LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Document Type	**LIGO-G000032-00-E**	Apr. 2000

Application of e2e to W2K IFO
- Talk at LSC meeting on 3/17/2000 -

Hiro Yamamoto

Distribution of this draft:

xyz

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California Institute of Technology
LIGO Project - MS 51-33
Pasadena CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project - MS 20B-145
Cambridge, MA 01239
Phone (617) 253-4824
Fax (617) 253-7014

WWW: http://www.ligo.caltech.edu/

Application of e2e to W2K IFO

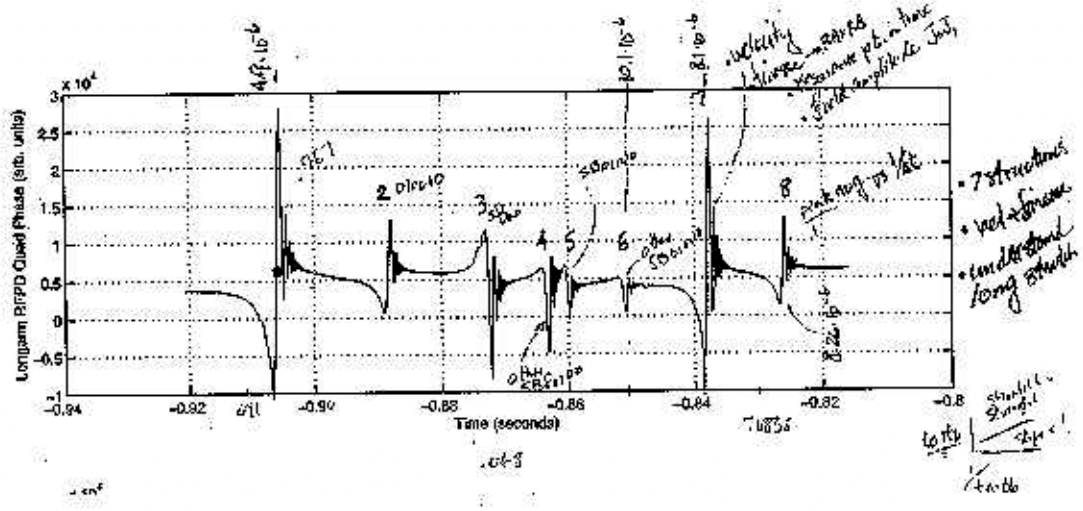
Hiro Yamamoto / LIGO Lab

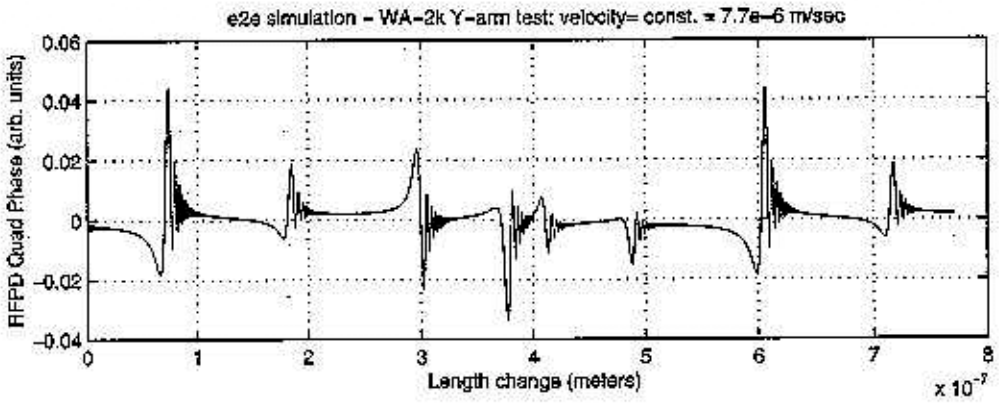
LIGO Livingston Observatory

March 17, 2000

- Luca built W2K FP servo model in a month, going to include WFS
  - » GUI HELPED
- From notes (Biplab, Rick, Kells)
- Ringdown data study (Hiro)
- PSL reference cavity (Cella)
- Seismic motion generator (Matt)
- Lock Acquisition (Matt)
  - » better optics model
  - » alignment included
  - » realistic seismic noise
  - » flexible environment

