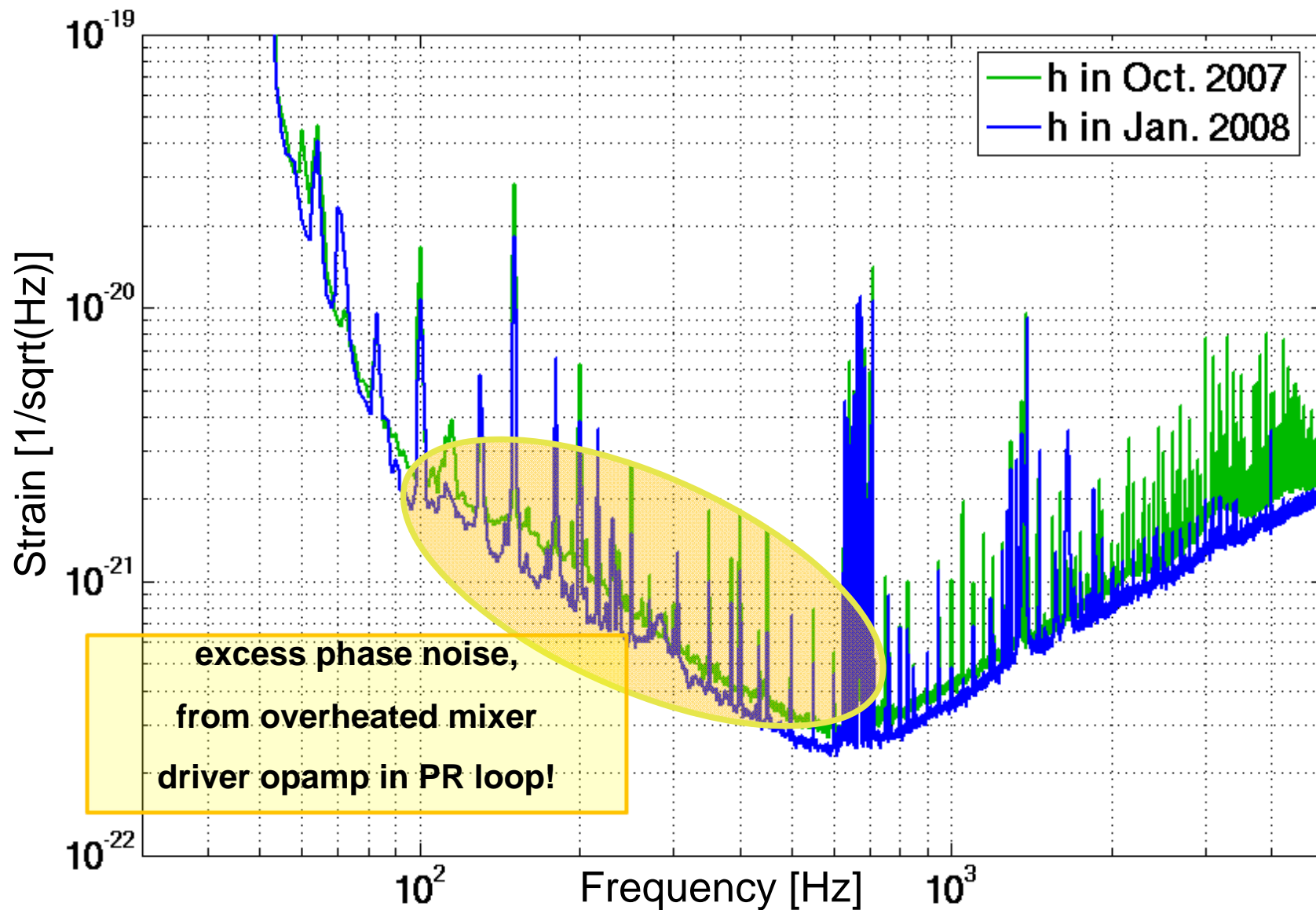




open/close electronic rack door

some bandlimited Irms of h

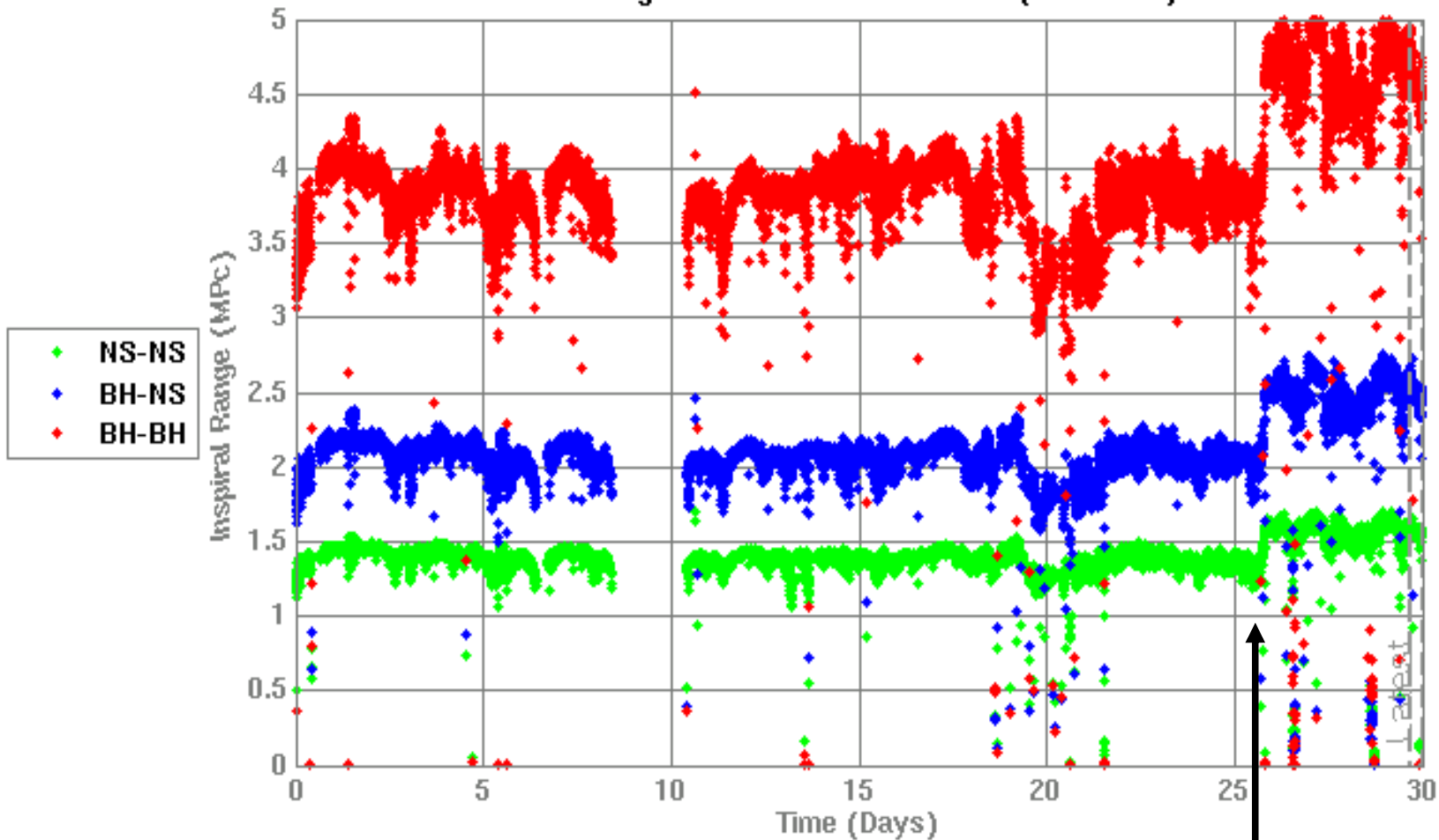


