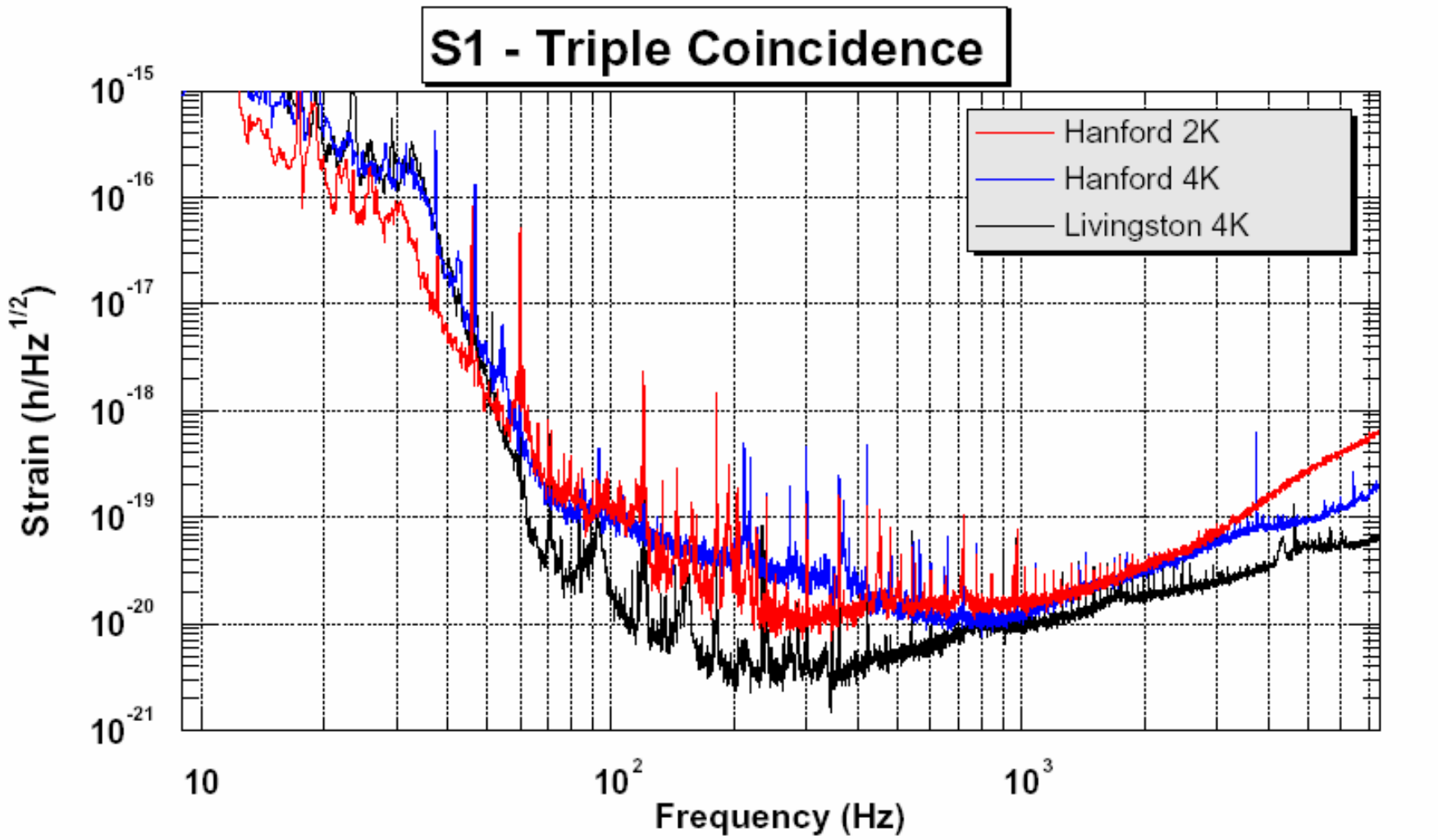
"First Science Run at Livingston LIGO Observatory: Data calibration and stability"

