S4/S5 Calibration

The Calibration team

http://blue.ligo-wa.caltech.edu/engrun/Calib_Home/

G050430-00-Z

S4 Calibration

- V1: only reference functions
- V2: do not use!
- V3:
  - new H1 and H2 reference functions (added time delay);
  - calibration coefficients α, β (t_s=60 sec and 1 sec)
- V4 (not ready yet - but will be final!):
  - LHO reference functions with filter residuals
  - New measurements of cavity poles
  - Consistency checks of DC calibrations
  - Error estimates
  - Calibration document
- Other news:
  - A cvs repository
  - No formal review yet
  - A specifications document in preparation (D. Brown)
  - S3 document & paper for reference in S3 papers (available in cal page)

S4 Calibration sign(s)

DARM_EXC
(cal line)

DARM_CTRL

DARM_ERR

ETM
(hw

AS_Q

Digital
filters

Input matrix
(-ve) ~β(t)

Output
matrix
(-ve at L1,
+ve at H1.H2)

Digital/Analog
filters

Analog/Digital
filters

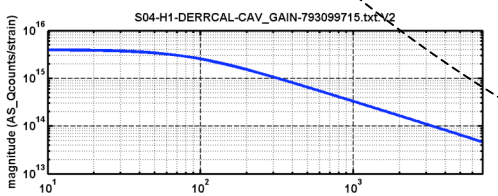
Pendulum

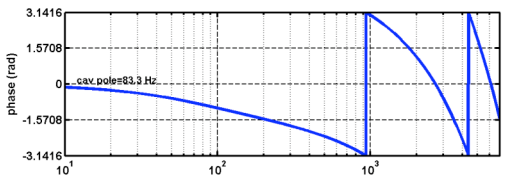
Mixer

α(t)
Interferometer

External excitation
(GWs!)

DARM==L_x- L_y





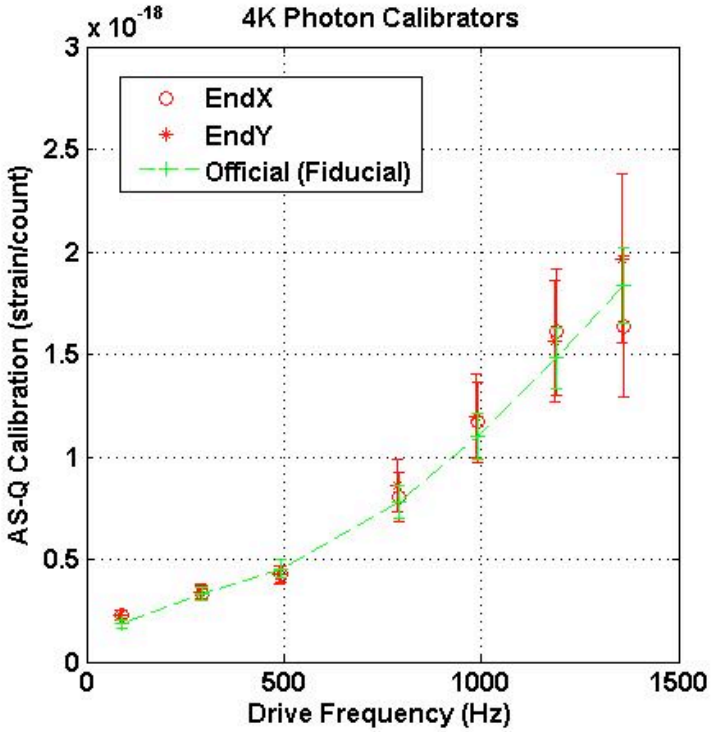
$$R(f,t) = \frac{1+\alpha(t)\beta G_0(f)}{\alpha(t)C_0(f)}.$$

