Update on LLO-ALLEGRO stochastic analysis
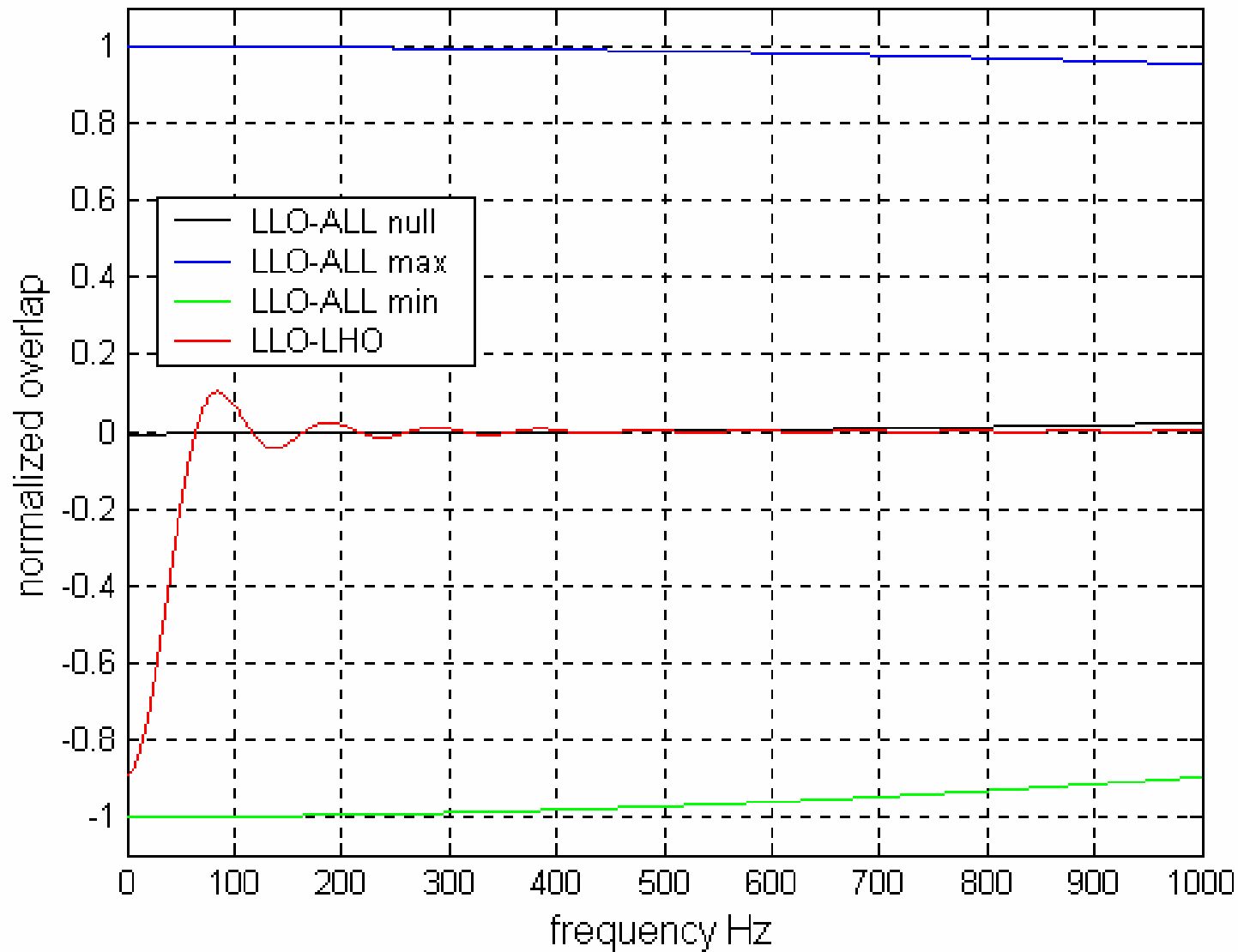
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Motivation for pursuing LLO - ALLEGRO correlation

- Good overlap (40 km separation) – sensitive to higher frequency range than LLO-LHO