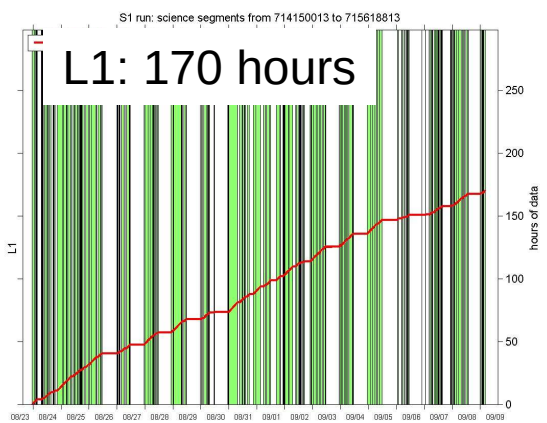
Gabriela González

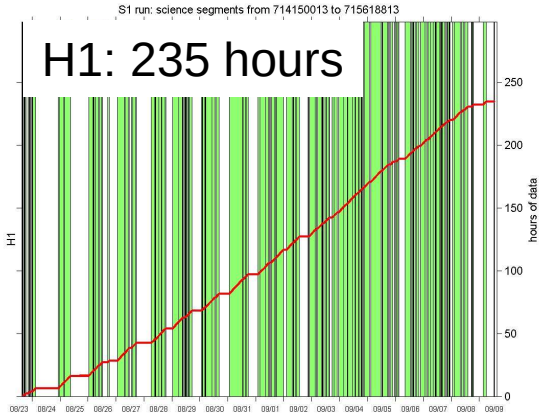
Louisiana State University

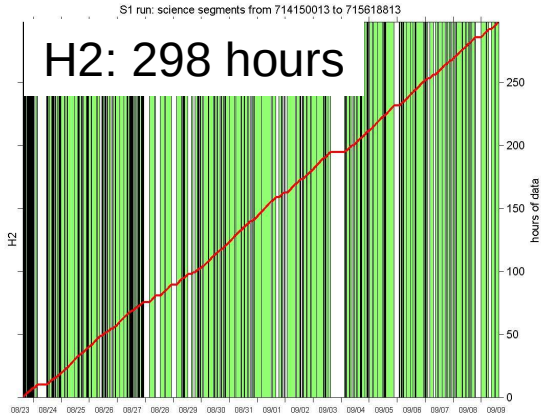
S1 run: Aug 23-Sept 9

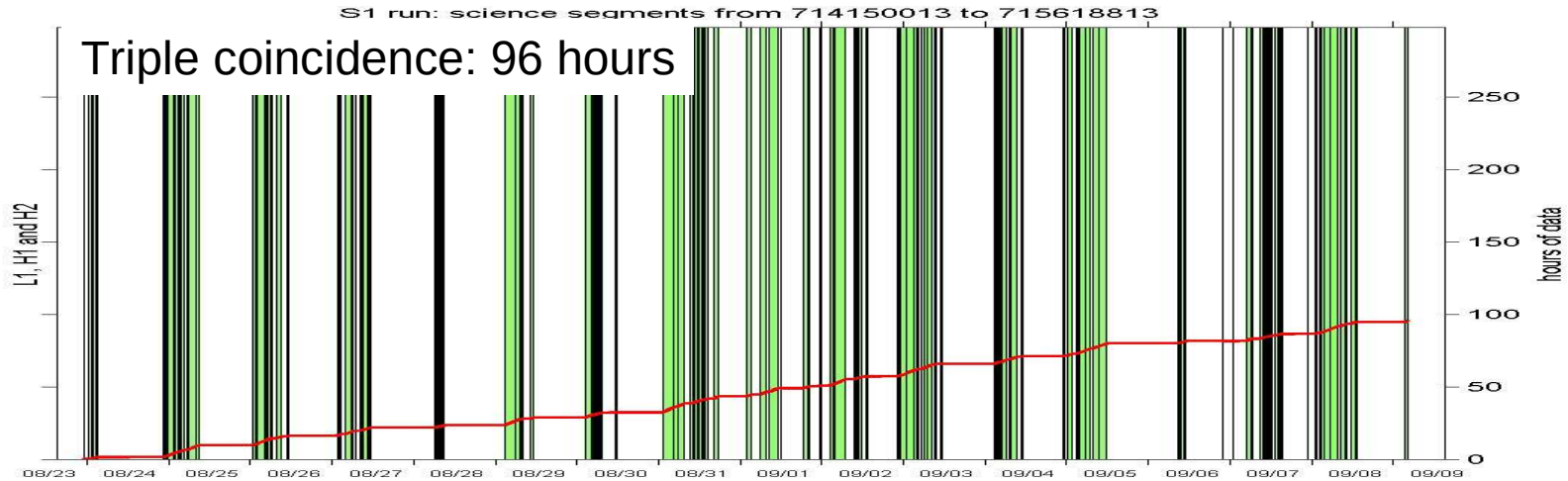


Lots of data…



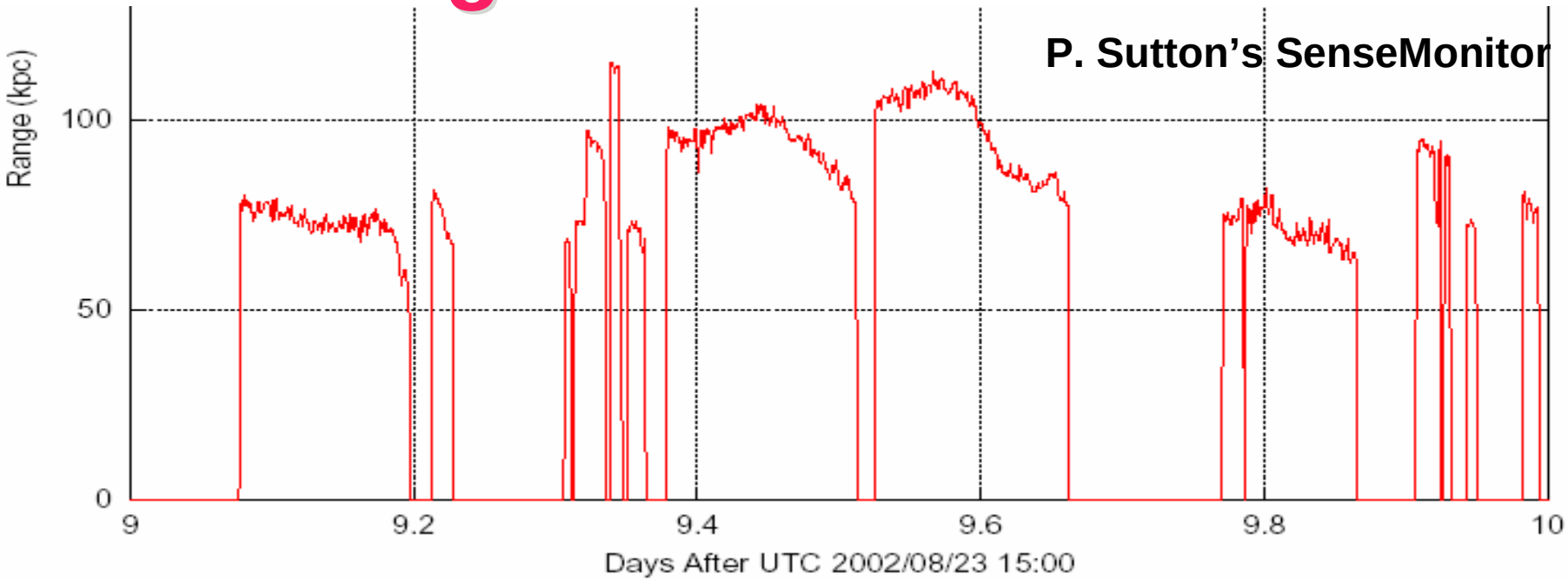