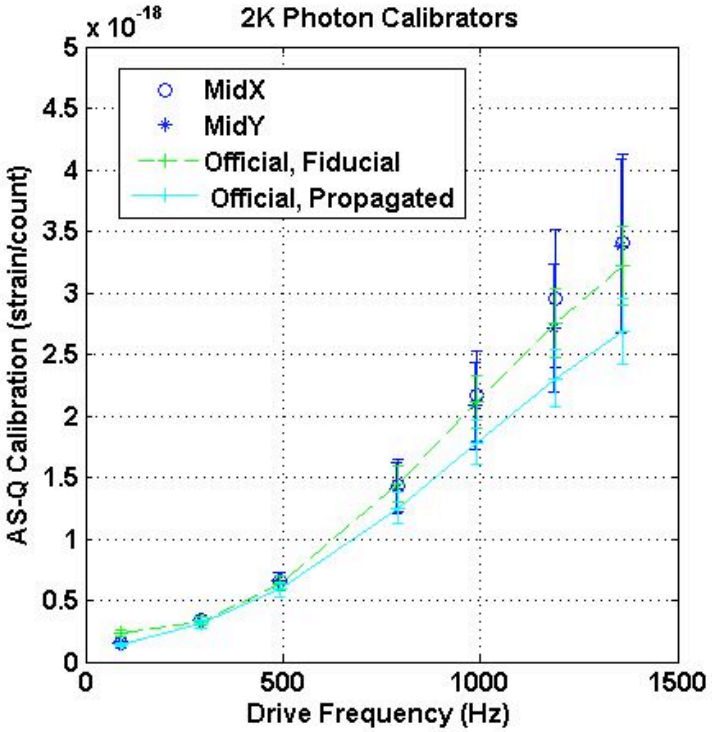
$$G_0(f) = C(f)D(f)A(f)$$

Photon Calibrators

Peter Kalmus (Columbia University): see talk on det char session for details!

- Installed and working in LHO: results consistent with present calibration
- Installed and ready to commission in LLO
- Plan to use them for pre-S5 calibration, and propose to keep a line during S5.



