

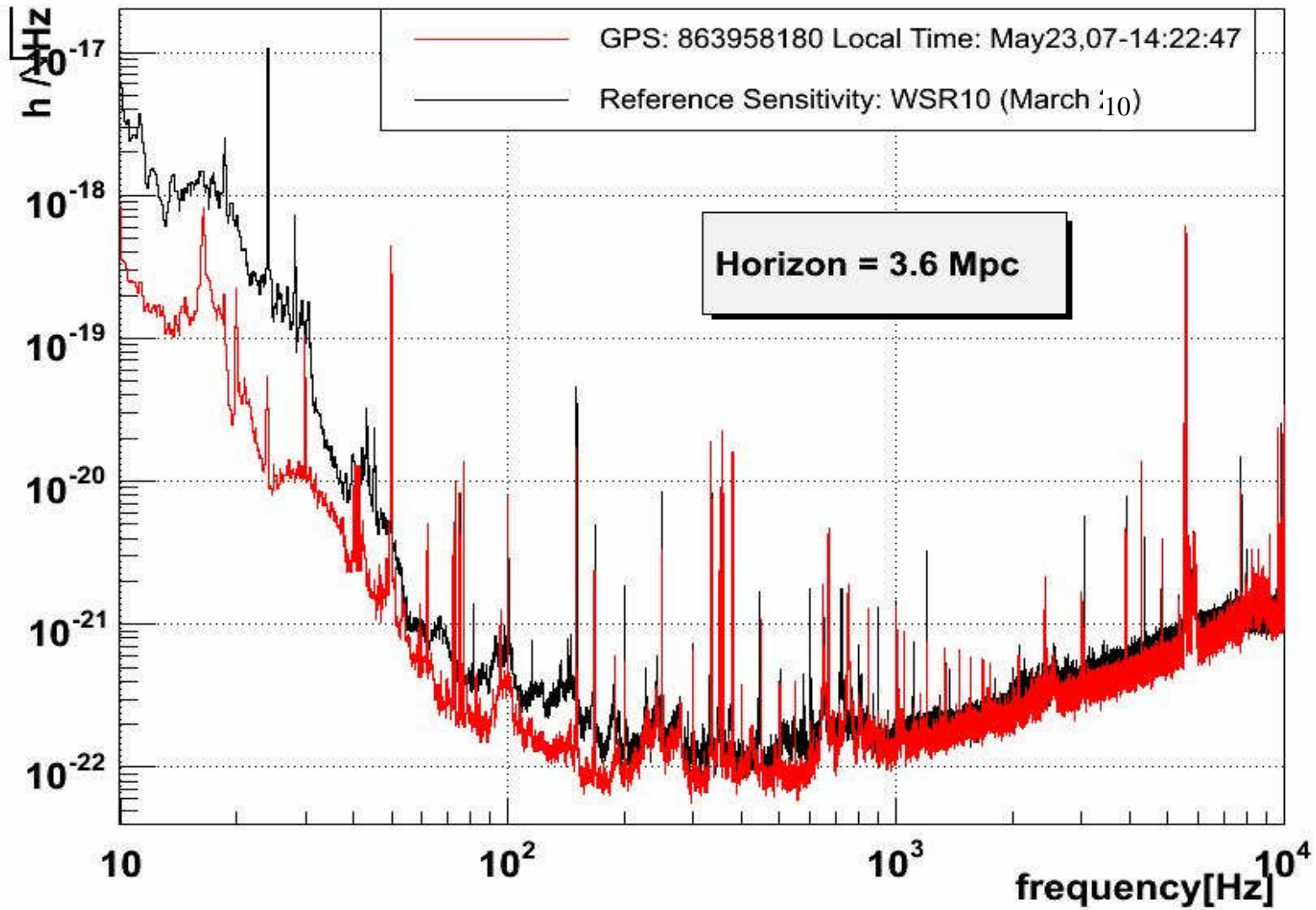
# Sensitivity of Virgo

E. Tournefier (LAPP-CNRS)

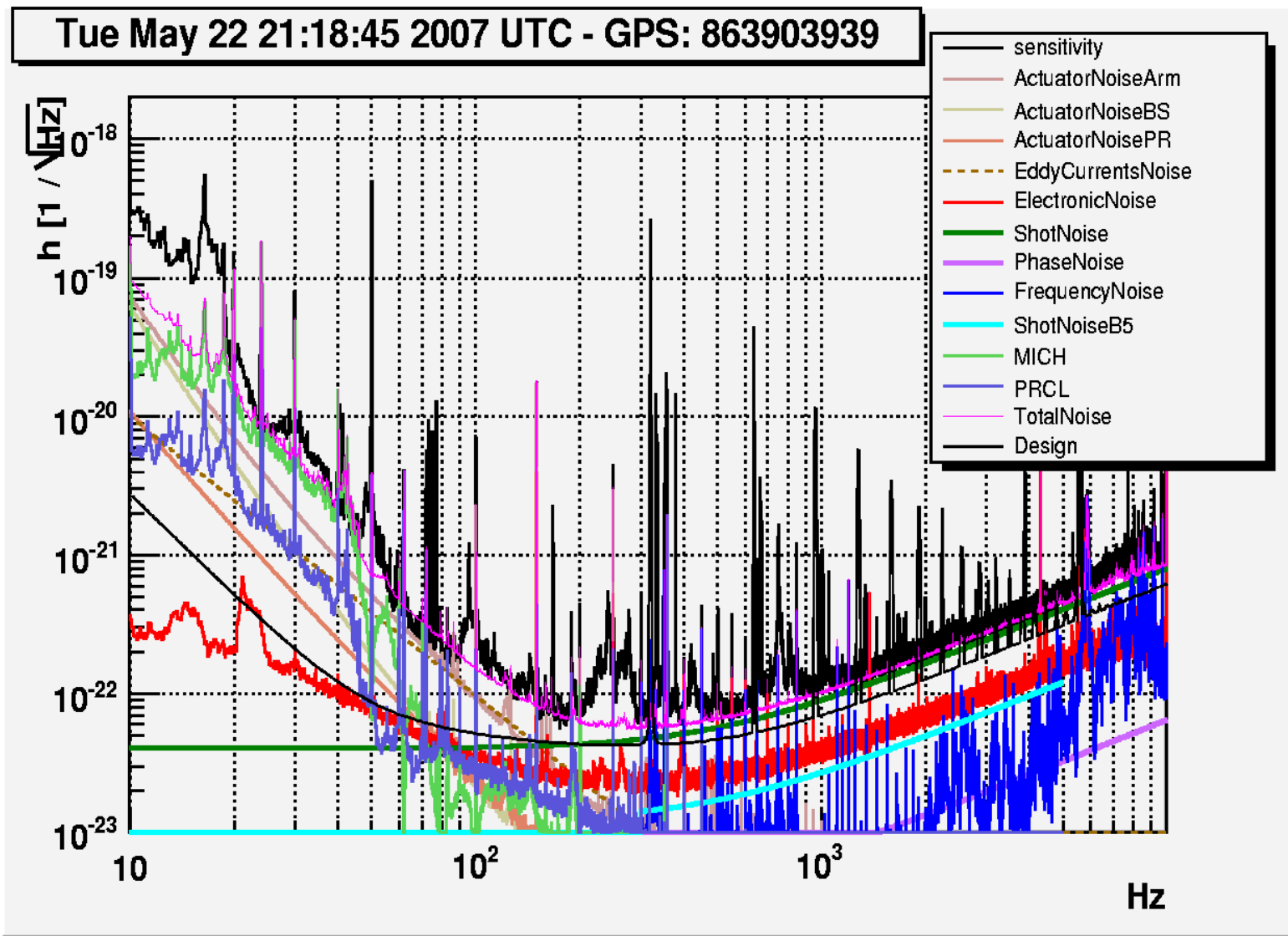
LSC-Virgo week  
May 23<sup>rd</sup>, 2007

LIGO-G070337-00-Z