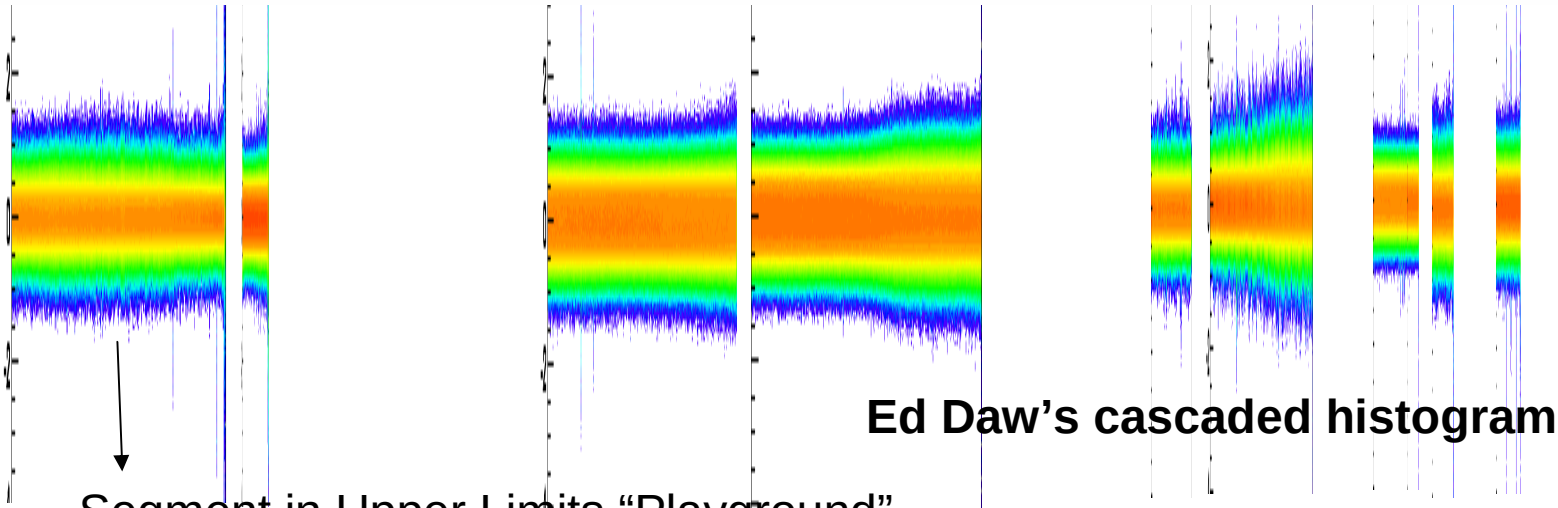




http://www.phys.lsu.edu/faculty/gonzalez/S1LockStats/

Looking farther than ever before

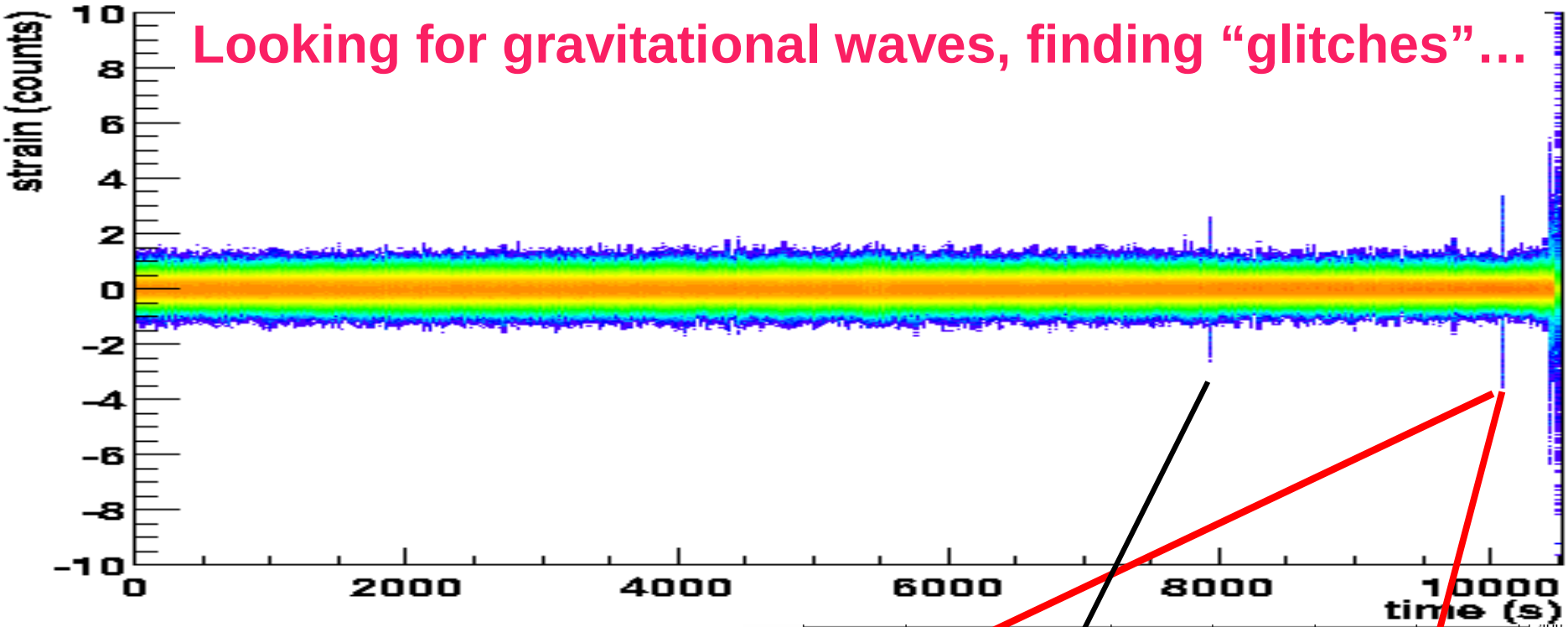


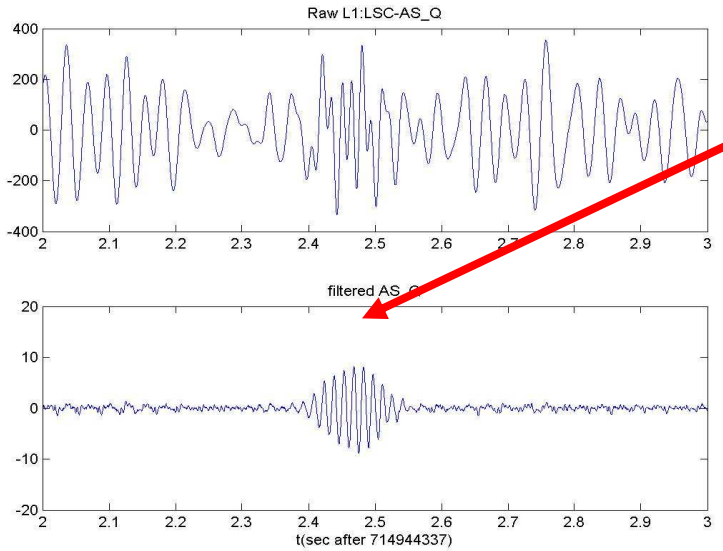


Ed Daw's cascaded histograms

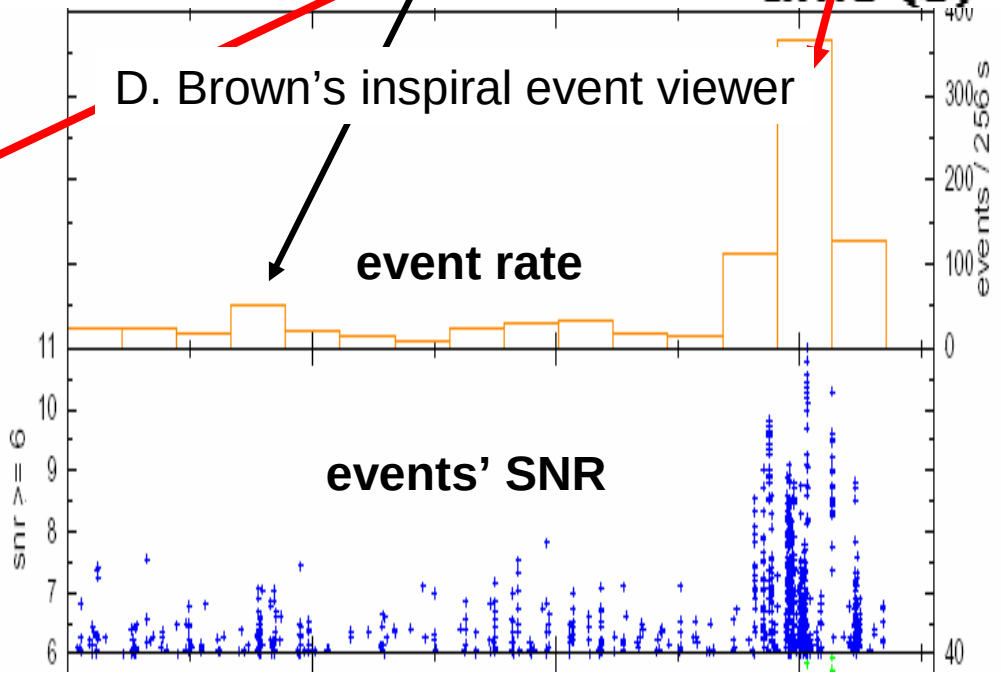
Segment in Upper Limits "Playground"