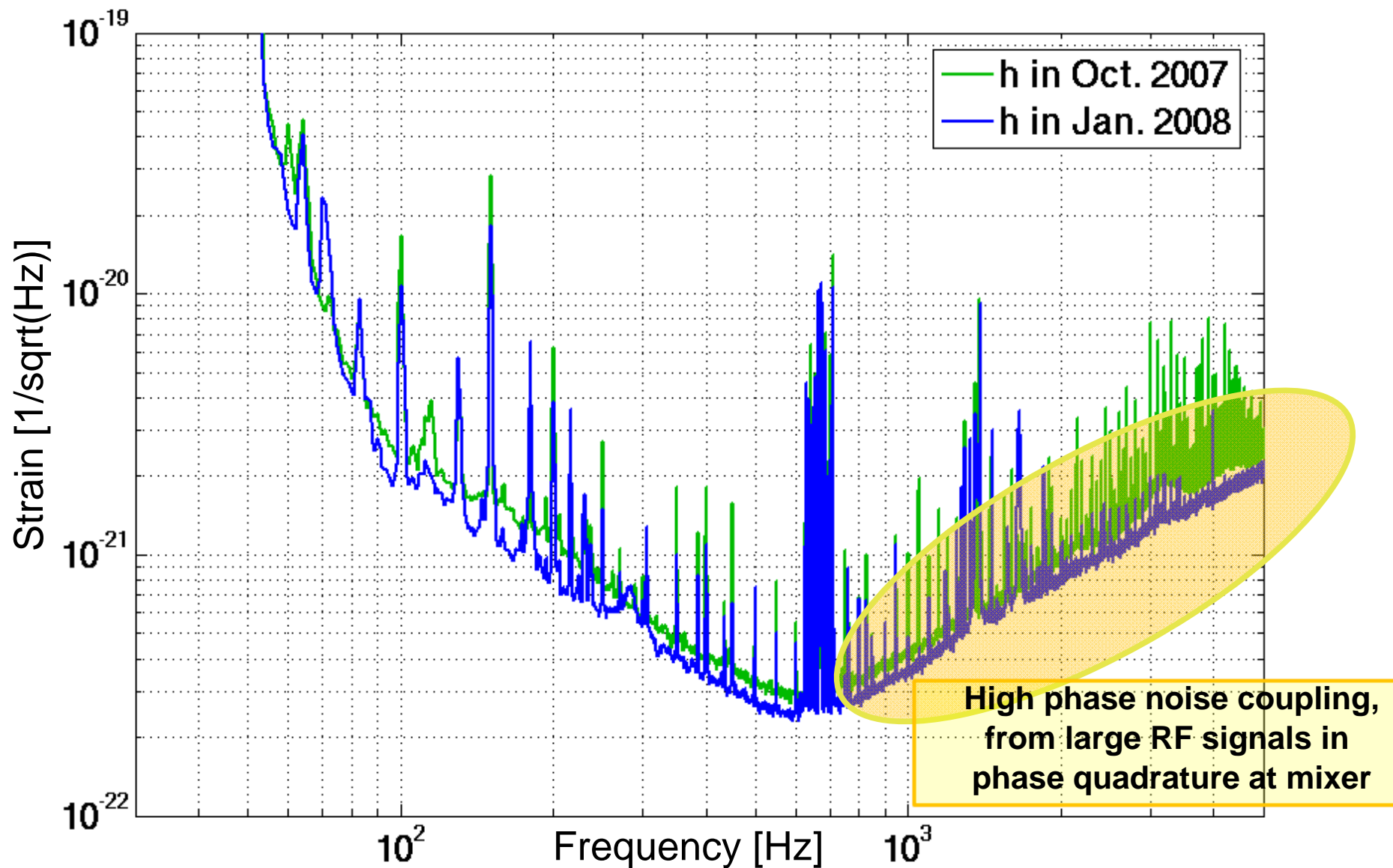


# Inspiral range increase...



Time origin from 2007-10-31 22:59:46 (877906800)