# Sensitivity: WSR10 (March) vs SR1 (May)



# Noise budget



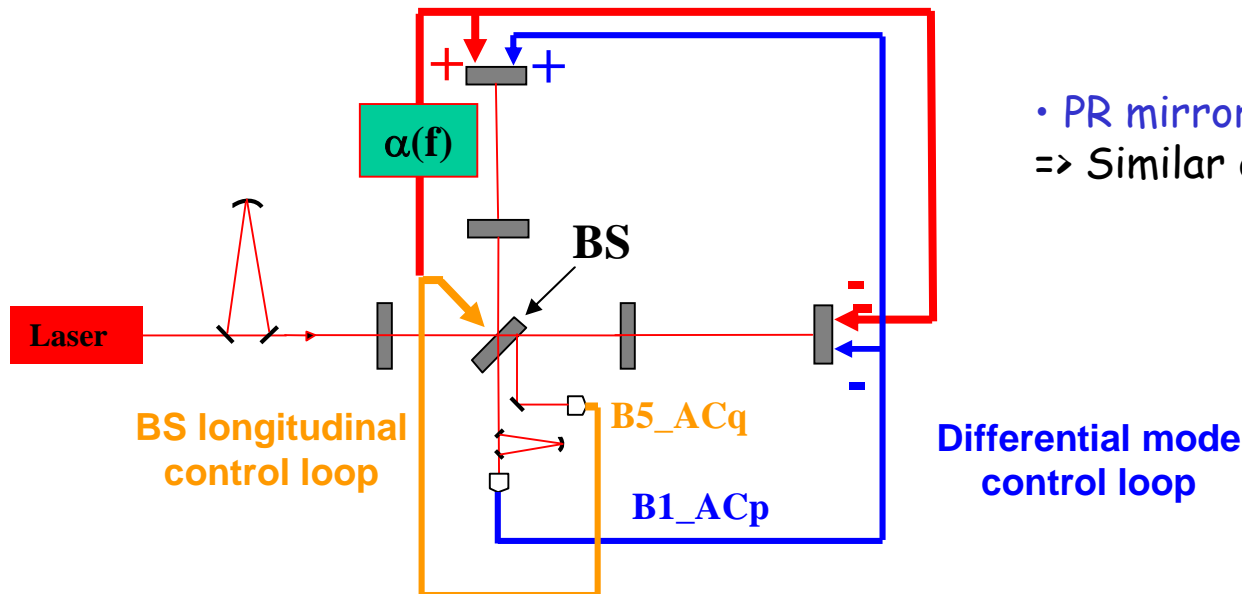
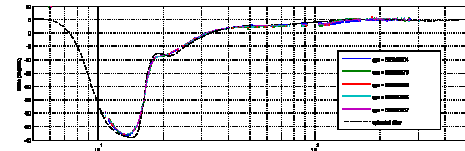
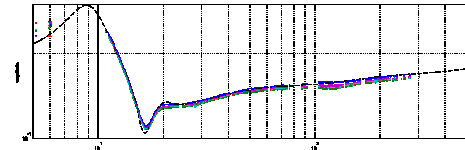
# Control noises: longitudinal controls