Looking for gravitational waves, finding “glitches”…

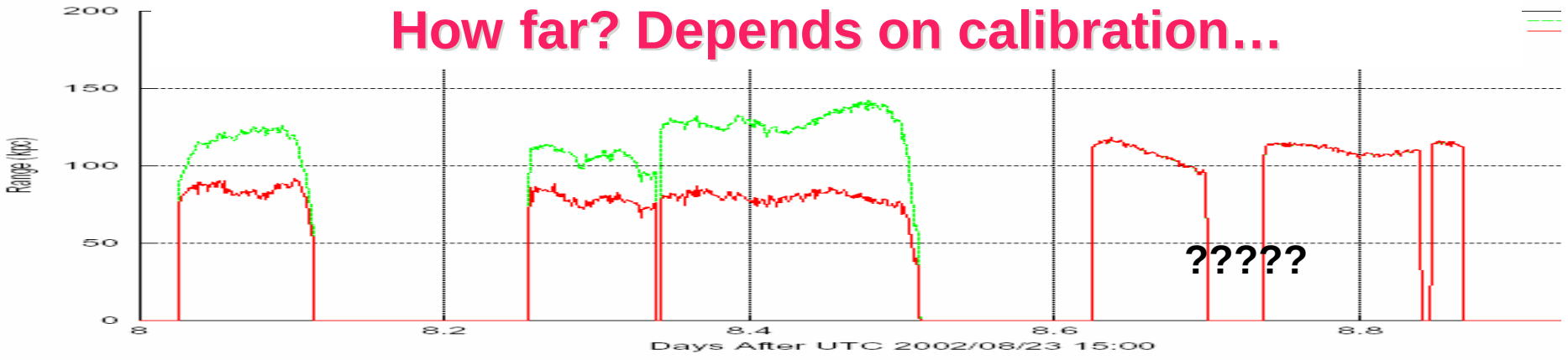




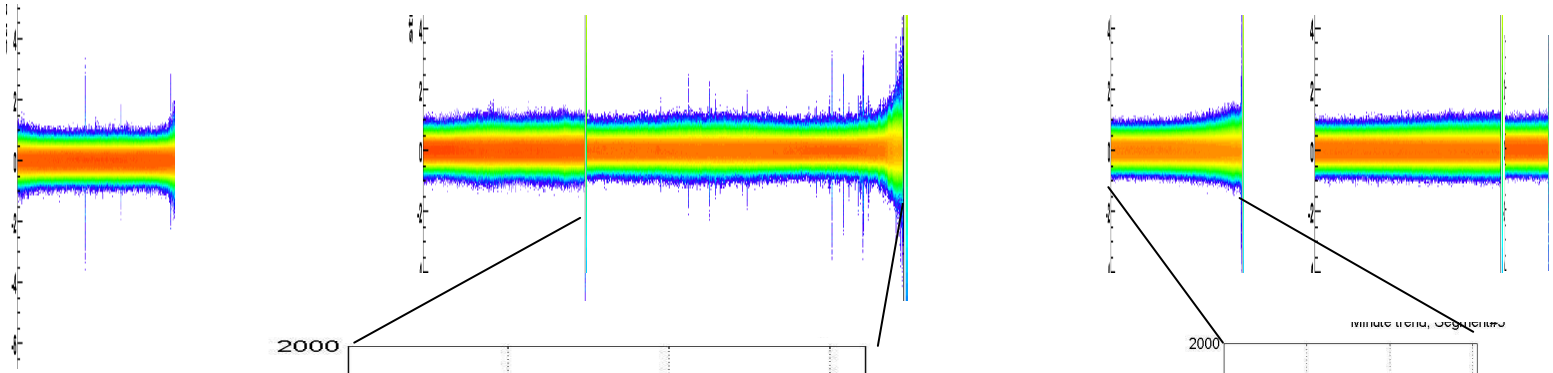
D. Brown’s inspiral event viewer



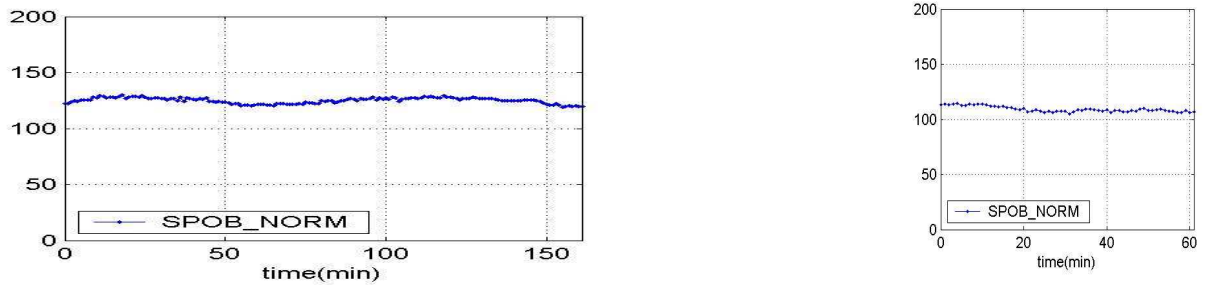
How far? Depends on calibration…



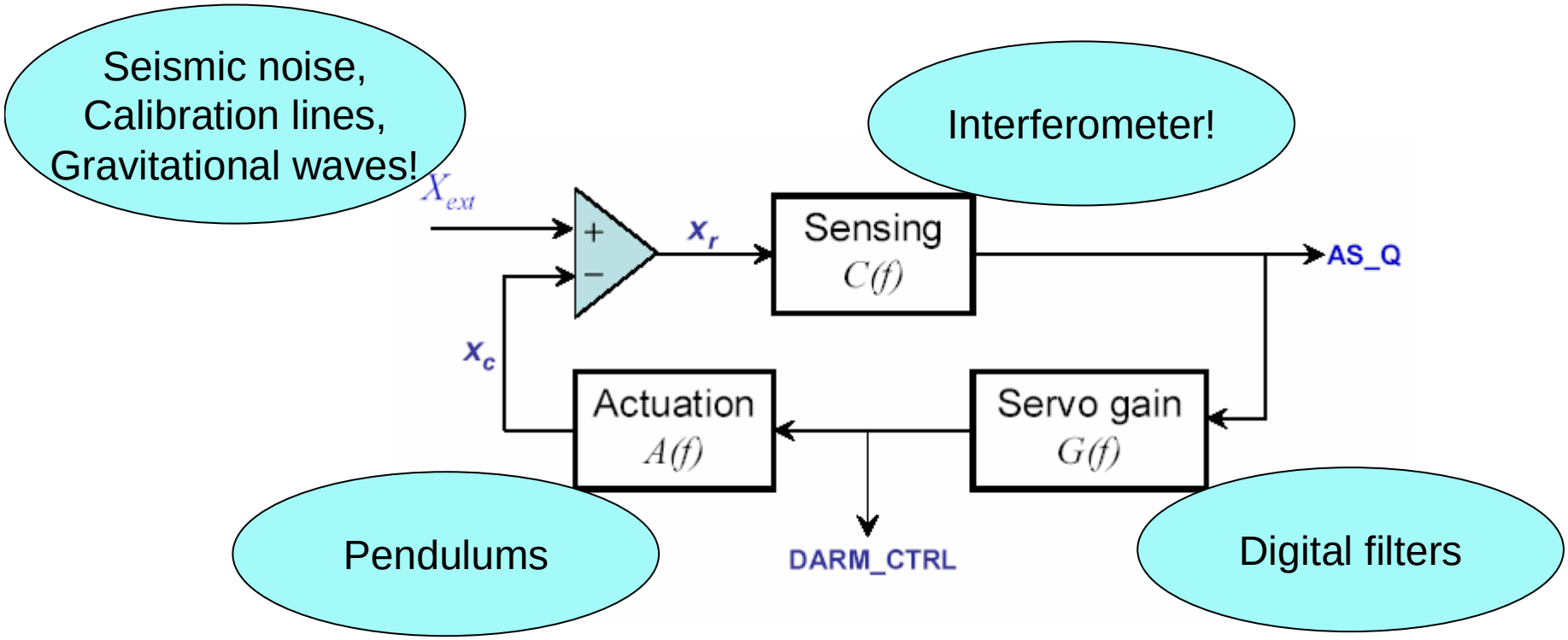