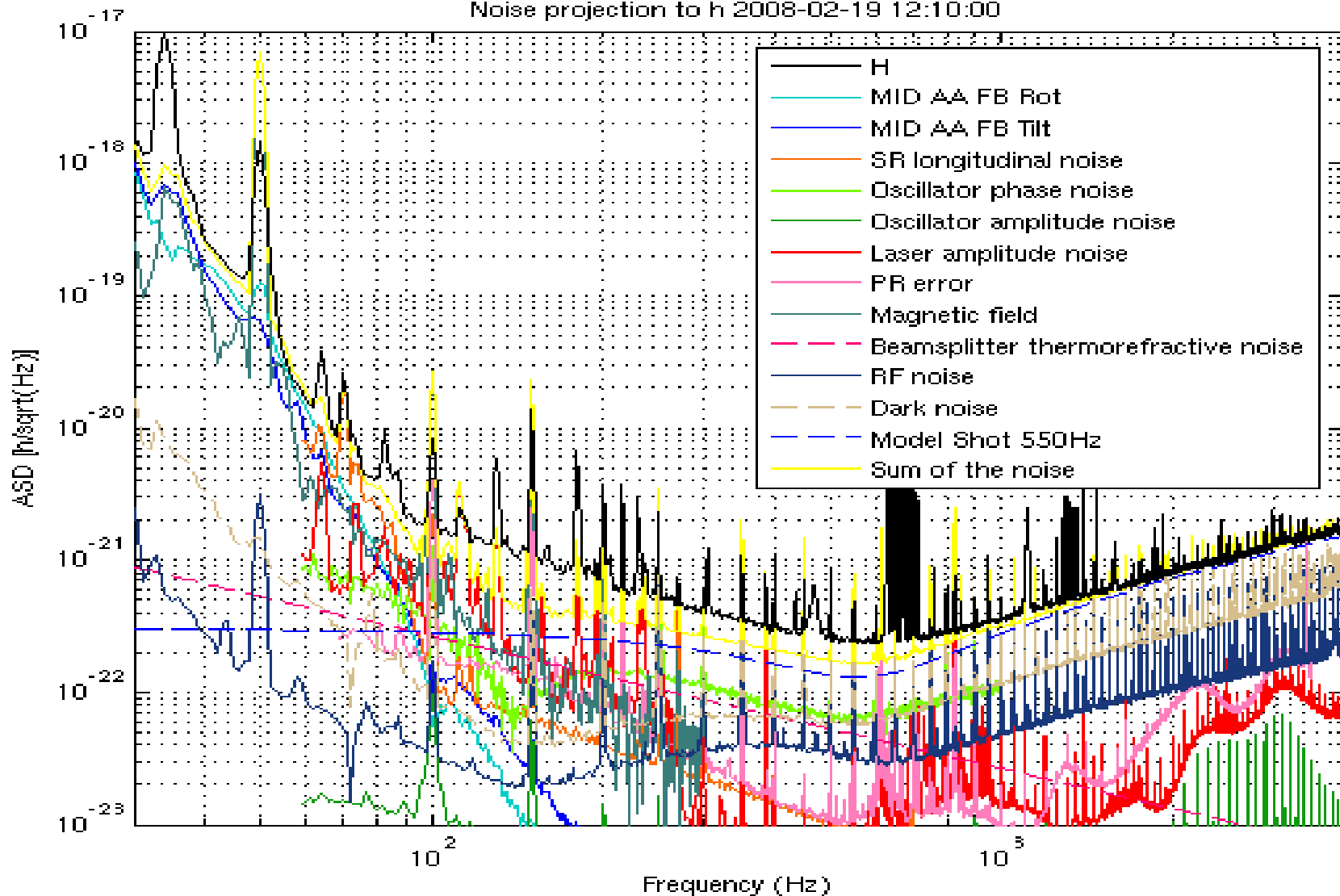


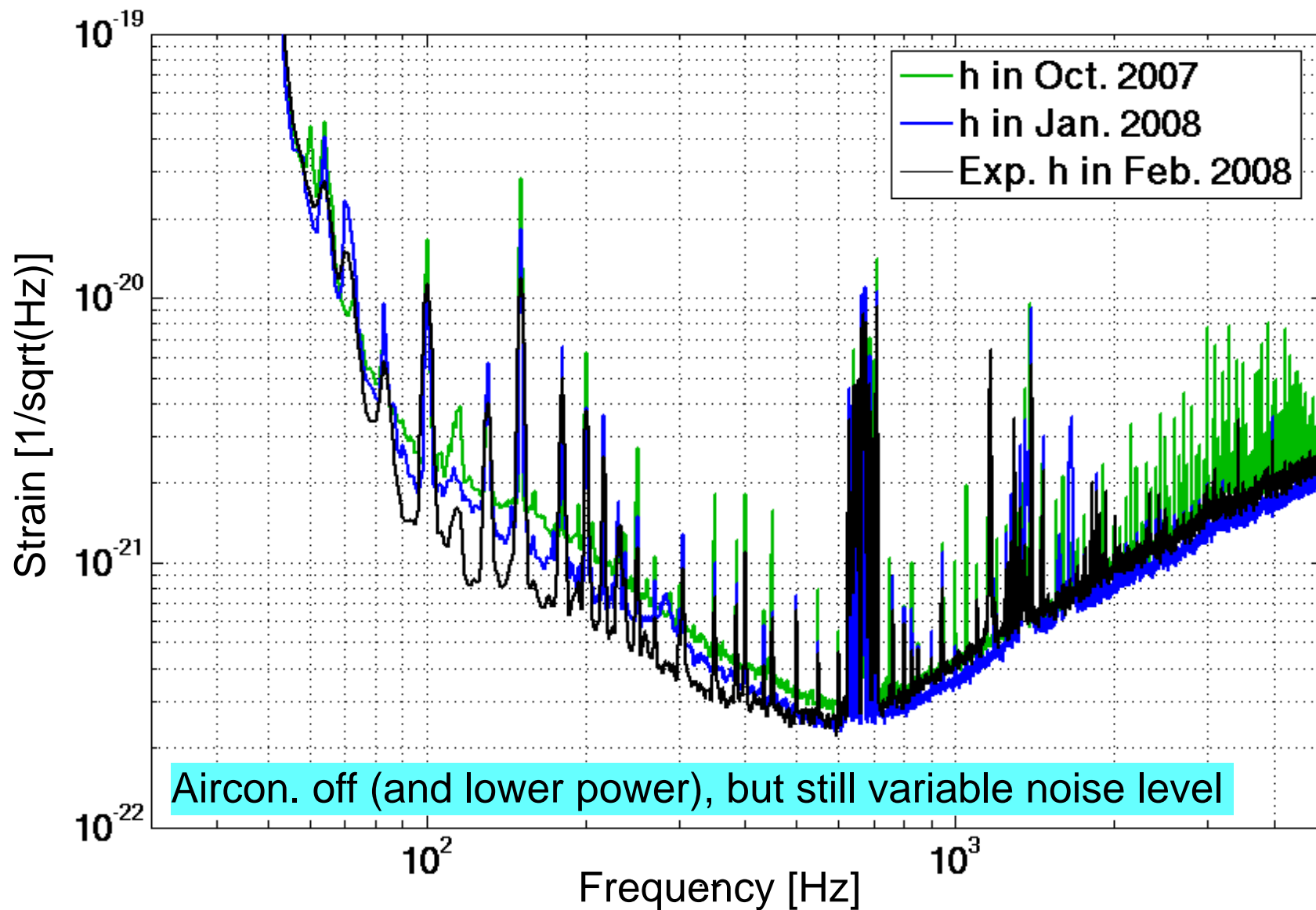






Noise projection to h 2008-02-19 12:10:00

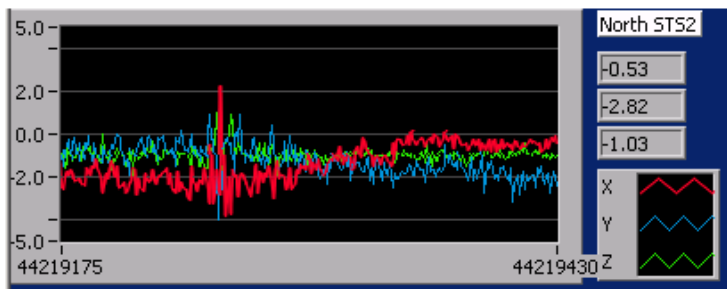