Fringe structure revealed



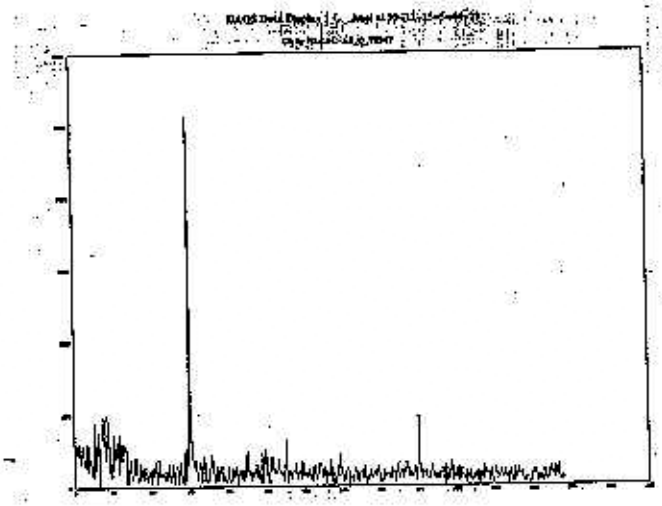


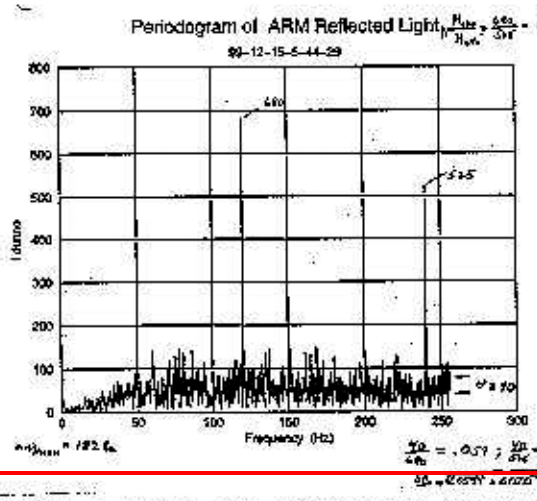
60Hz laser noise revelased

...about a factor of 5) peak at 180 Hz. The periodogram of the reflected light signal showed a peak at 120 Hz and a smaller (by about 1.3) peak at 240 Hz.

During a discussion on 12/15/99 Daniel Sigg proposed that the data may be explained by frequency modulation at only 60 Hz.

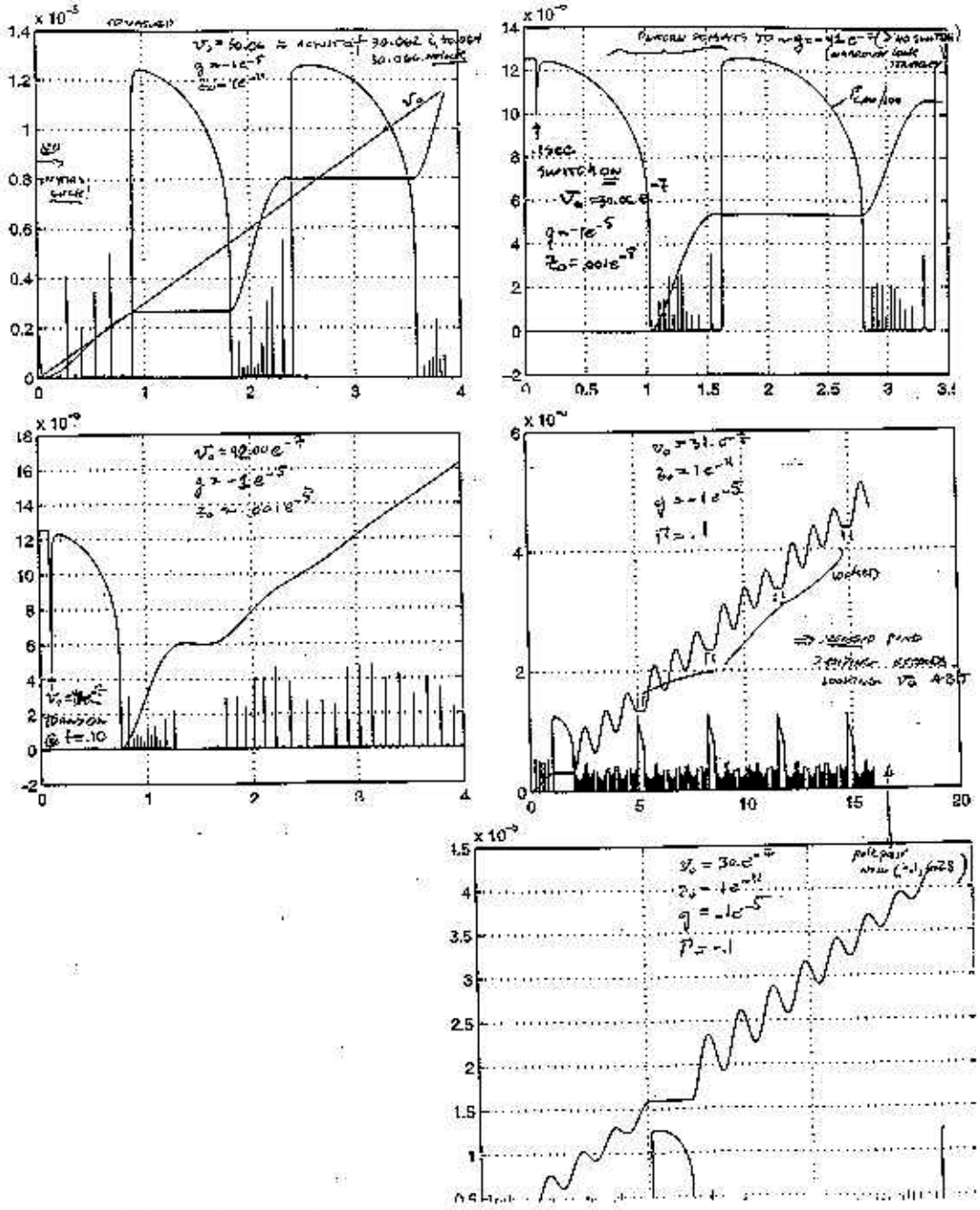
Biplab and Rick used the M2K model to simulate frequency modulation (actually length modulation) with the long arm cavity. See ~e2e/033_arm/60Hz/ for all the relevant e2e .box files.