Power in the arms



Sideband power in the PRC



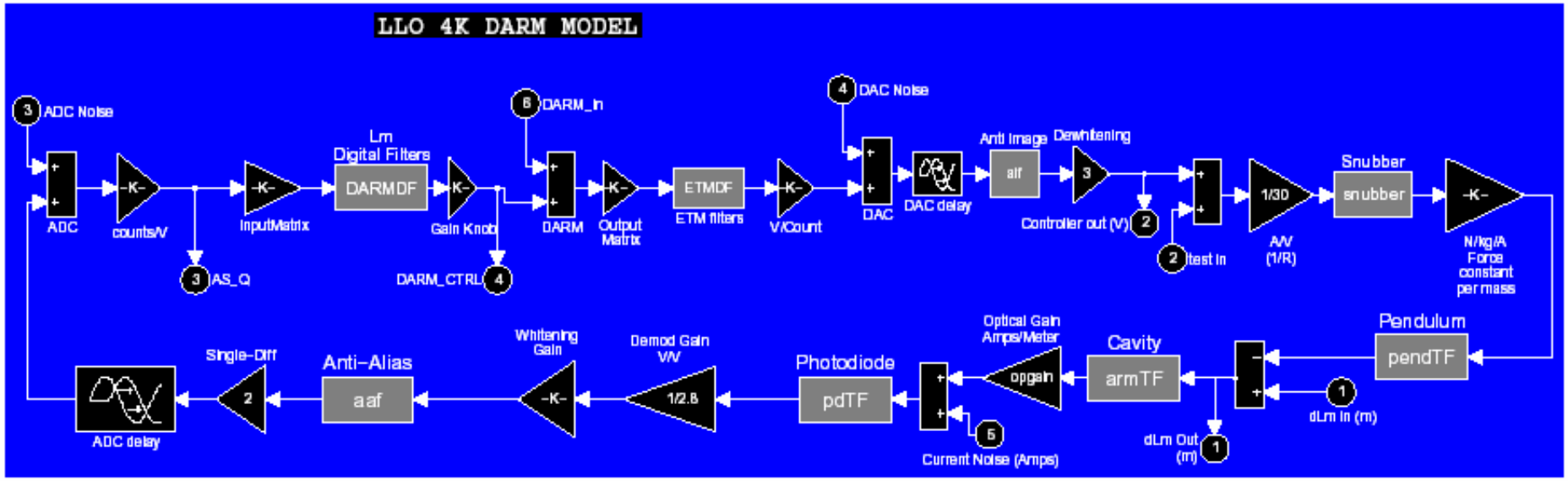
Calibration? What calibration?



$$H(f) = A(f)C(f)G(f)$$ Open Loop Gain

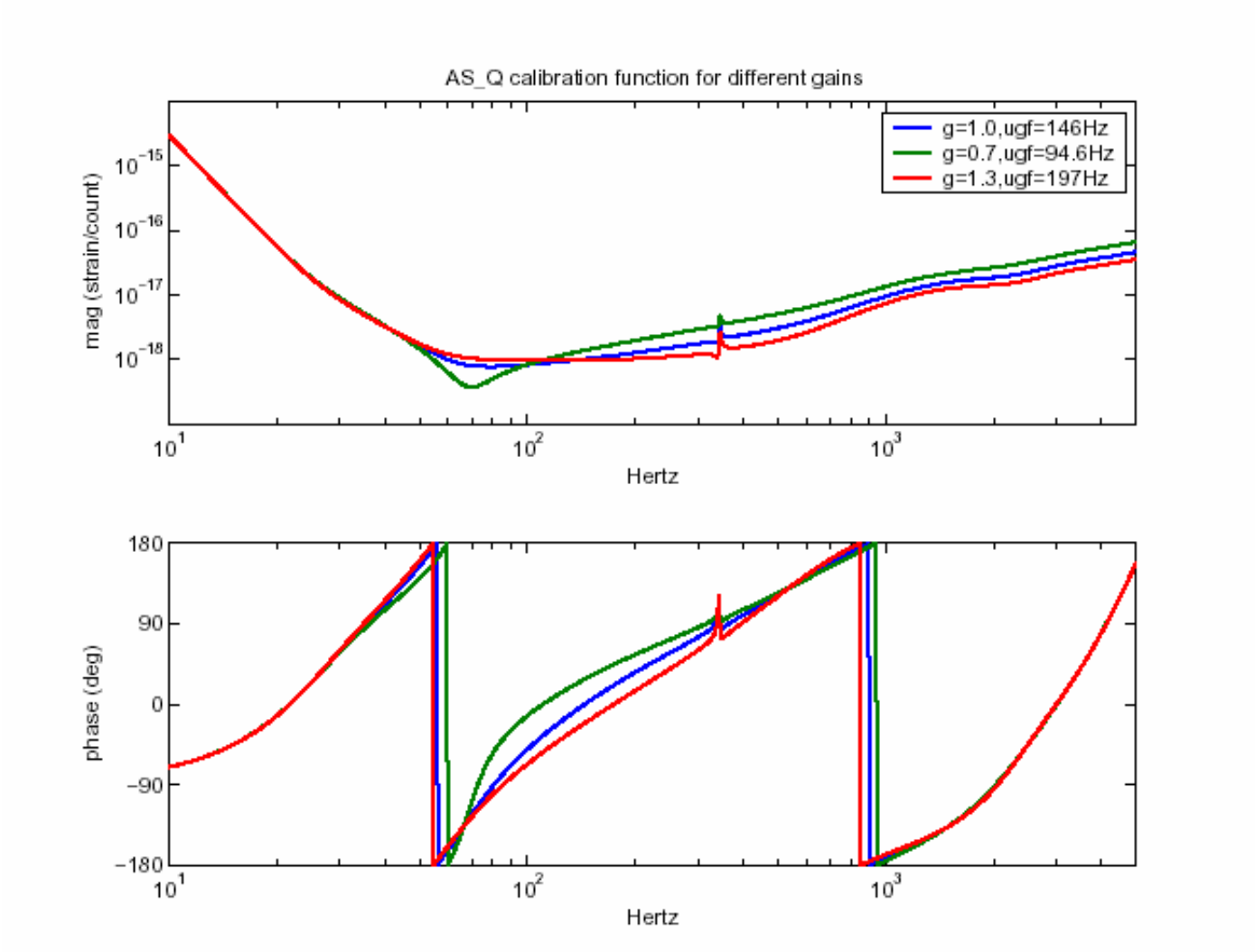
$$AS\_Q = X_{ext}\frac{C(f)}{1+H(f)}$$ Calibration of AS_Q