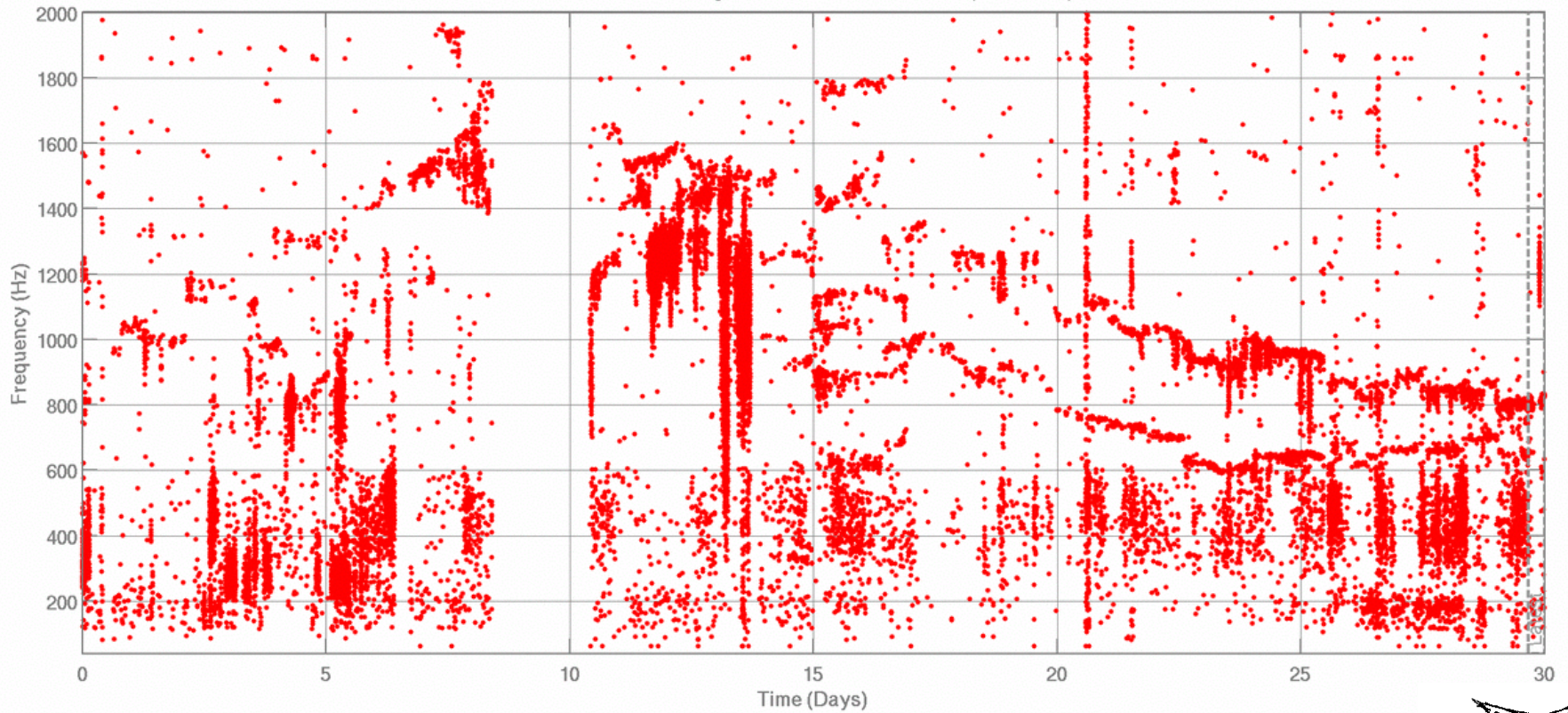
sheep at the northbuilding

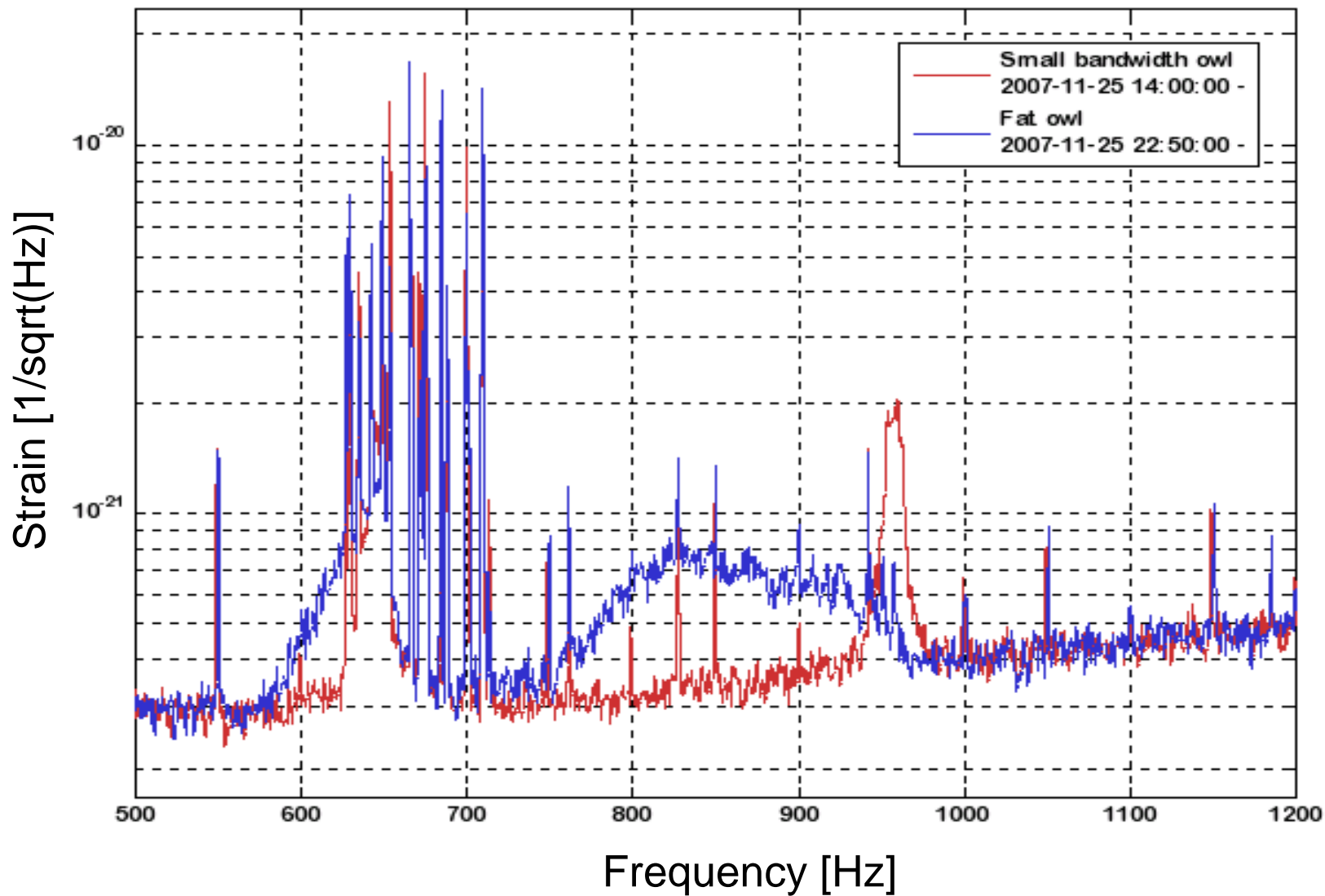
2008-01-09 CET 1





HACR H: Time origin from 2007-10-31 22:59:46 (877906800)