- Beam Splitter motion  $\Leftrightarrow$  end mirrors differential motion
- $\Rightarrow$  Noise introduced by the BS control can be compensated by moving the end mirrors

Difficulty: the  $\alpha$ -coefficient is frequency dependent

$\Rightarrow$  The BS noise is subtracted with a precision of  $\sim 2-3\%$

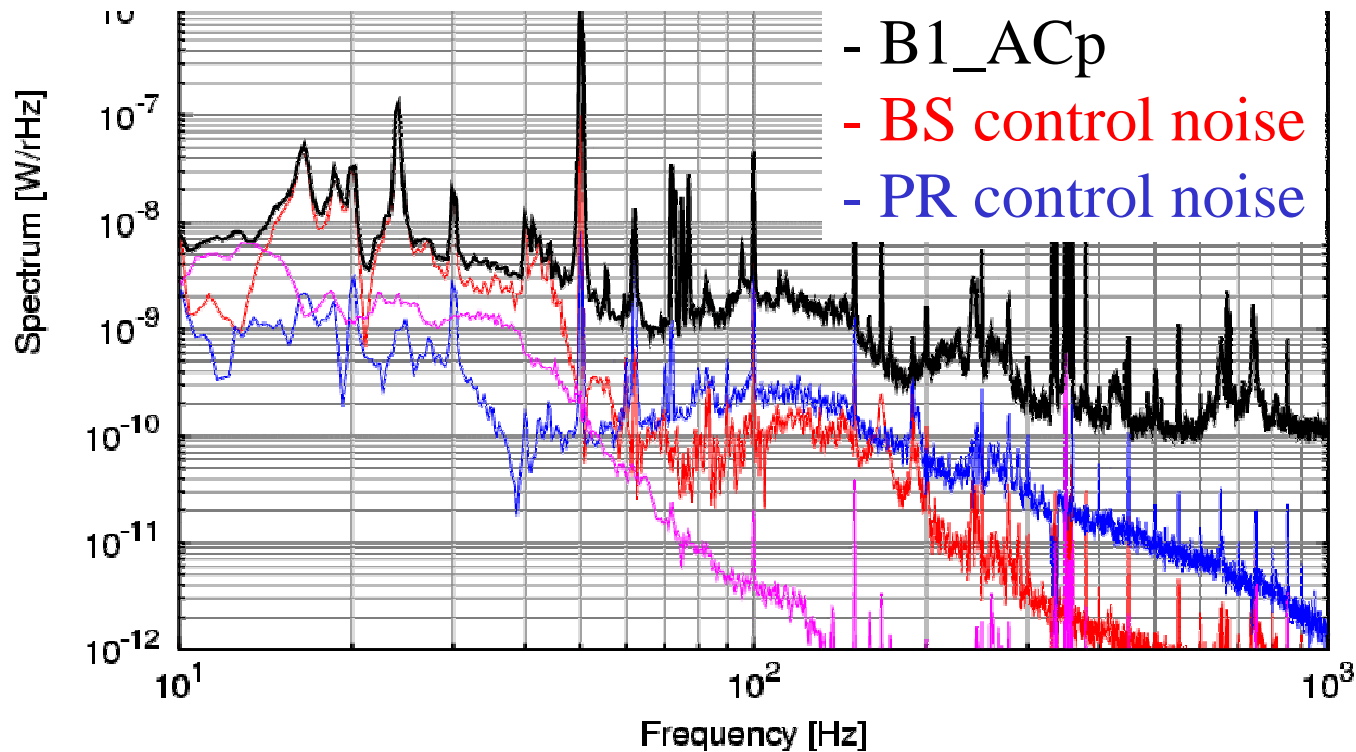
Other action: reduce the BS control noise itself



- PR mirror control also couples to DF
- $\Rightarrow$  Similar online subtraction:  $\beta$  technique