A “simple” DARN model

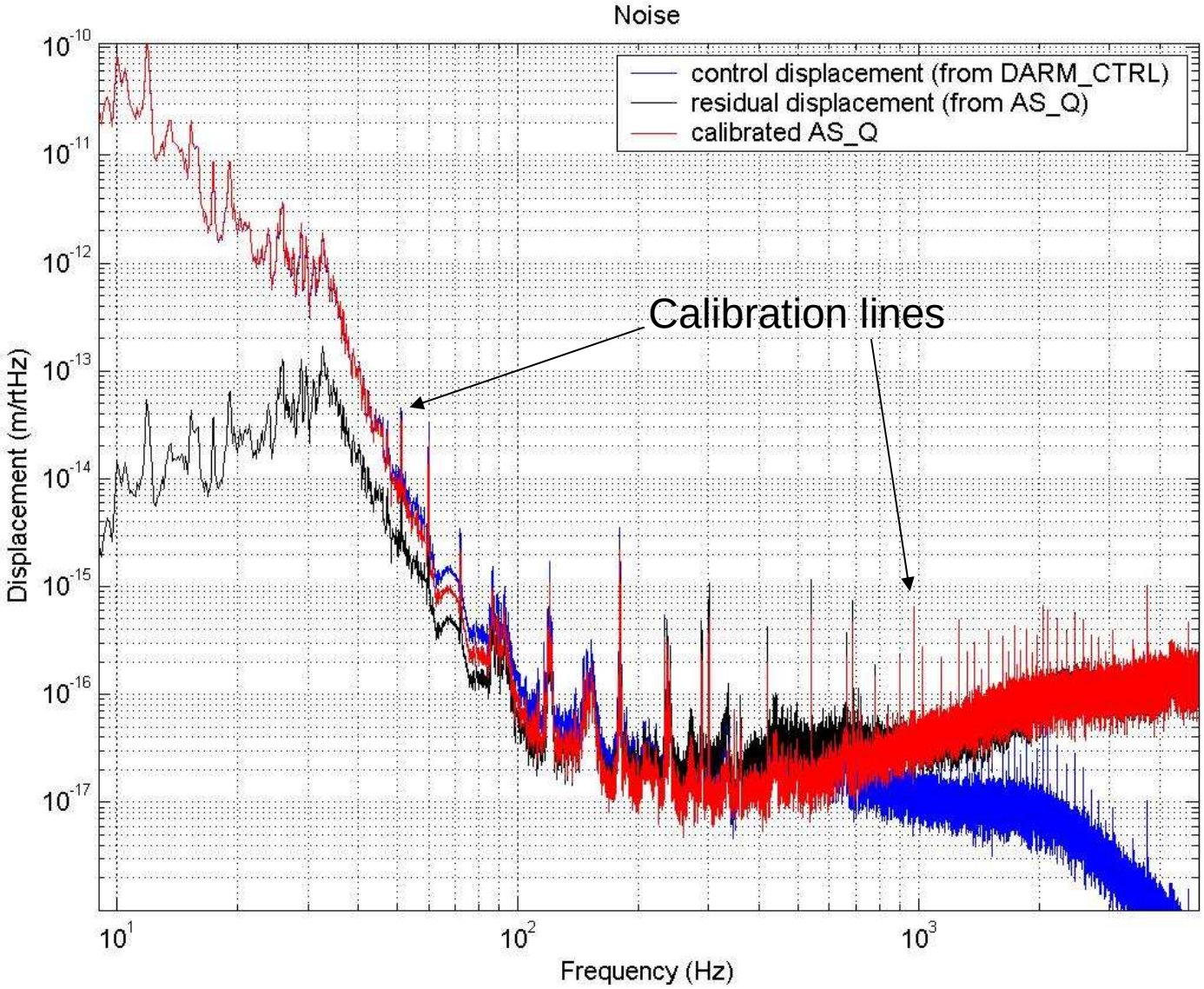


Rana Adhikari’s Simulink model

Why does calibration matter?