## RF world:

- 3154 Measurement of environmental RF in the controlroom (SR, MI, PR)
- 3333  Exchanged Wenzel oscillator
- 3338 Checked in MI RF forward power
- 3344 Injecting RF to Q compensation to check dark noise
- 3393  MU3 rotation
- 3442 looking at reflected RF

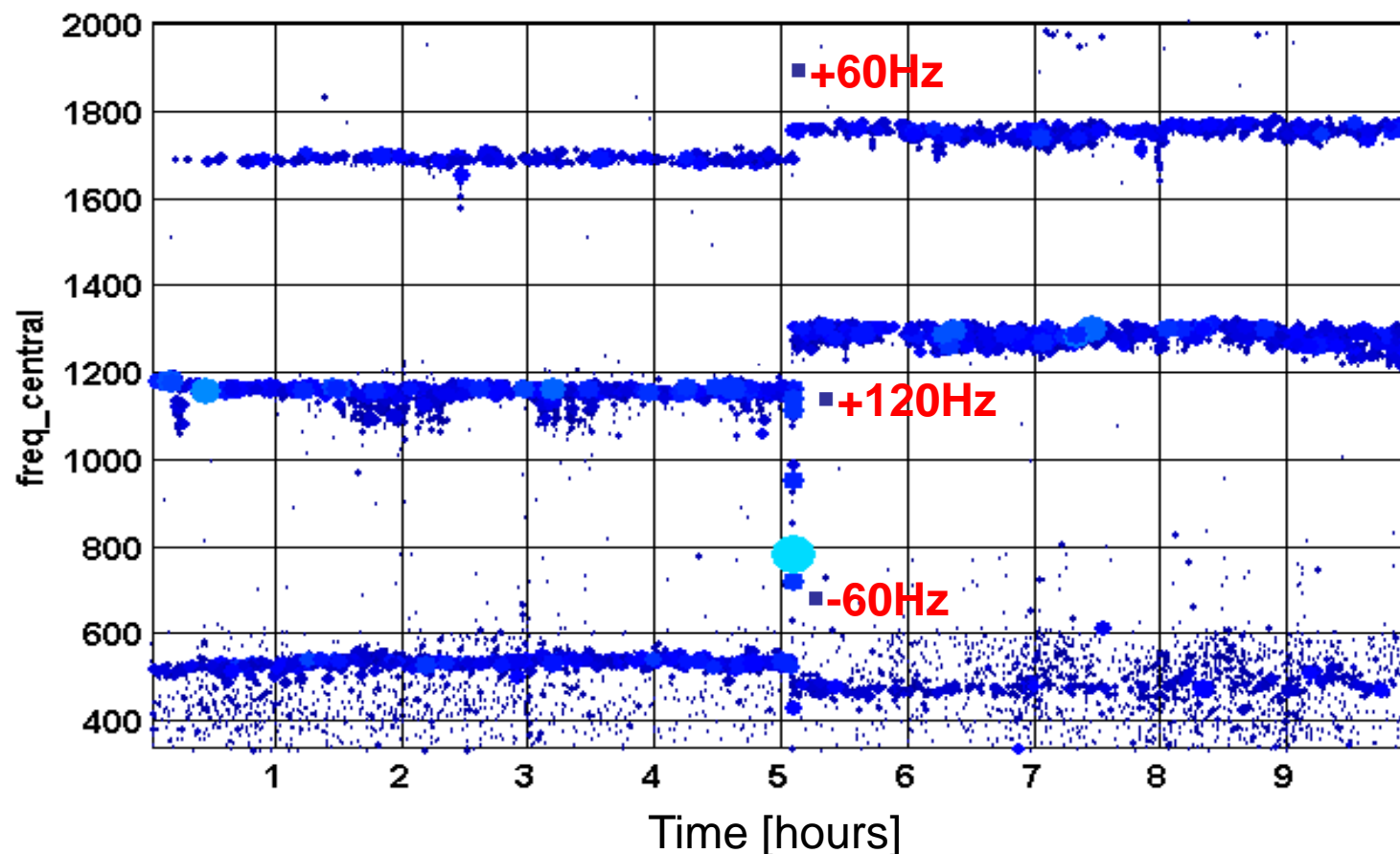
## PR loop:

- 3338 Changing PR RF modulation by 500 Hz
- 3349 Changed master laser pump current
- 3417  Changed long gain of PR, MC1 and MC2
- 3417  Switching off PR scanners
- 3434 Blocked PR AA path.

## Other observations:

- 3341  Owl sometimes changes frequency with a period of 0.558 Hz
- 3346  Observation of 2nd and 3rd order owl
- 3350 Sawtooth
- 3353 MPR misalignment influences the strength
- 3389 Shifting spot on bdipr seems not have influence
- 3359  Owl doesn't see optical transfer function (owl not h like)
- 3421  Owl is h like
- 3391  heater experiment to check for higher order modes
- 3393  SR tuning 100 Hz up
- 3396  Owl sometimes jumps
- 3415  MI scanner off
- 3415  Pstab loops off
- 3419  change alignment of MFE, MFN, BS and BDO1
- 3419  SQRT circuits in/out
- 3477  lowering bias for ESD, switching press. sensors off in central bldg.
- 3570  switching of pressure sensors in the middle of the tubes.
- 3570  owl was excited by doing a single MCE handy click in rotation
- 3571  owl changes frequency and amplitude with various alignments
- 3575 Owl's frequency depends on MPR alignment, but not on alignment on MCE, MCN, MFN, MFE or the output beam.
- 3578 Blocked PR\_AA path and disconnected both PR scanners. no influence.
- 3580  Owl's frequency depends on MPR alignment but not on BDIPR alignment.
- 3590  Change PRC gain. no influence.
- 3590  Owl's frequency depends on MPR rot alignment, but not on tilt.
- 3593  Spot position on BDIPR changes owl's frequency.
- 3602 Turning fibre attenuator.
- 3602 Tried to excite owl by driving the fibre attenuator with 800 Hz no influence.
- 3602 Turned lambda plate and increased input power, no influence.
- 3591, 3596, 3597, 3612 locking for owl at higher frequency. No clear influence.
- 3719  OWL stuff
- 3768  Owl flying low
- 3955  Owl again?
- 4566  Owl vetoed by nullstream?
- 4568  some (owlish) thoughts
- 4894  owl is h-like