- Modulate the signal – rotate to align/misalign/anti-align antenna patterns *
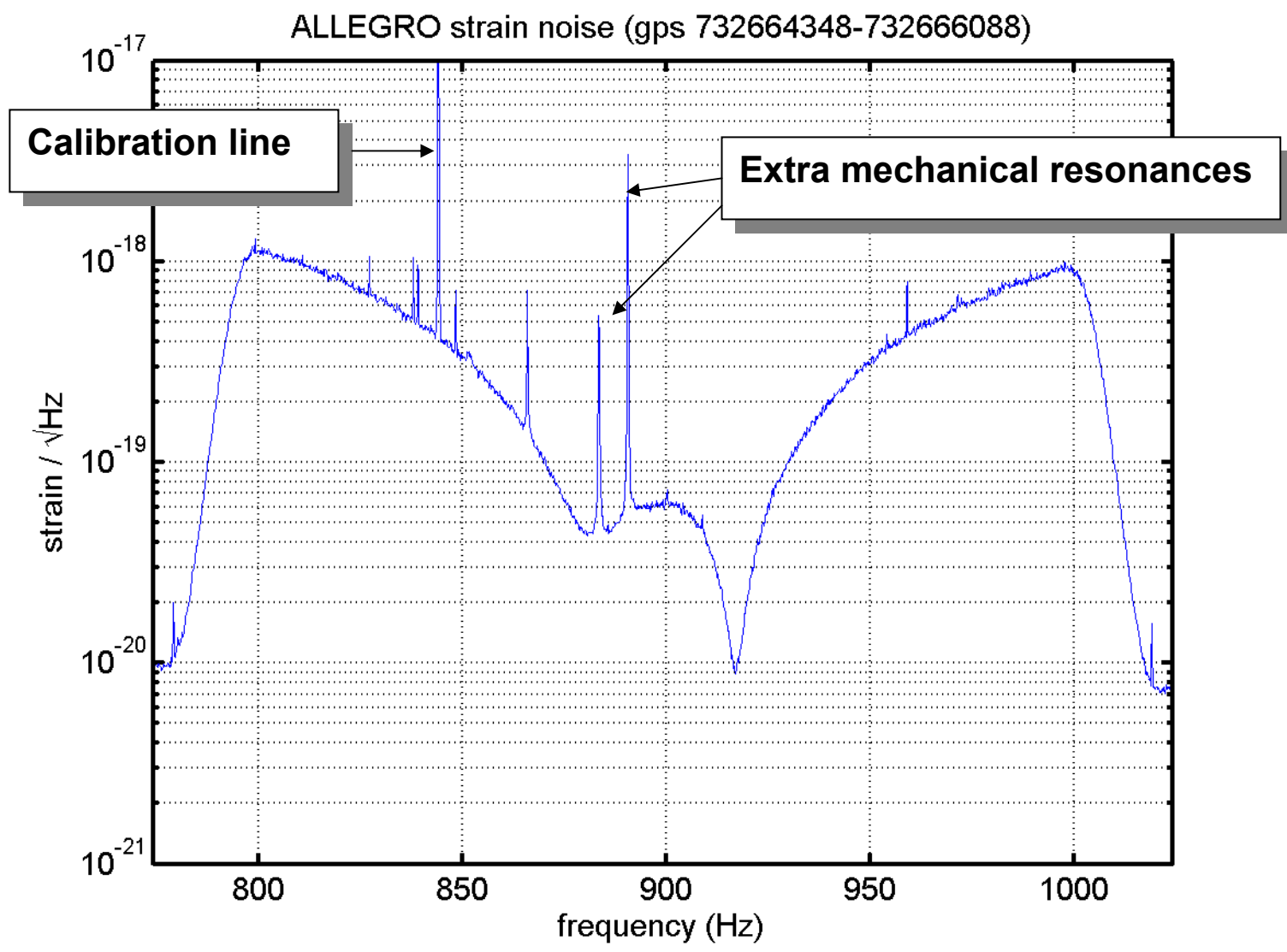
- Another independent detector

*Modulating the experimental signature of a stochastic gravitational wave background, **Lee Samuel Finn and Albert Lazzarini** Phys. Rev. D **64,** 082002 (2001)   xxx.lanl.gov/abs/gr-qc/0104040

Overlap functions for LLO-LHO and LLO-ALLEGRO for various orientations

ALLEGRO during S2—243hrs coincident with LLO

Orientation	GPS	UTC
Null alignment (63° W of N)	731716133-732132263 732153628-732747448 732758424-732909594	14-Mar-2003 22:28:40- 19-Mar-2003 18:04:10 20-Mar-2003 00:00:15- 26-Mar-2003 20:57:15 27-Mar-2003 00:00:11- 28-Mar-2003 17:59:41
Aligned with Y-arm (18° W of N)	732935836-733198936 733450252-733779682 733813685-733960813	29-Mar-2003 01:17:03- 01-Apr-2003 02:22:03 04-Apr-2003 00:10:39- 07-Apr-2003 19:41:09 08-Apr-2003 05:07:52- 09-Apr-2003 22:00:00
Aligned with X-arm (62° E of N)	733964413-734378555	09-Apr-2003 23:00:00 – 14-Apr-2003 18:02:22

ALLEGRO strain noise (gps 732664348-732666088)