Control room calibration

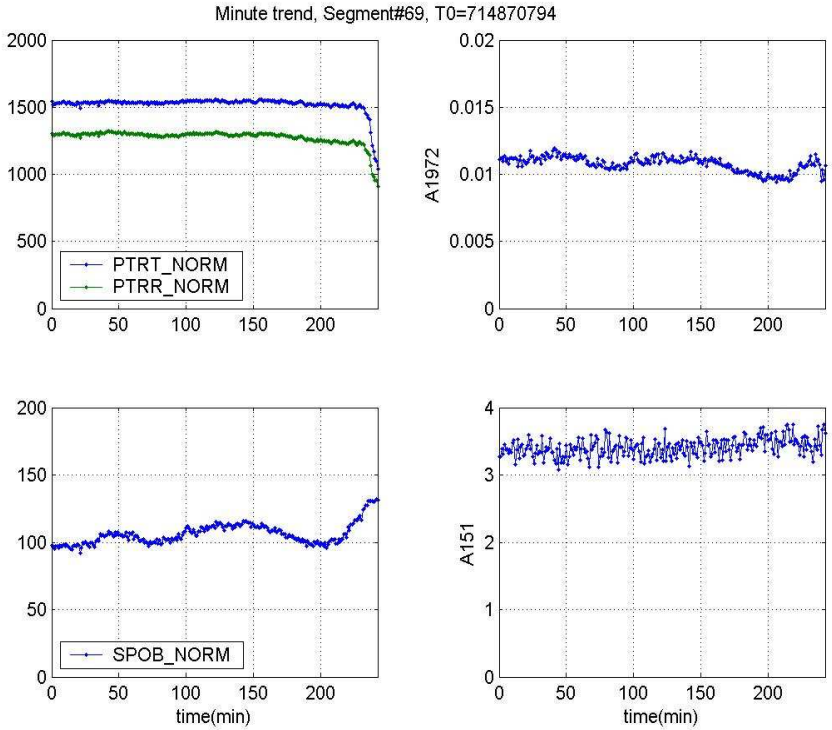


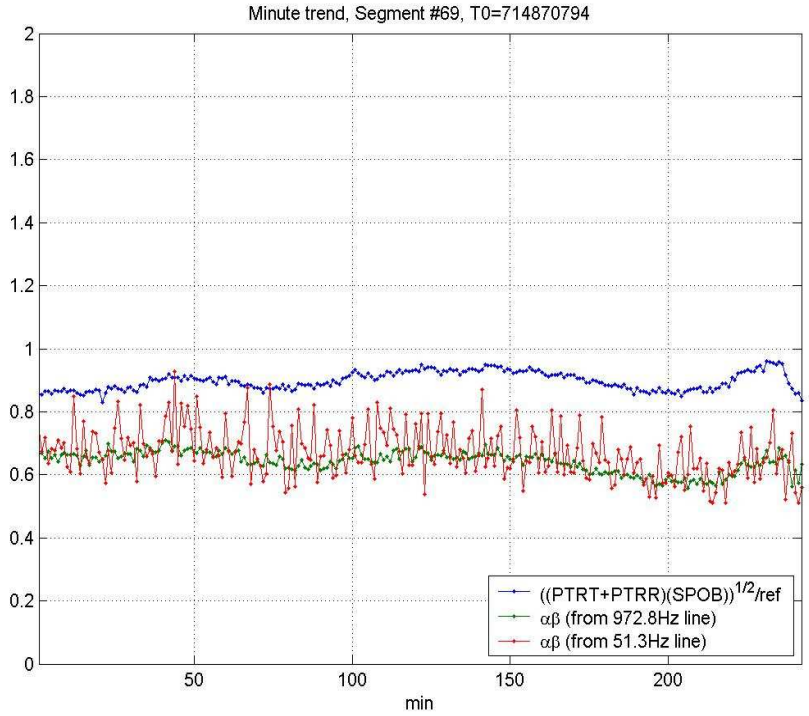
Why would calibration change?

$$\text{If } C(f) \rightarrow \alpha C(f), \qquad AS\_Q \rightarrow X_{ext}\frac{\alpha C(f)}{1+\alpha H(f)}.$$

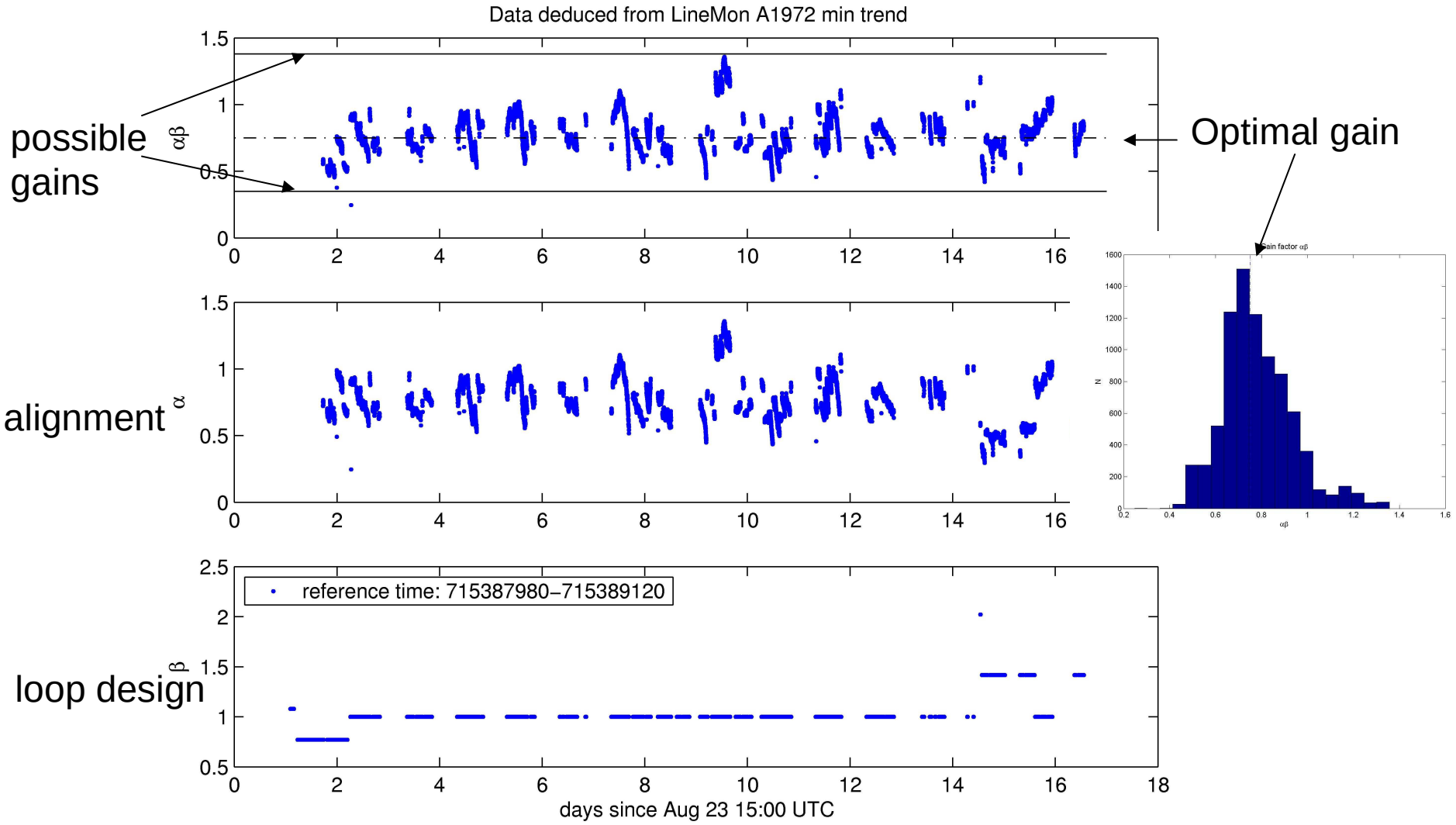
$$G(f) \rightarrow \beta G(f) \qquad AS\_Q \rightarrow X_{ext}\frac{\alpha C(f)}{1+\alpha\beta H(f)}.$$

We can get information about a from changes in the amplitude of known displacements: we push the mirrors with sine waves, or “calibration lines”.