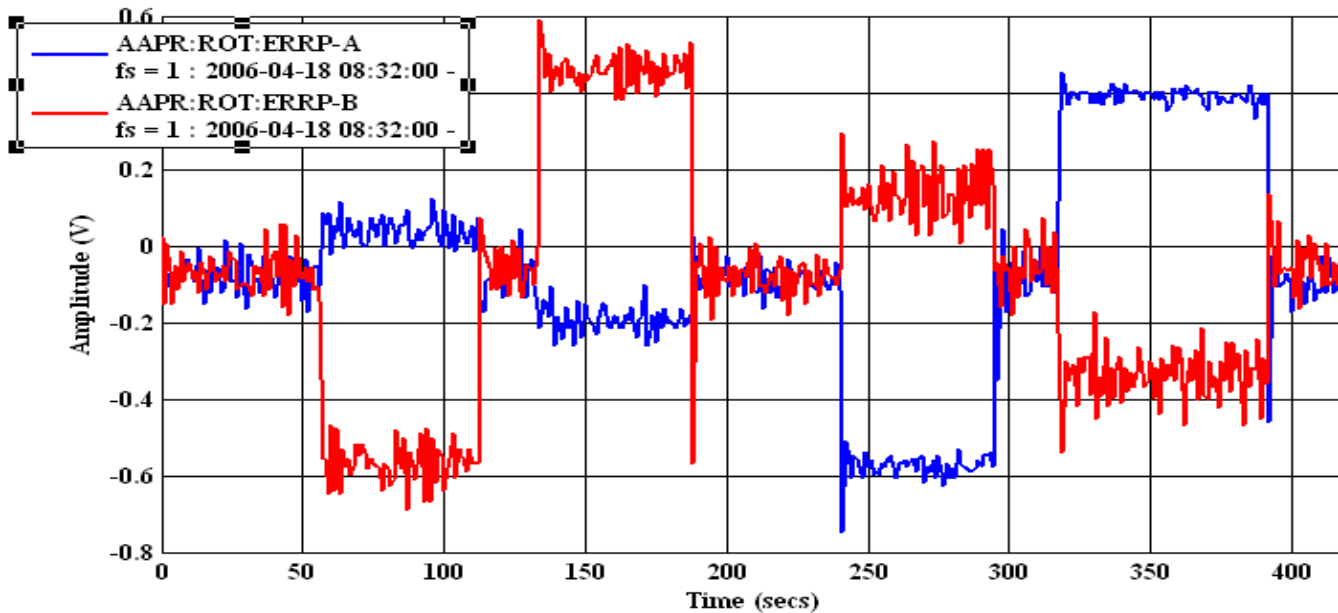




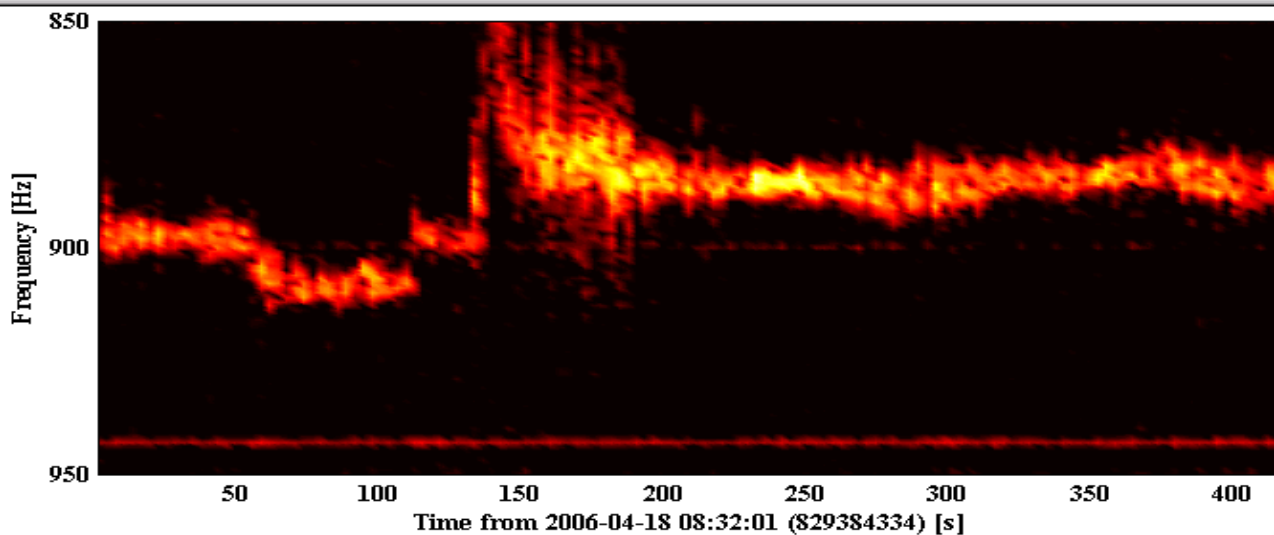
Next step is to check hour trend data...

- looked at all (47) signals that contain the 'offset' and 'rot'. Nothing suspicious at the corresponding time.
- looked at all signals containing 'offset' and 'tilt'. => no result
- looked at all signals containing 'offset' and 'long'. => no result
- looked at all PEM channels (seismic, acoustic, magnetic, temperature). => nothing suspicious
- looked at trend data of all fast channels => nothing
- looked at all flag data (138 channels)