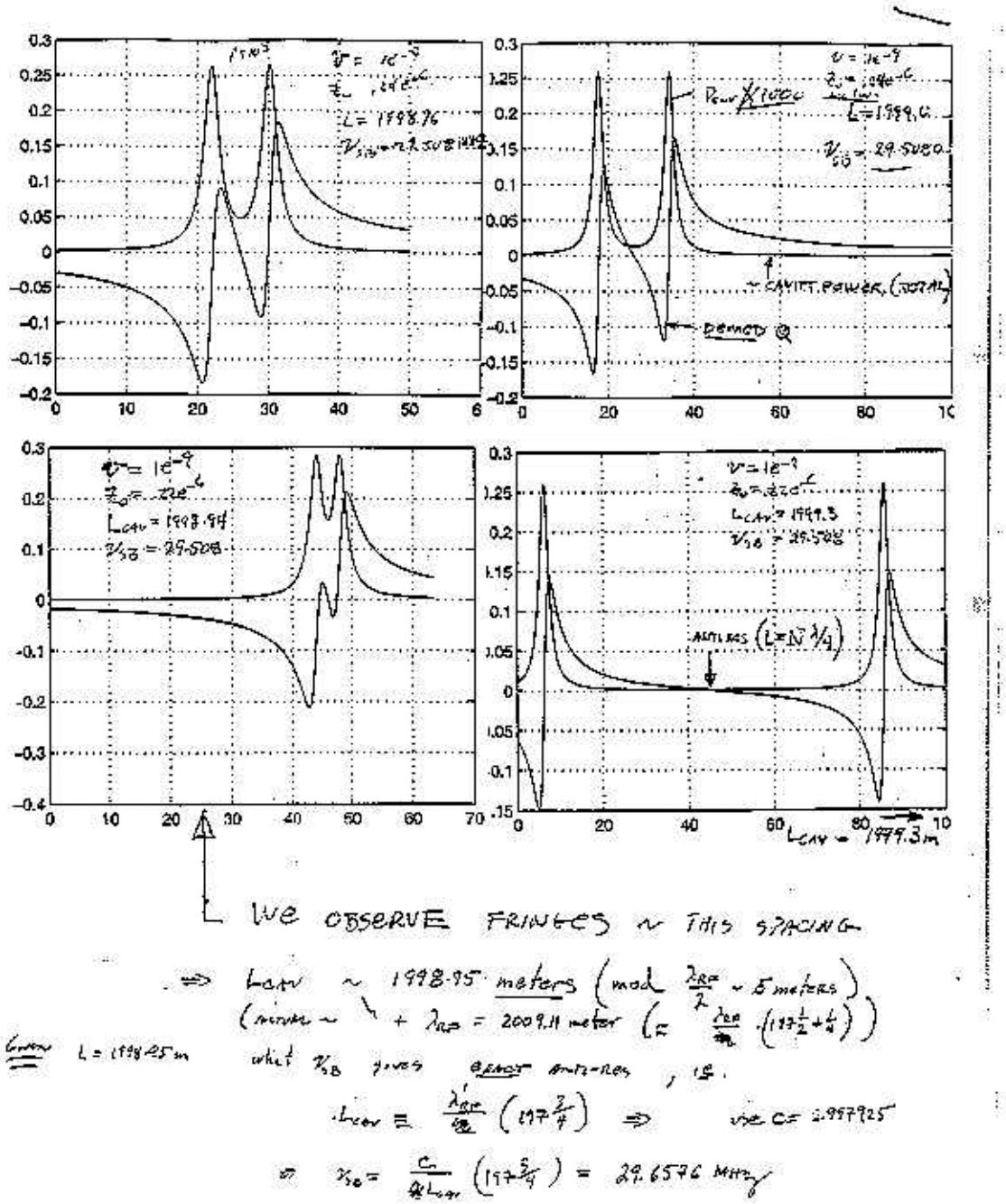


Conclusion: Modulation amplitude of 2.55*HWHM gives the observed ratio of 60Hz to 180 Hz in the RFPD In Phase signal and the observed ratio of 120Hz to 240Hz in the Reflected Light signal. 2.55*HWHM corresponds to 464 Hz peak. This will be compared to observed signals such as control signals from the mode cleaner in an effort to locate and eliminate the source of the 60 Hz modulation.