Calibration line

Extra mechanical resonances

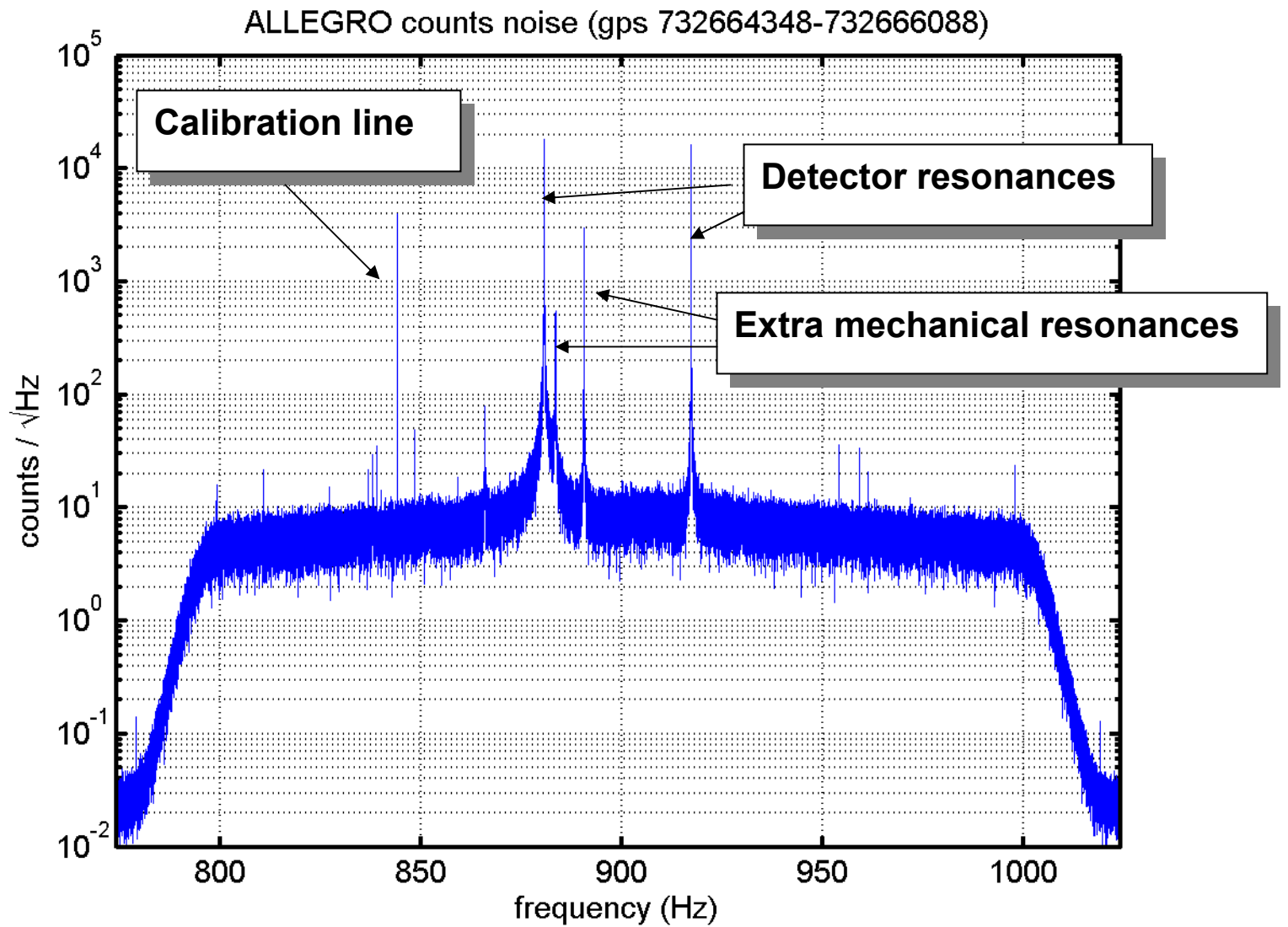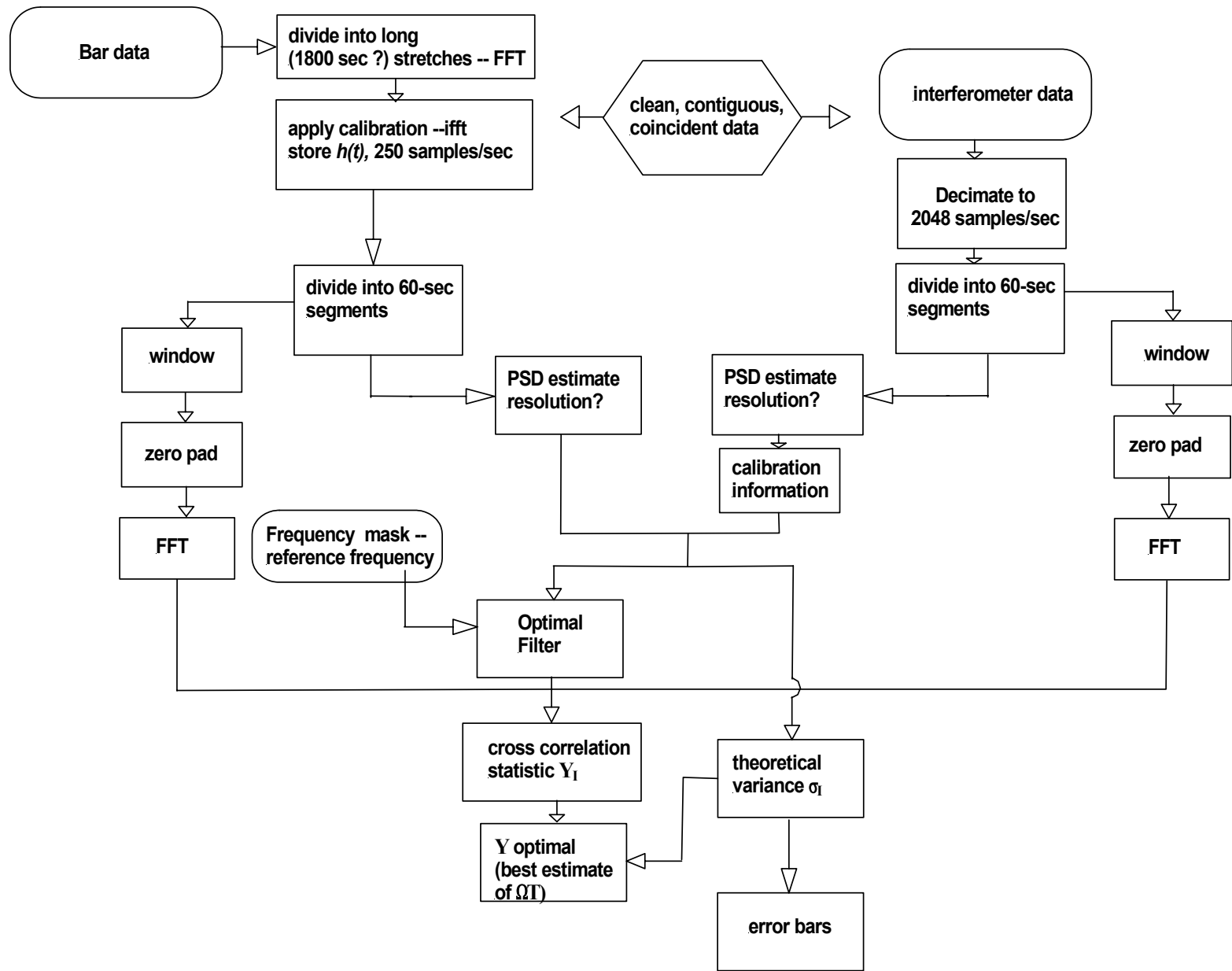LSC meeting, LIGO Hanford
Observatory 12 November, 2003