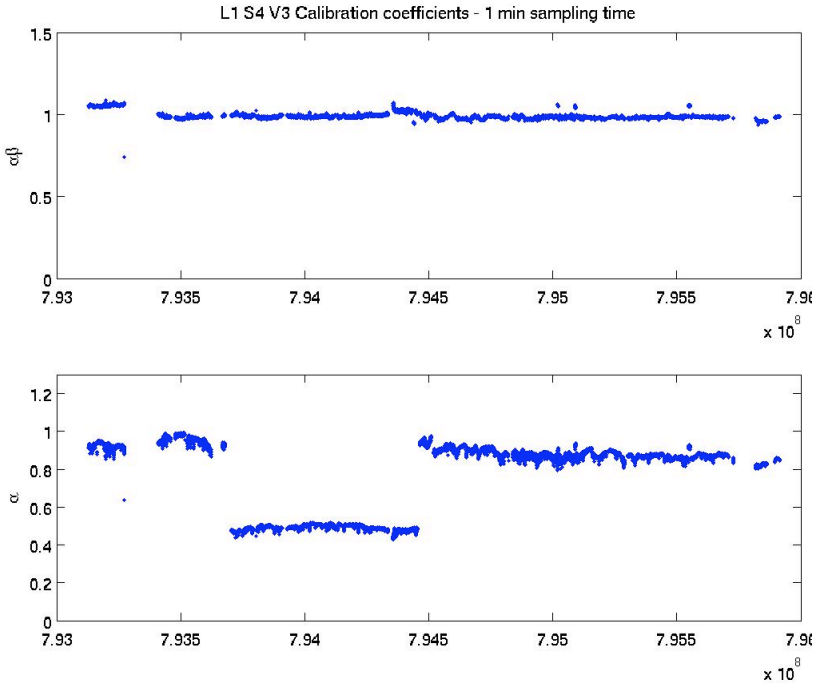


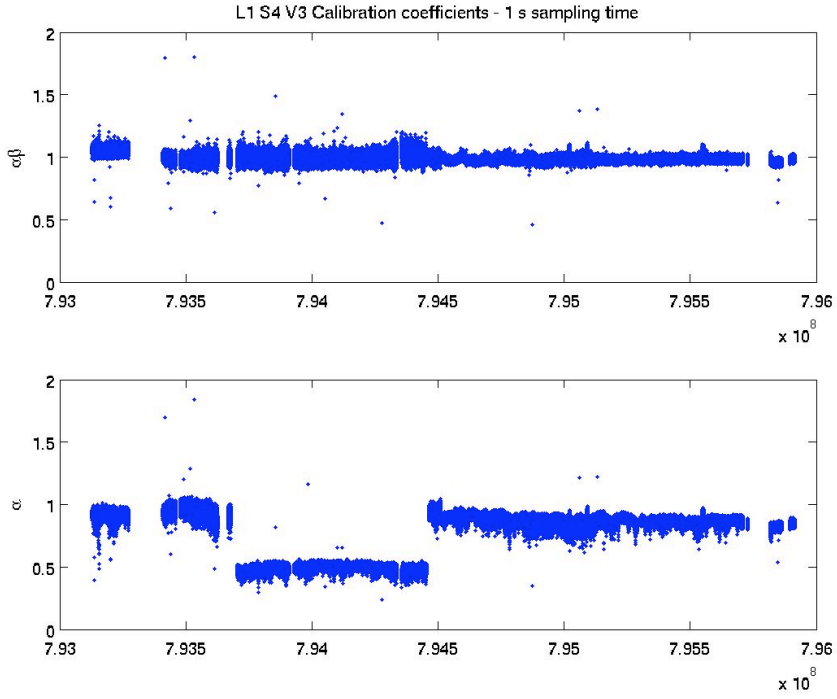
S4 Calibration Coefficients

Myungkee Sung

http://ligo.phys.lsu.edu/sung/Factors/S4/factors/3/AnalyseFactors.html

- Uses same LAL code as h(t) (but not necessarily identical coeffs)
- 1sec and 1min sampling time

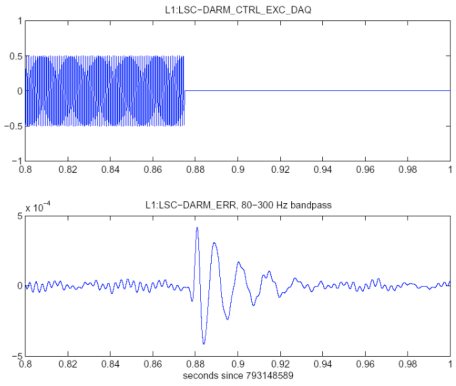


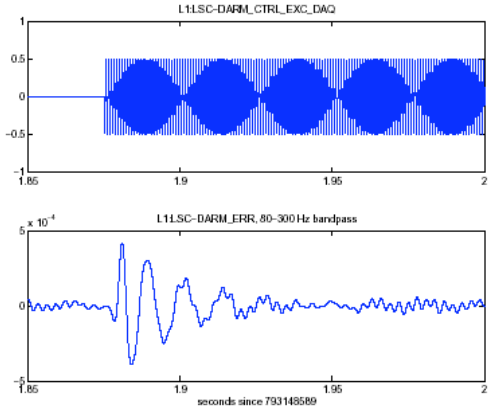


S4 Calibration Data Quality Flags

- CALIB_LINE_DROPOUT
  - 2^13 Short dropout of injected calibration line (can cause transients in GW channel)
  - Created by John Z., 3 sec long, looking for glitches in filtered EXC channel
- CALIB_LINE_V01
  - 2^28 No calibration line or line strength out of range
  - Created by M. Sung, 2 sec long, looking for outliers in loop gain sampled at 16 Hz
  - (dropputs + glitches in loop gain)
- CALIB_LINE_V03_60_SEC
  - 2^35 No calibration line or line strength out of range during minute
- CALIB_LINE_V03_1_SEC
  - 2^36 No calibration line or line strength out of range during second
  - M. Sung, flagging zero or bad coefficients for S4 V3 calibration
- Effect on inspiral triggers: see inspiral log entry