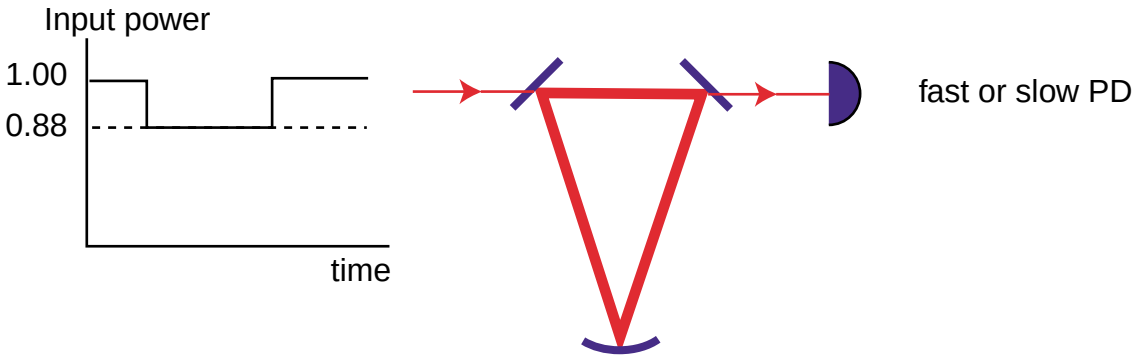
Tidal effect studied

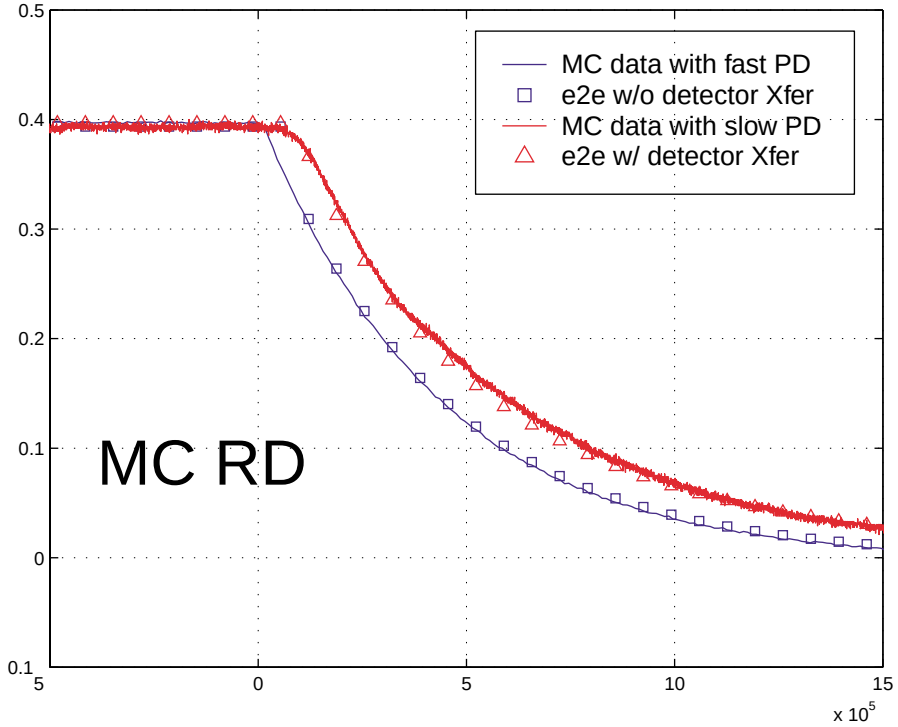


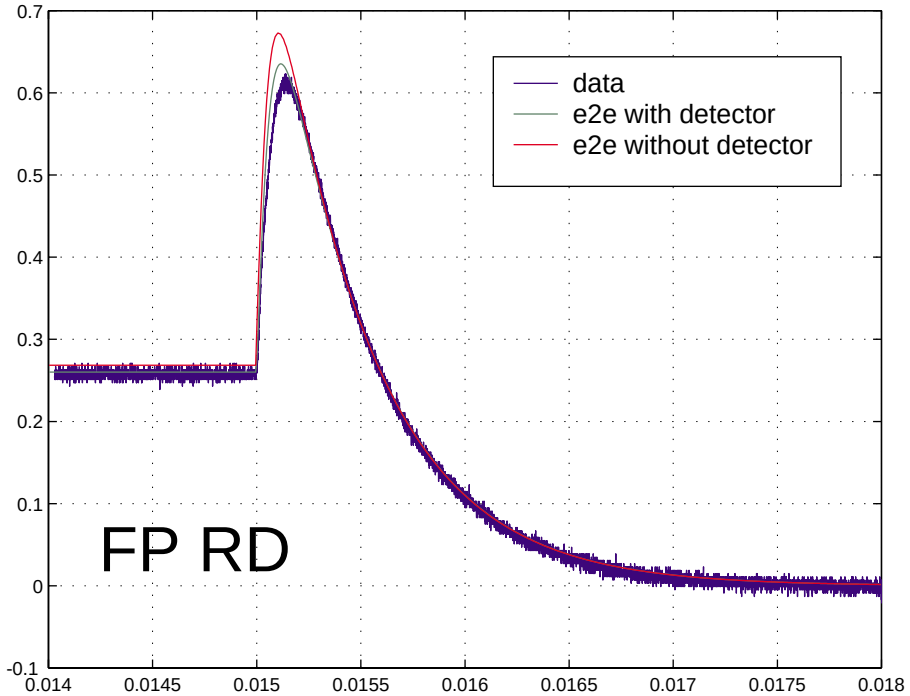
Arm length “measured” with sub cm accuracy