# Control noises: longitudinal noises

## Longitudinal noise budget

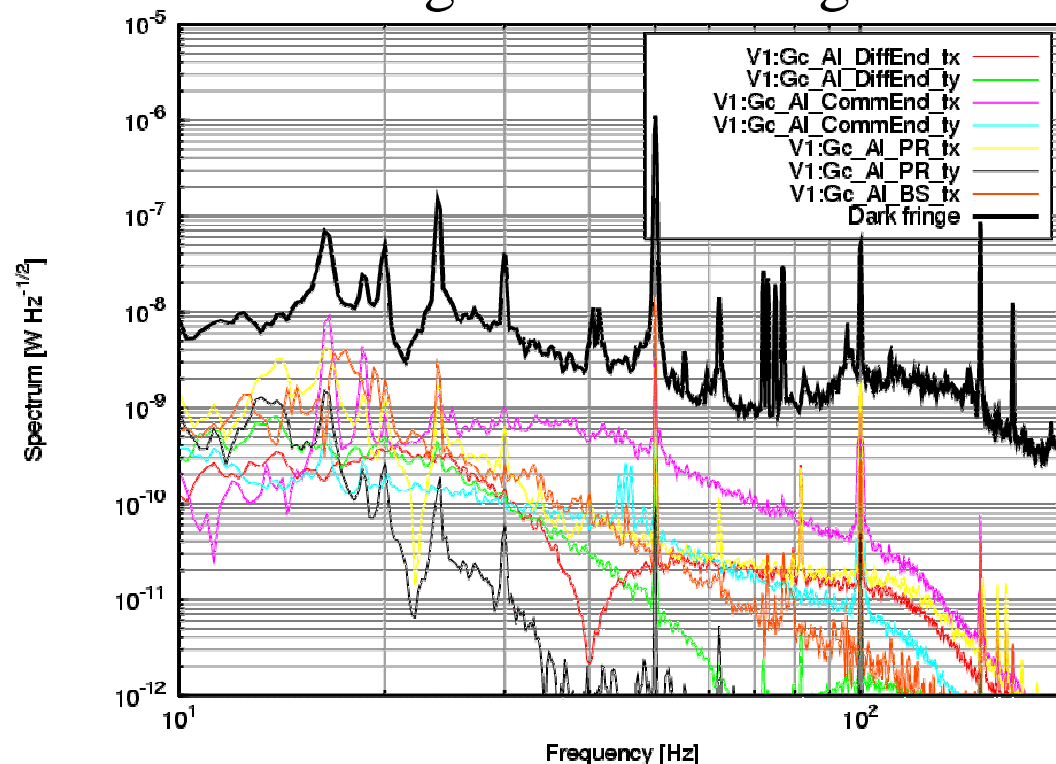


- BS control noise limits the sensitivity below 35Hz  
possible improvements:
  - more online subtraction
  - understand and reduce the control noise

## Control noises: angular

- Angular control noise couples through mirrors mis-centering
  - ⇒ Improved centering ( $\sim$ mm)
  - ⇒ Improved control filters

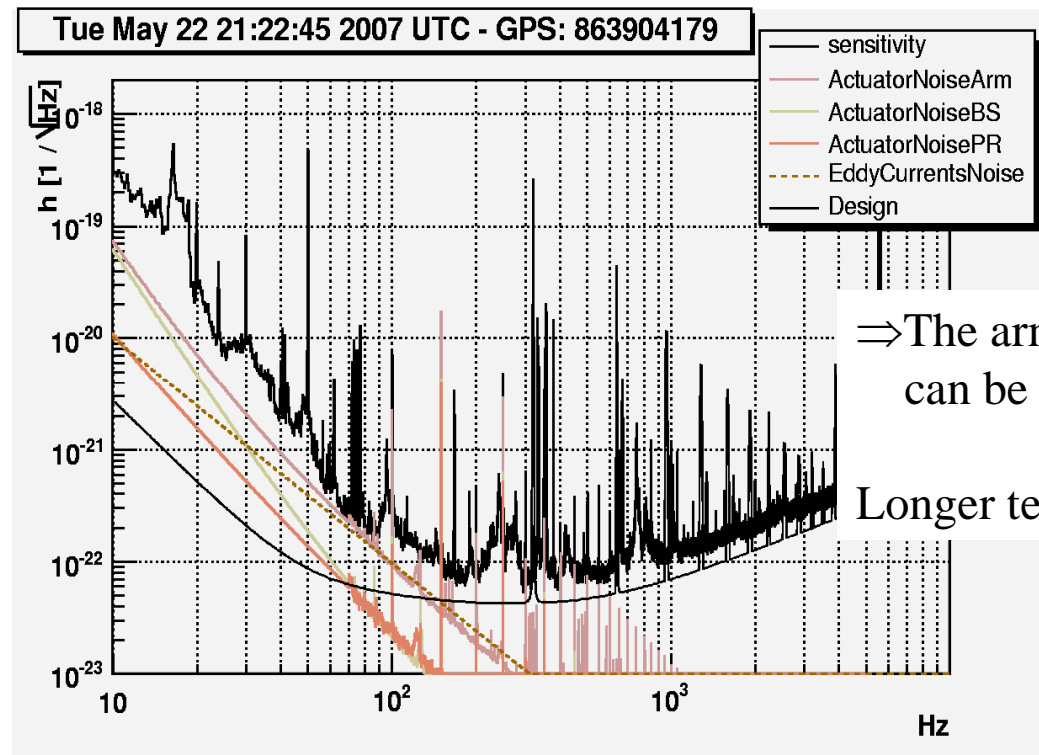
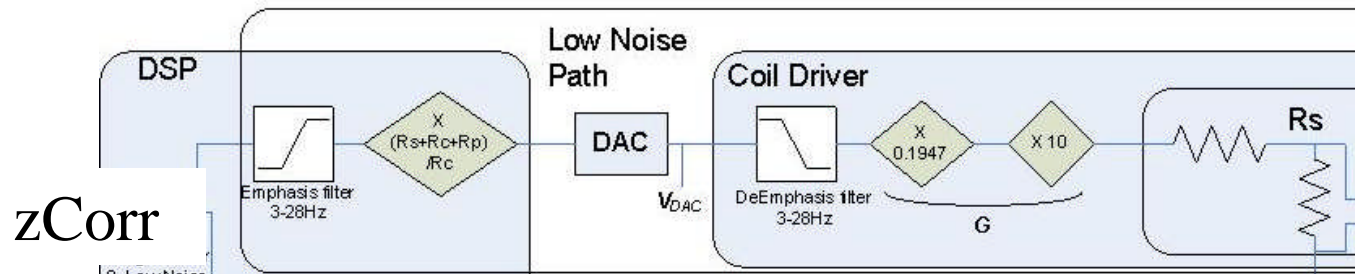
Angular noise budget