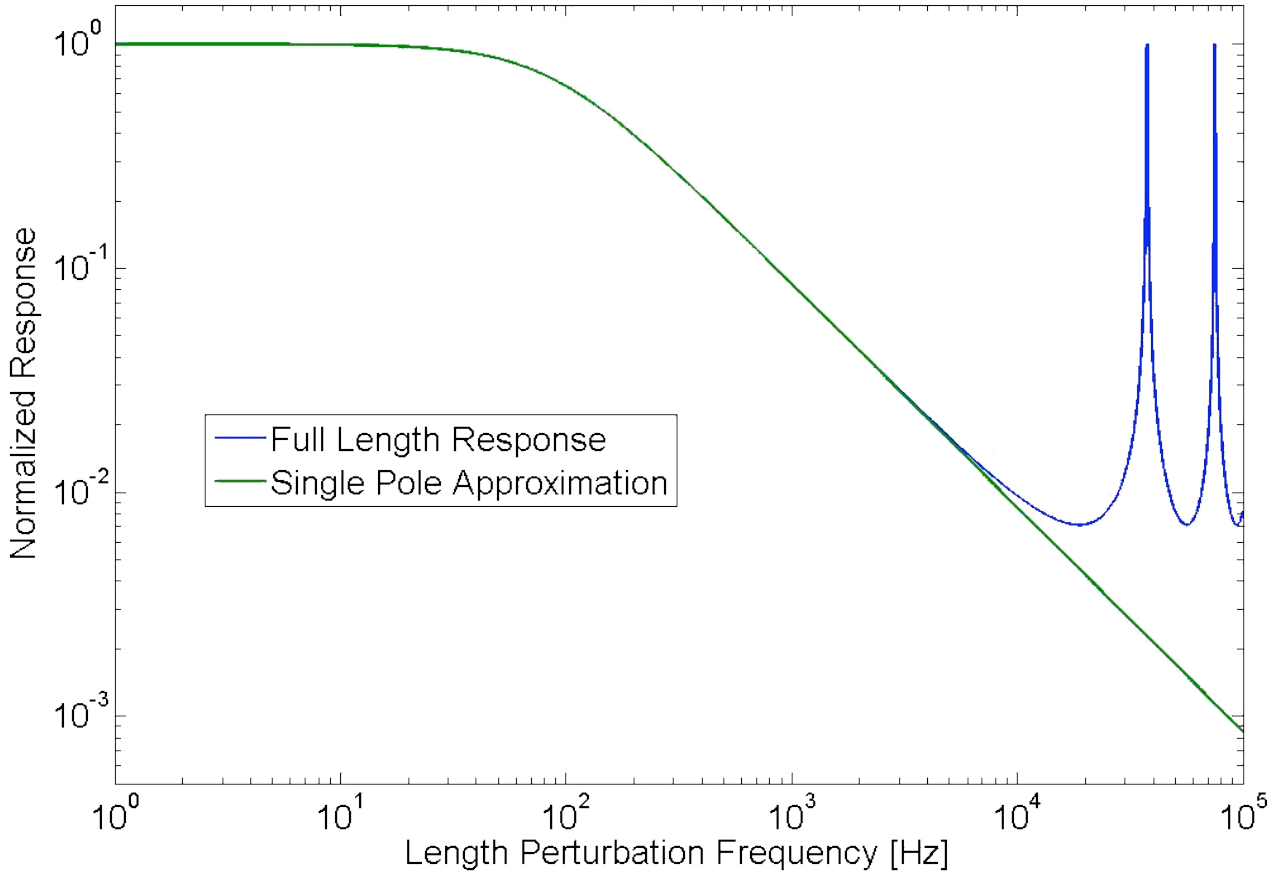
http://www.lsc-group.phys.uwm.edu/cgi-bin/enote.pl?nb=iags4detchar&action=view&page=17





The “real” calibration

- Hunter Elliott (+Rick Savage, Greg Mendell, Malik Rakhmanov)



Also, see technical documents by Rochester group (Melissinos et al) in cal page

S5 calibration

- Measurements needed:
  - Mirrors DC actuation (vetted with photon calibrators)
  - Cavity poles
  - Hardware filters
  - Open loop gains
  - Consistency with autocalibrator
  - Signs (!)
- Models:
  - same as S4 (with new parameters)
  - Plus high frequency response
- Coefficients:
  - Calculated promptly (hours?), vetted and posted ASAP (days?)
- How often do we want to break and have “calibration runs” to check loop gains, DC calibrations, etc?
- What accuracy do we want, at what sampling rate? Online, offline?
  - 10% systematic is ~easy (!), 1% takes years (if possible)
  - The shorter the sampling time, the larger the lines (+ sidebands).