# Only known influence on owl yet:



Beam position  
in central cluster





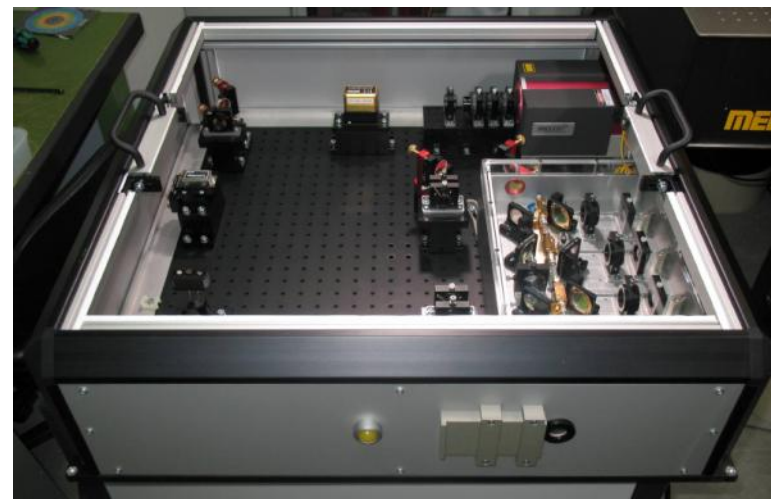
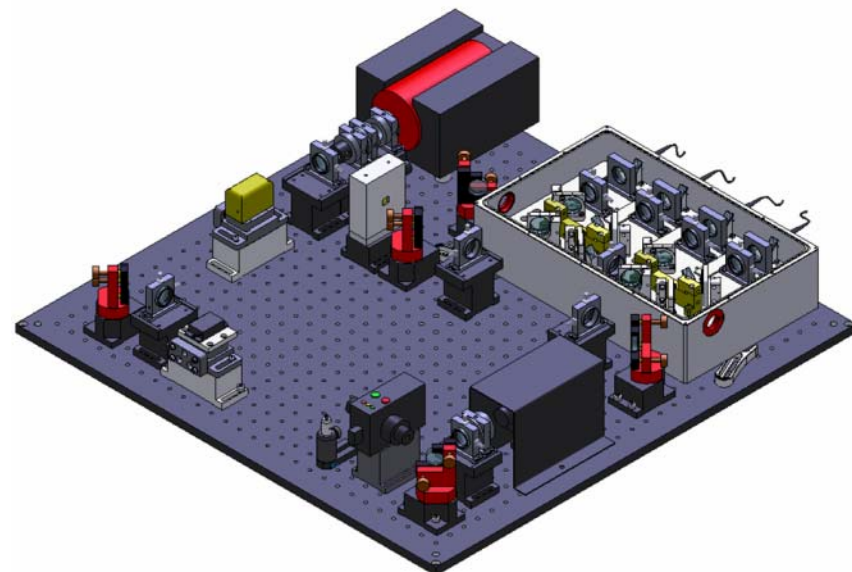


- continue astrowatch and low-level commissioning until S6 starts (early 2009)
  - Continue noise investigations
  - Acoustic isolation of detection bench
- preparation of squeezed light injection into dark port
  - (DC-tuned) DC readout,
  - investigate OMC solution
  - rearrange/improve MI wavefront sensors



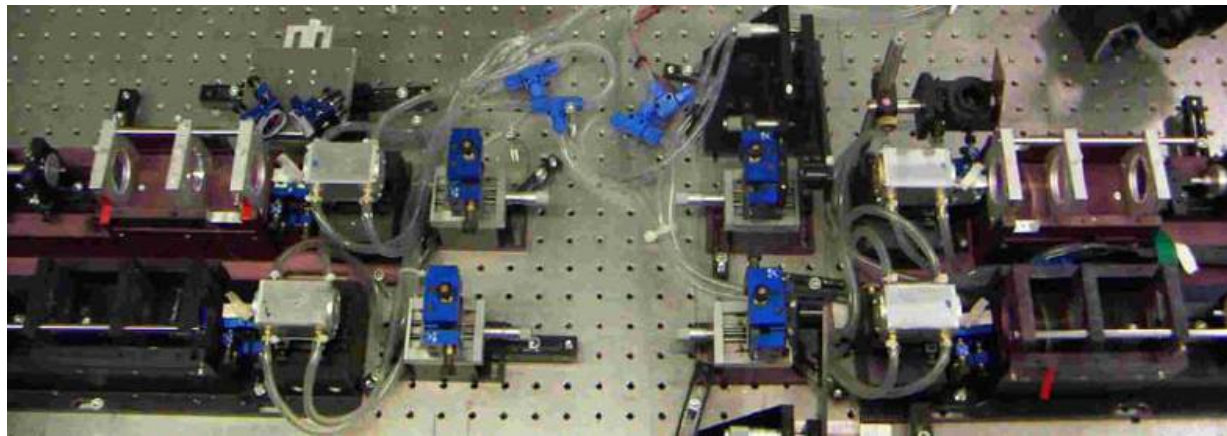


- changed front end design from oscillator to amplifier (power 35W, suitable for ELIGO)
- found additional resources to finance this design change
- found additional manpower to speed up development and fabrication
- delivered prototype to Caltech in June 2007
- first observatory laser arrived at LHO in January, installation next week
- second observatory laser ready for shipment to LLO
- successful integration test of laser controls with EPICS environment at AEI





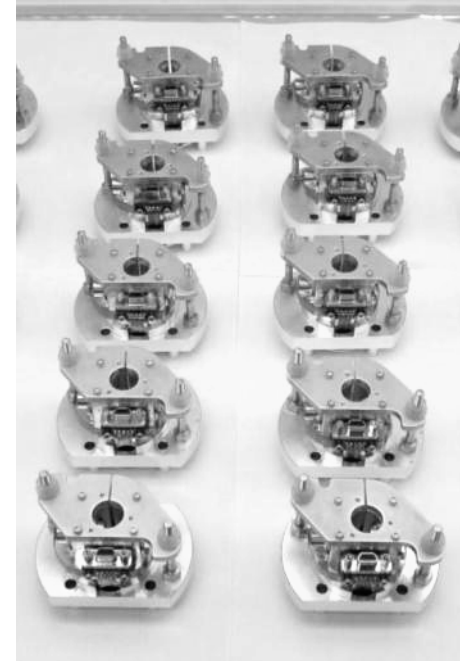
- continue 180W laser development at LZH
  - ongoing problems with component damage due to dust
- integrated PSL test at AEI
  - long term test of 35W reference laser and of a 2W NPRO
  - continuous operation of AdvLIGO type PMC at relevant power level
  - locked 35W laser to LIGO type reference cavity using the Advanced LIGO RTLinux/Epics environment
  - power stabilization experiment
- talks in instrumental plenary session and LaserWG





## Birmingham-OSEMs:

- 50 Advanced LIGO B-OSEMs delivered to date
- Installed in LASTI Quad, OMC and tip-tilt stages



## Control Electronics:

- Noise Prototype coil drive electronics & satellite boxes delivered to Caltech for inspection and testing
- to be installed at LASTI in early April