- ⇒ The angular noise does not limit the present Virgo sensitivity
- ⇒ Improvements will be needed to reach the Virgo design (some plans post-SR1)

# Mirror actuator noise

- Electronic noise of the coil drivers would limit the sensitivity
  - ⇒ Shaping filters, more gain



I (A) to mirror coil

⇒ The arm mirrors actuators need to be improved  
can be done during SR1

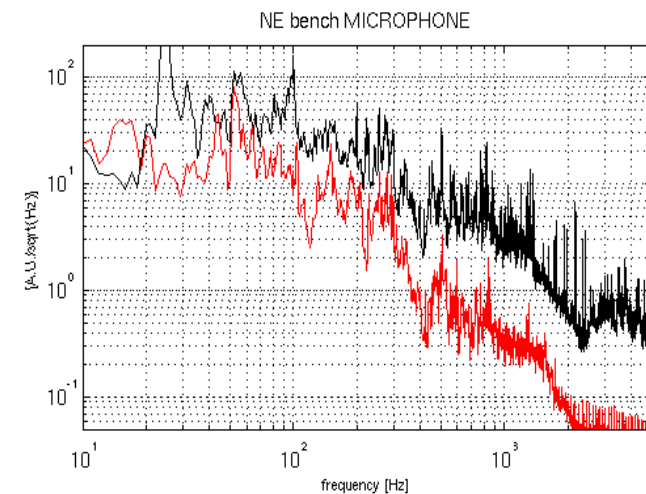
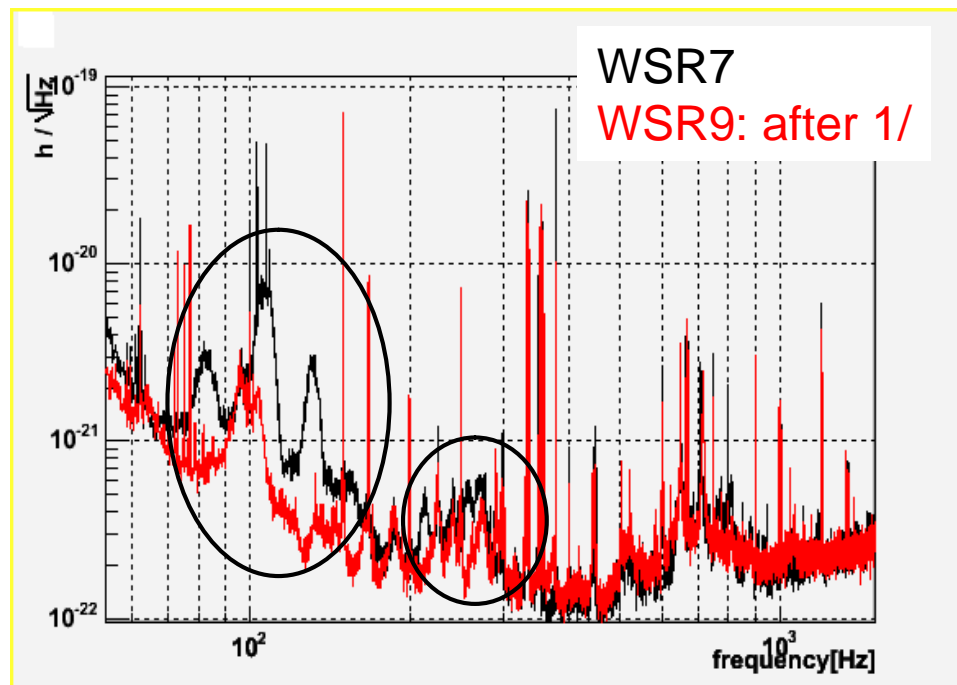
Longer term: new coil drivers

# Environmental noise: acoustic noise

Evidence for diffused light by the optics of the end benches (Jan 2007)

Actions:

- 1/ use more rigid mounts for critical optics and dump secondary beams (Feb)
- 2/ install acoustic enclosures