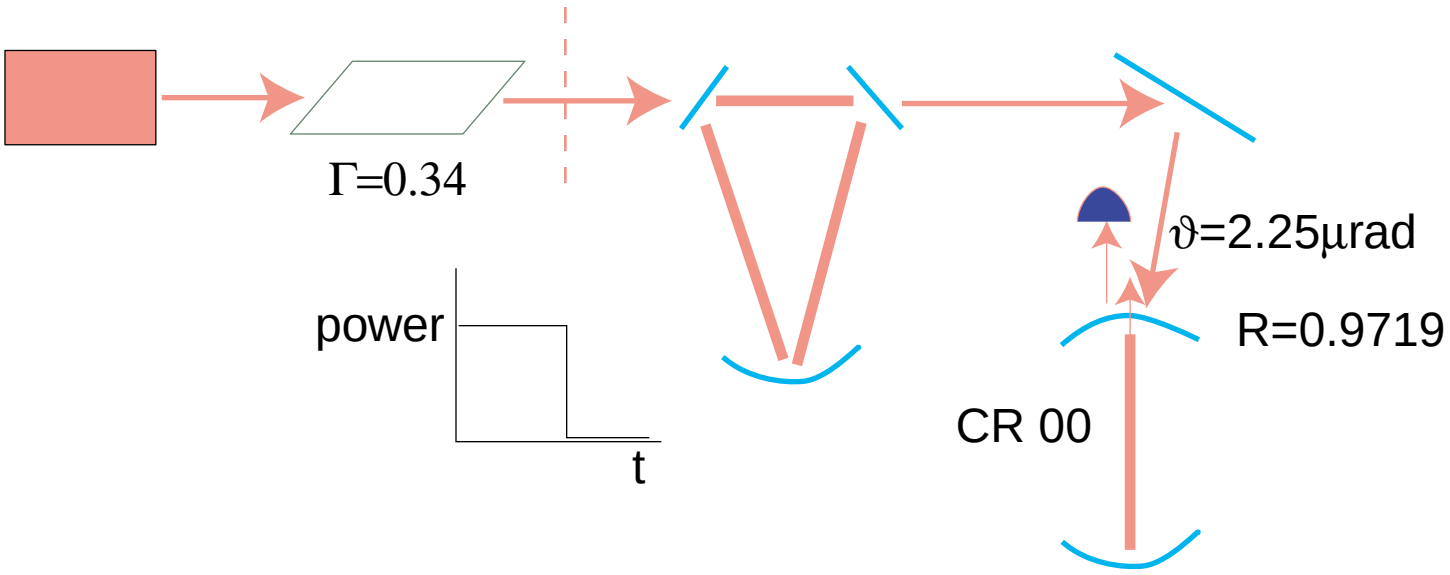
W2K mode cleaner ringdown

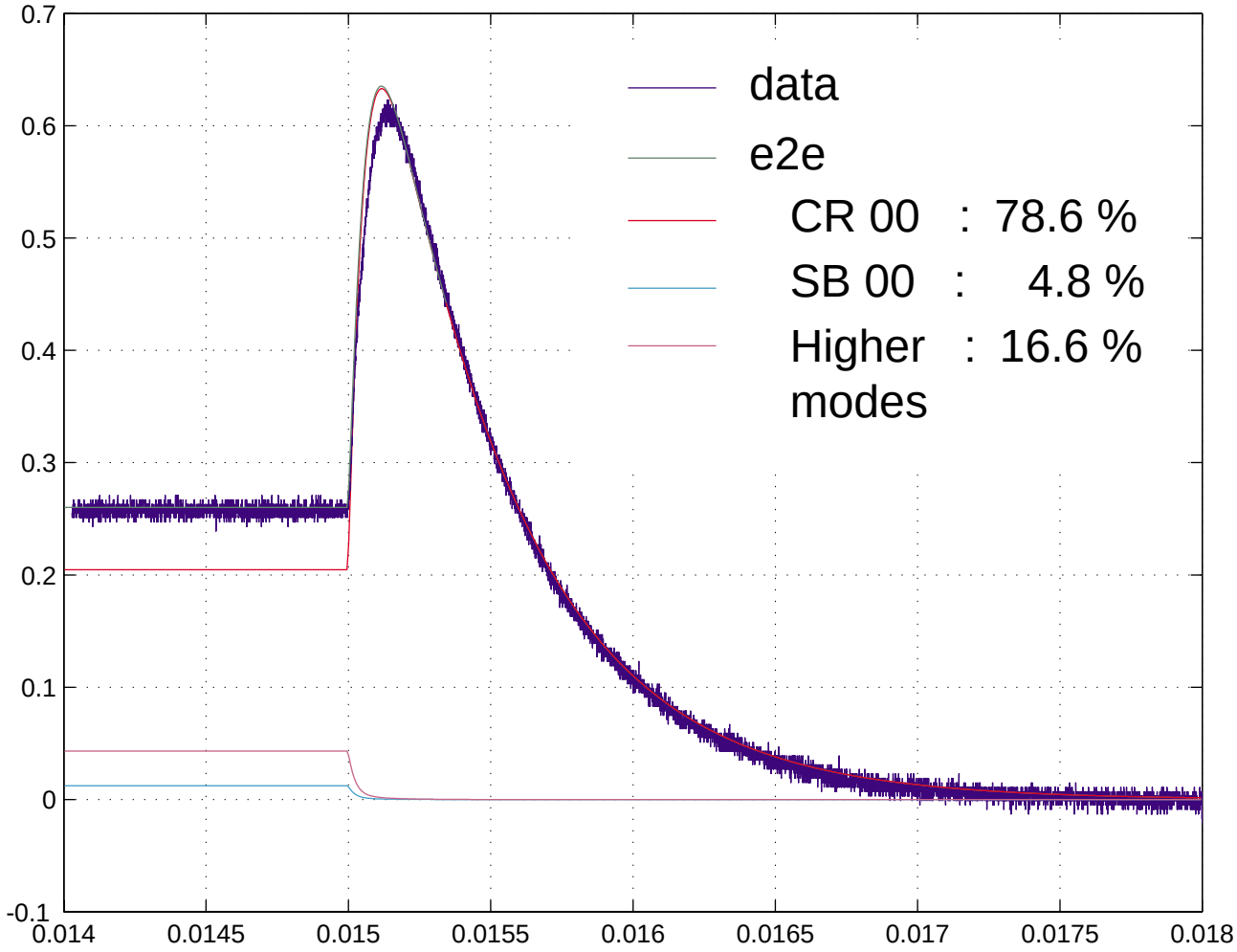




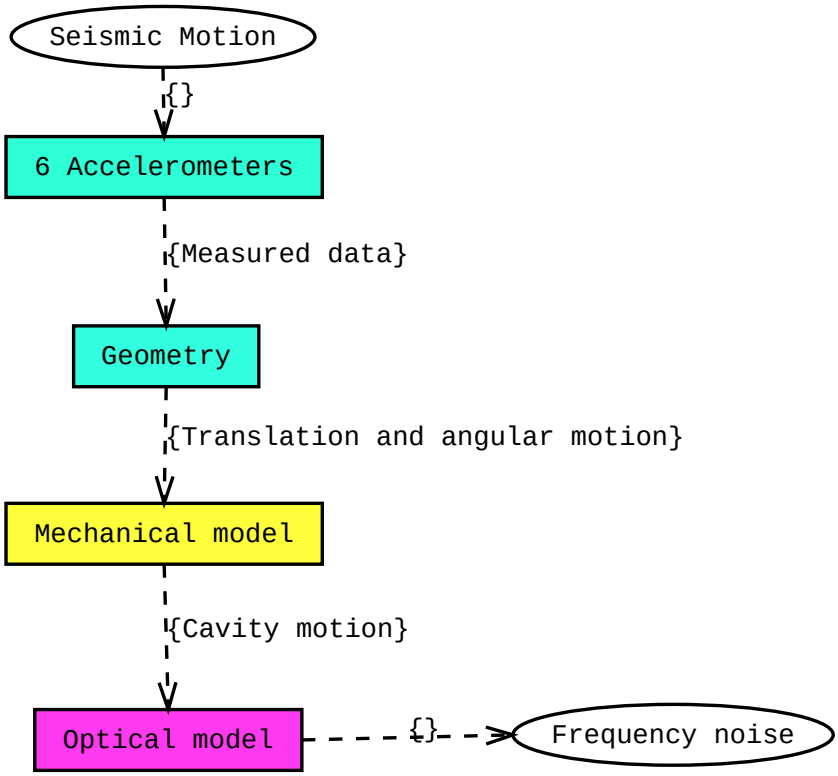


W2K FP ringdown





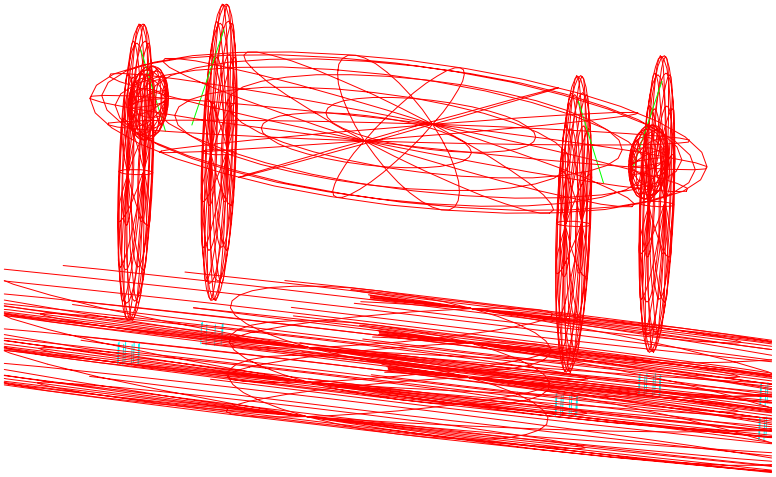
Simple model for the LIGO reference cavity



✔ Reconstruction of rigid body motion of optical table

✔ Mechanical simulation in time domain

✔ Output to optical simulation



- ✔ Cavity,plates and legs are respresented as a rigid bodies
- ✔ Spring suspensions
- ✔ Rubber spring between plates
- ✔ Eddy current damping

Simulation

In addiction to transfer functions the library give also the time evolution under some arbitrary external force.

Improvements:

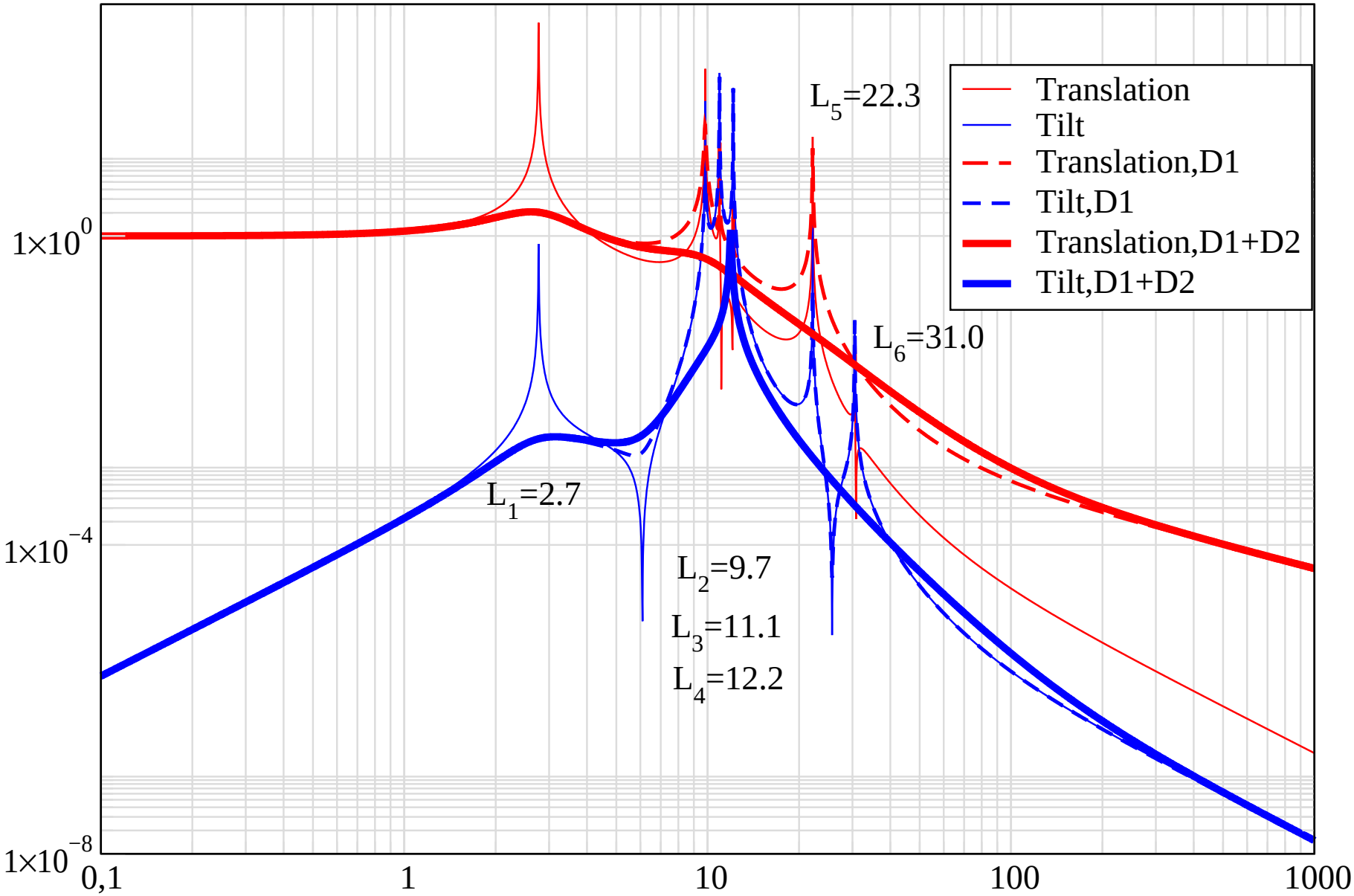
✔ More accurate extimate for damping

✔ Internal modes of the cavity (easy)