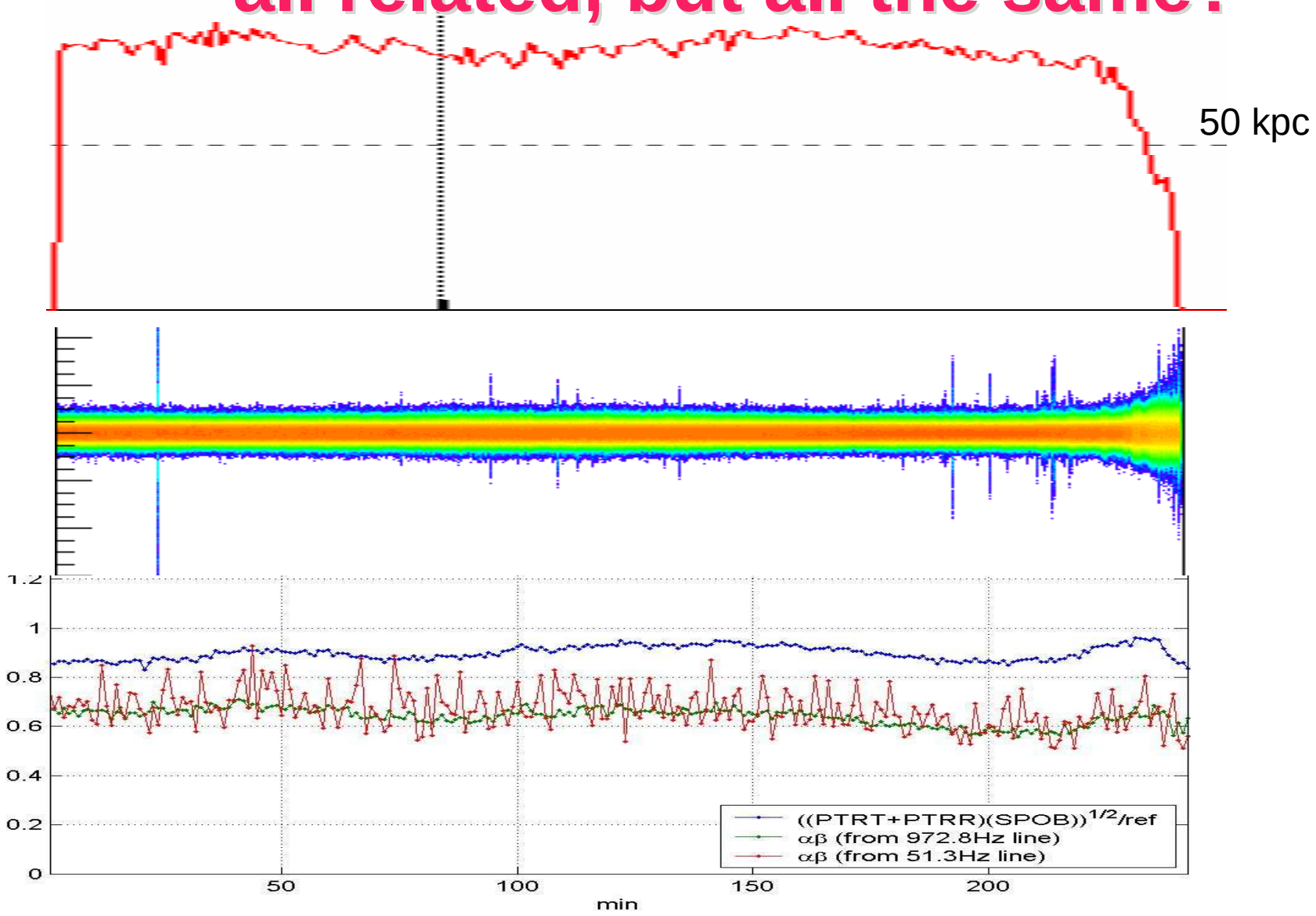




How much did the calibration change?

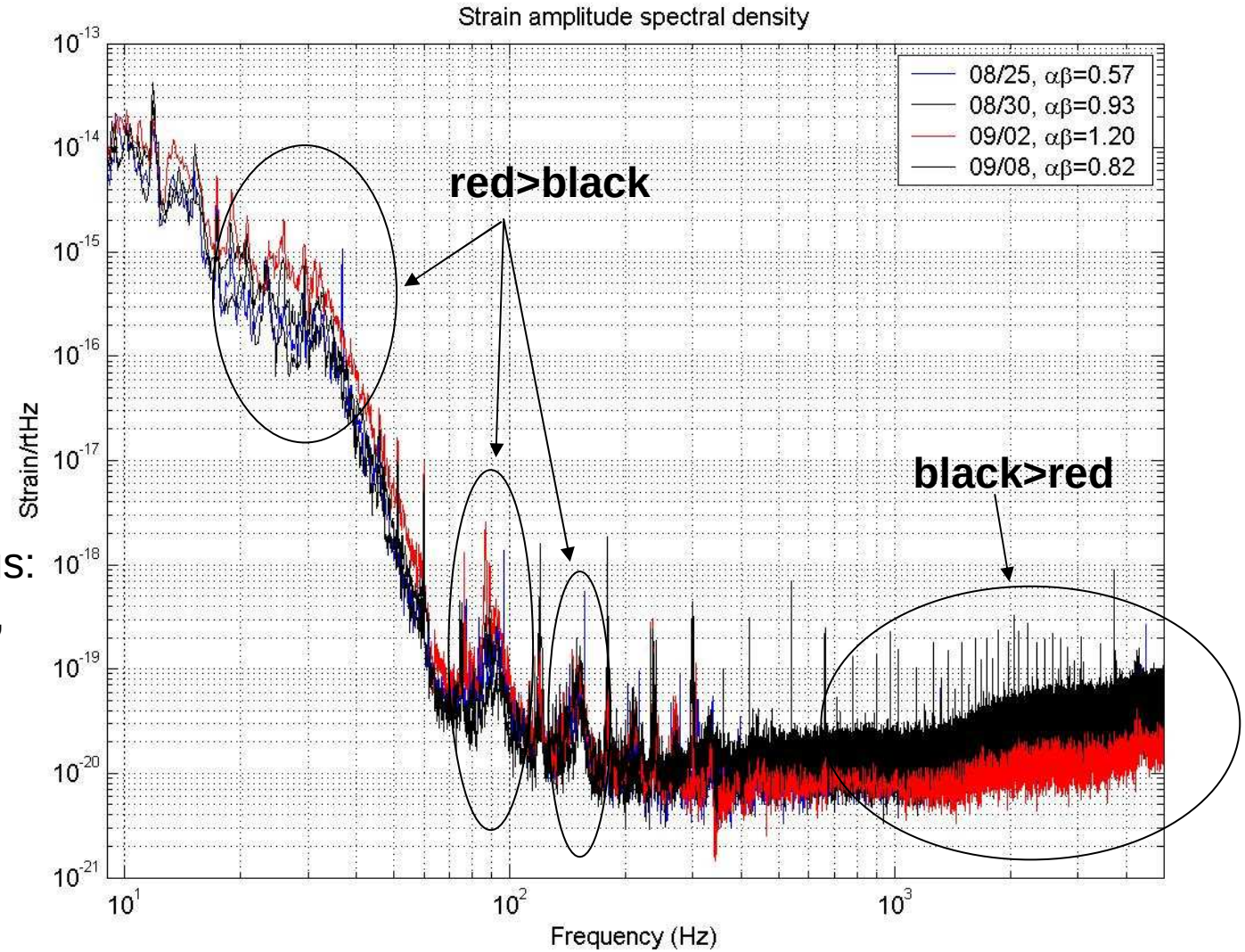


Range, histograms, calibration: all related, but all the same?



Not really :

gain is not the only indicator of noise (or even a good one)



Bilinear couplings:
V. Chickarmane,
R. Adhikari

Conclusions

There's a lot of work to do!

- Understand the noise:
  - Dominant sources
  - Not-so-dominant sources
  - Model comparison
  - …
- Find out a good tracking calibration method

- Keep the alignment controlled so that the calibration does not change!

- Find good criteria to evaluate performance in REAL TIME