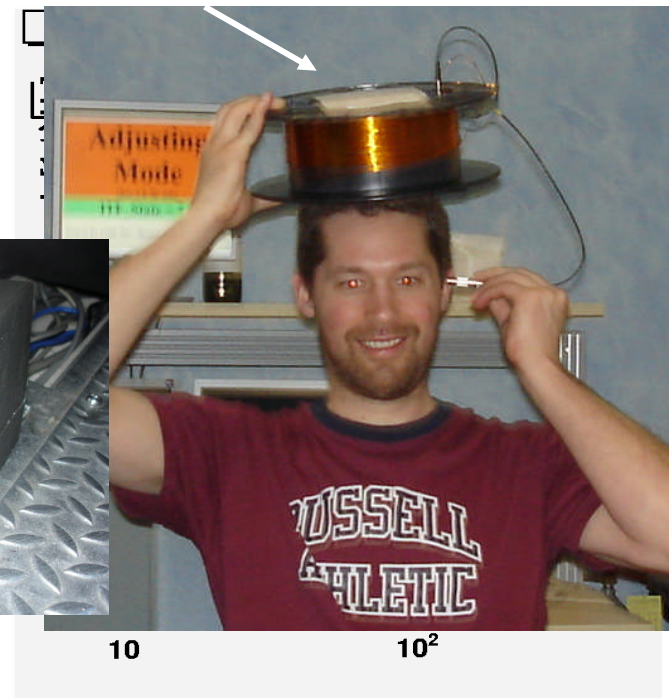
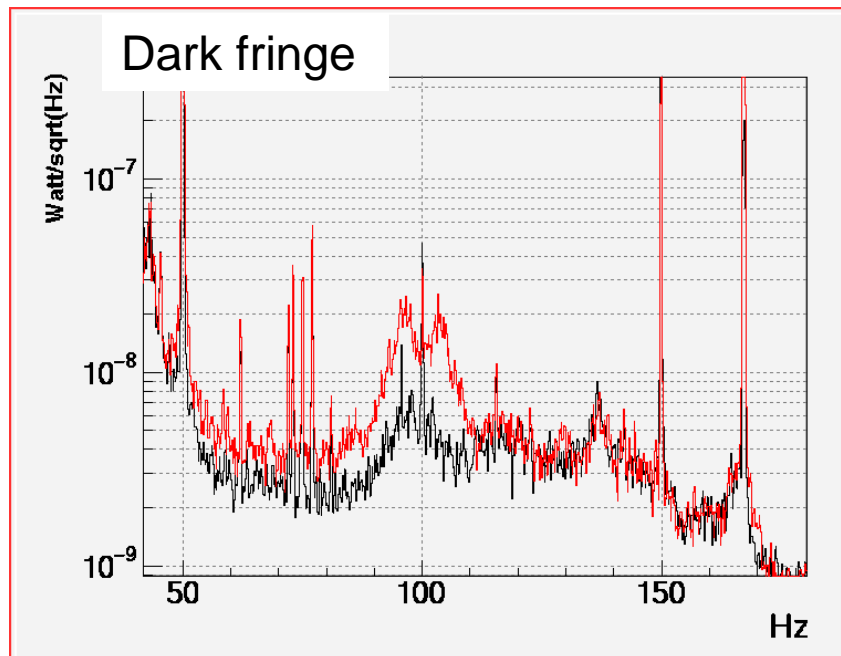
- Next steps: improvement to the acoustic enclosures



# Environmental noises: magnetic noise

- Before WSR10 magnetic noise was limiting the sensitivity between 50 and 110 Hz
- Investigations: track the sources of magnetic field close to the mirrors
  - => found noisy power supplies
  - => noise well reduced when switched OFF!