Expected S2 sensitivity

- Over 2Hz around 917Hz
  - ALLEGRO strain $\quad \sim 2 \times 10^{-20} \frac{1}{\sqrt{\text{Hz}}}$
  - LLO strain $\quad \sim 1.2 \times 10^{-21} \frac{1}{\sqrt{\text{Hz}}}$

- for 240 hrs of data $\quad \Omega \approx 25$

Issues

- Heterodyning – bar data is in-phase and quadrature output of a lock-in amplifier with reference frequency (899 Hz for S2)

- sampling rate – 250Hz

- frequency resolution and dynamic range – raw output is 2 sharp lines at the bar resonant frequencies

- Data preparation/cleaning

ALLEGRO counts noise (gps 732664348-732666088)

LSC meeting, LIGO Hanford
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Bar–Ifo Stochastic Analysis Chain

- Calibrate bar data (freq domain) to get h(t) time series (250 Hz), store in frames – eliminates sharp spectral features that require high resolution
- Decimate ifo data to 2048Hz
- Cross-correlation in frequency domain – bar reference frequency an integer number of Hz (899 for S2) so frequency bins line up

Recent/current activities

- Calibration

- Frames of S2 data have been made

- SimulateSB module of inject package modified to do simulations for bar-ifo analysis

- ALLEGRO installed new calibrator, fixed many leaks, aiming to take data for second half of S3

Calibration

- calibration pulse method too noisy

- Response function model
  - Need 4 numbers, 2 mode freqs, gain and phase
  - Tests indicate we can stitch together strain time series with overlapping stretches
  - Tukey windowing?