**more updates on suspension and thermal noise work in instrumental plenary talks and suspension WG parallel session**



## prototype strategy

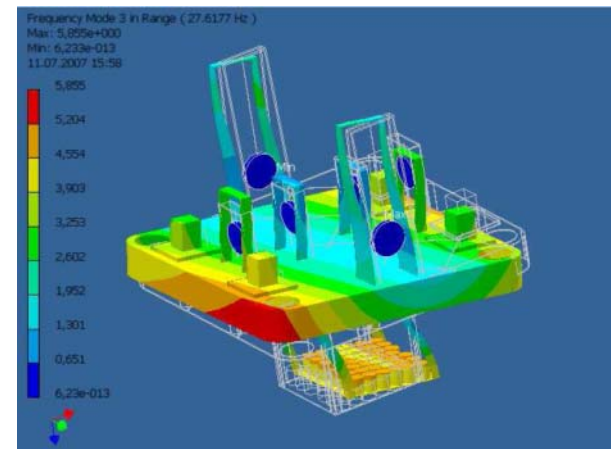
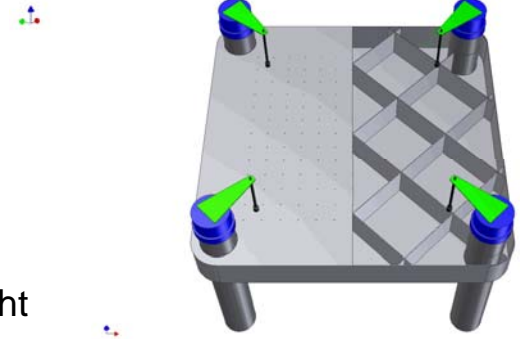
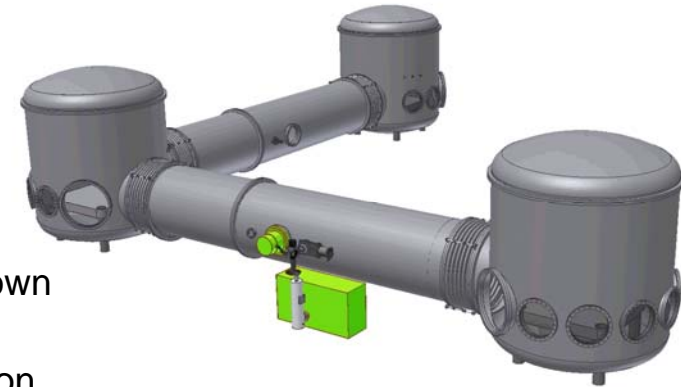
- training new people to work on low noise, high fidelity suspended mass interferometers
- develop techniques and optical “modules” for advanced detectors
- exploit radiation pressure dominated regime

## Glasgow prototype

- **new control ideas** applied to a 3-mirror suspended test cavity in preparation for working with radiation pressure dominated cavities
  - COMPLETE
- **diffractive cavity module** with low-efficiency, 2<sup>nd</sup>order Littrow grating (with Hanover and Birmingham)
  - IN PROGRESS, now characterising the grating and cavity
- **direct thermal noise measurement**
  - IN PROGRESS, we aim to measure thermal noise in composite structures
- **radiation pressure dominated cavities**
  - IN DESIGN, aim to test high-power / light-mirror cavity to feed into Hanover prototype QND experiment (plan to extend this work to include demonstrations of appropriate readout methods)

## Hannover prototype

- infrastructure:
  - 10m baseline L-shape, 3m diameter tanks, fast pump-down
  - isolated platform locked via platform IFO
  - 30W PSL, modecleaner serves as frequency and common mode reference
  - Advanced LIGO type RTLinux / Epics control system
- towards GEO-HF
  - set up digital RT control and train people on it
  - train students on the control of suspended mass interferometer
  - test GEO-HF subsystems like OMC, PSL, squeezed light sources
- experiments
  - reach radiation pressure dominated regime
  - surpass SQL for medium size mirrors (100g)
  - performe QND and entanglement experiments

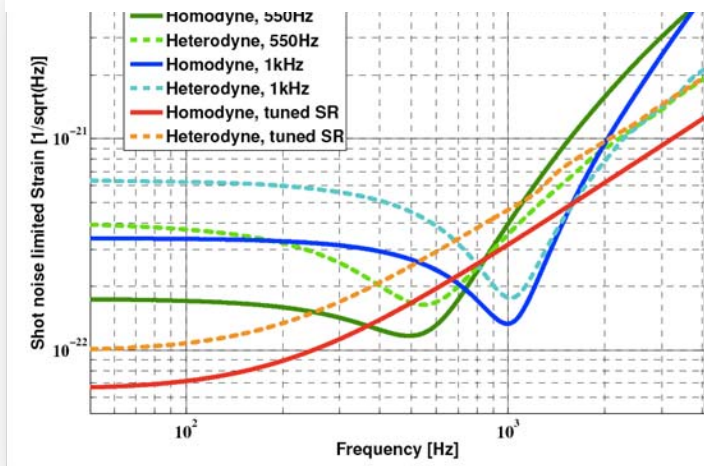




- Develop and maintain optical simulation tools for the GEO 600 collaboration and the LSC
- Provide simulations to guide experimental work for GEO600, prototypes (Hannover and Glasgow), LTP, LISA, R+D
- Several simulation tools available to the GW community (Finesse, OptoCAD, WaveProp, LTPDA, Liso):



Example: Readout options for GEO600

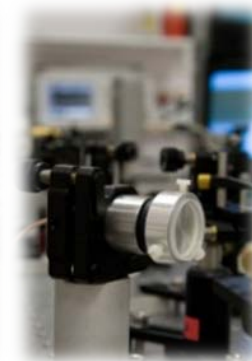
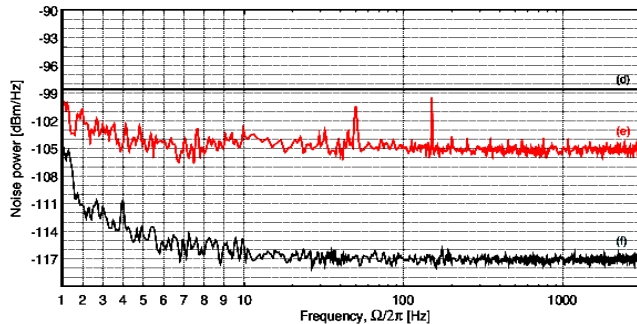
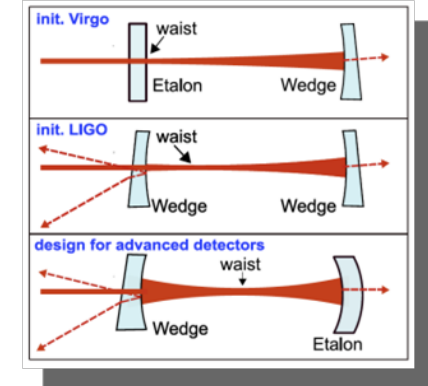


<http://www.sr.bham.ac.uk/dokuwiki/doku.php?id=geosim:home>

contact: Andreas Freise / Birmingham



- thermal noise in coatings, suspensions and test mass material at room and cryogenic temperatures
- optical topology studies
  - all reflective interferometers
  - etalons as cavity end mirrors to tune arms
  - alignment issues in higher order mode IFOs
- novel techniques for laser power stabilization
- generation and control of squeezed light sources
  - installation in GEO600
  - installation in H1 ??



**and a lot of work in data analysis !!!**