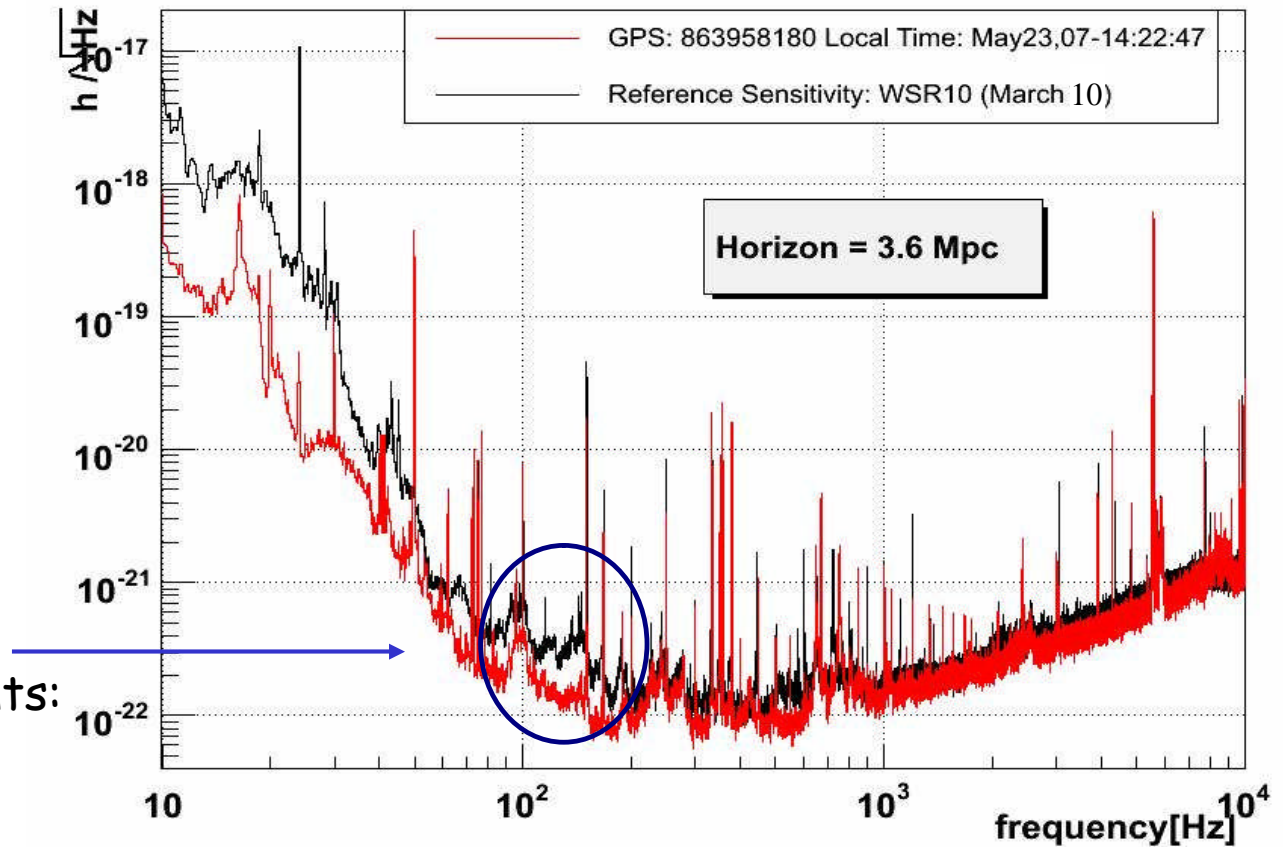
Home made portable magnetometer



- Need to check if there are still magnetic noise contributions to the present sensitivity

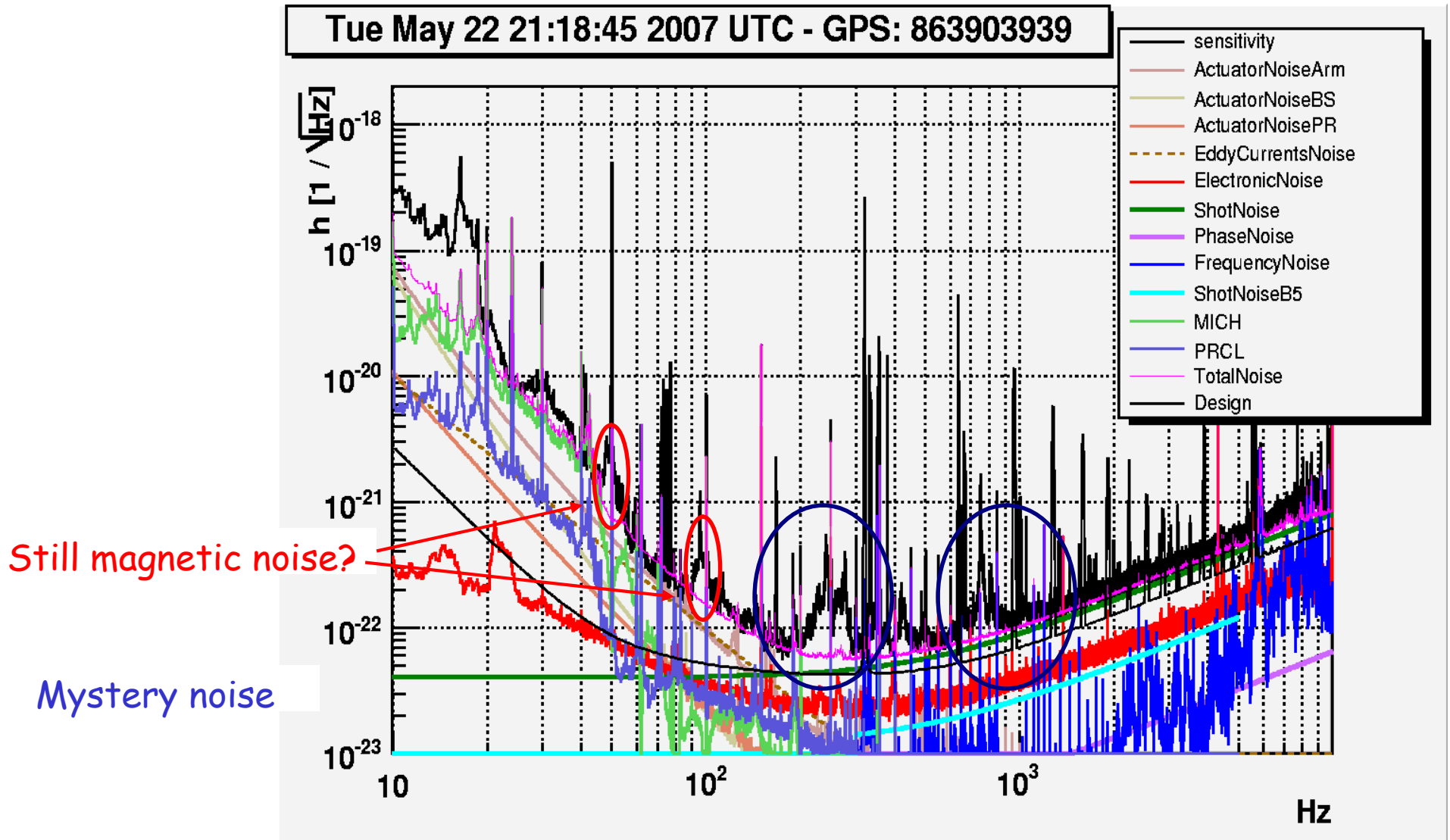
# Environmental noise: others

Replace SR turbo pump  
with a smaller one  
(+ other small improvements:  
diffused light, ...)



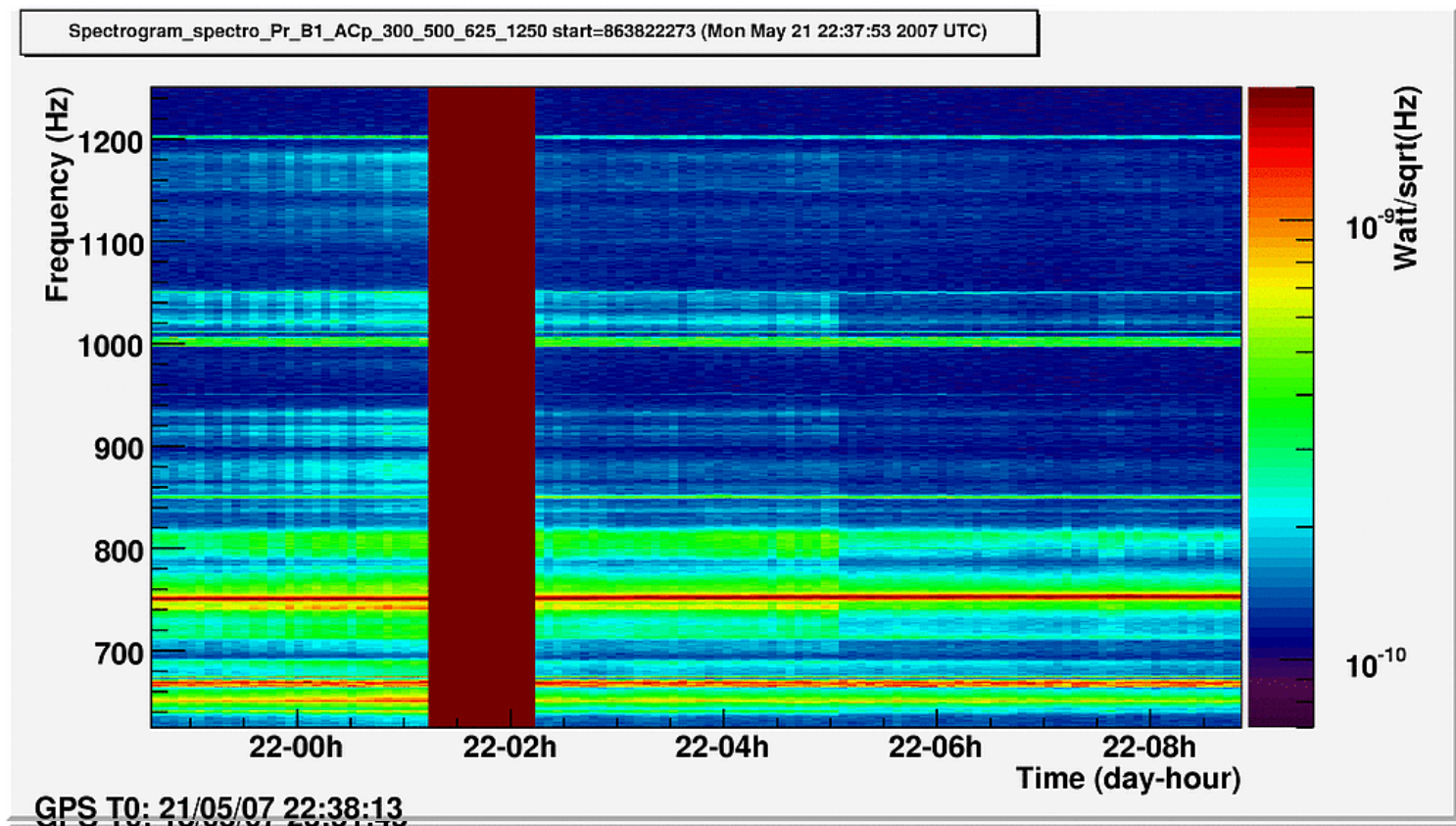
# Noise budget

- Noise reasonably well understood, some improvements planned except for...



# Mystery noise

- Observations:
  - Coupling to DF increases with misalignments
  - Sudden decreases/increases
  - Structures not excited with noise injections/tapping tests around benches/towers



Under investigation ...



# First fixes / investigations

- Studies of drifts during lock longs:
  - Alignment drifts (quadrants centering)
    - ⇒ Temporary fixes: realign from time to time
    - ⇒ Improvements planned
  - Start to study effects of long term drifts:
    - Variation of the coupling of control noises

- Quadrant alignment (BS alignment)
- PR control noise coupling ( $\beta$ )