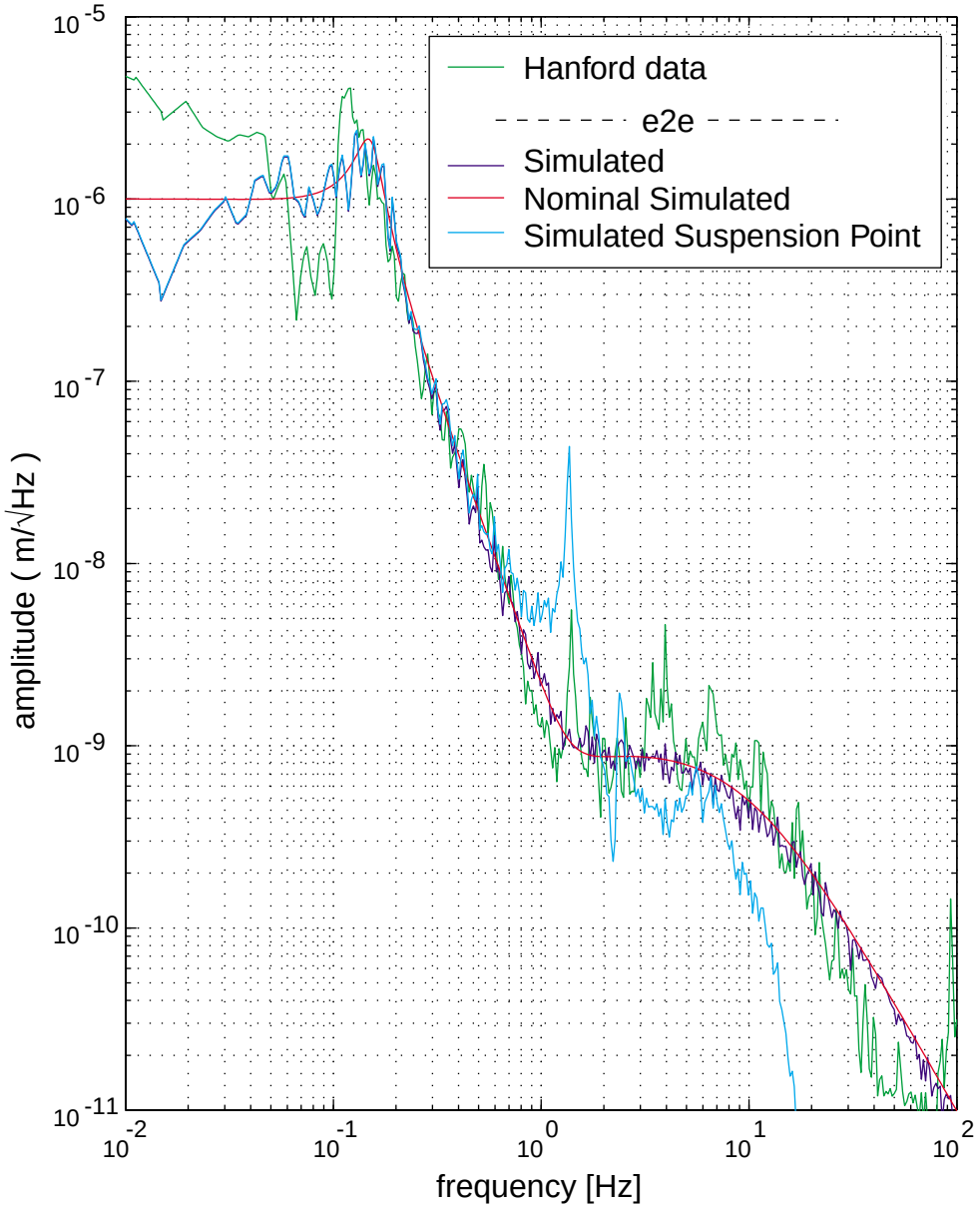
✔ Internal modes for the legs and wires (easy)

✔ Internal modes for the plates (not so easy!)

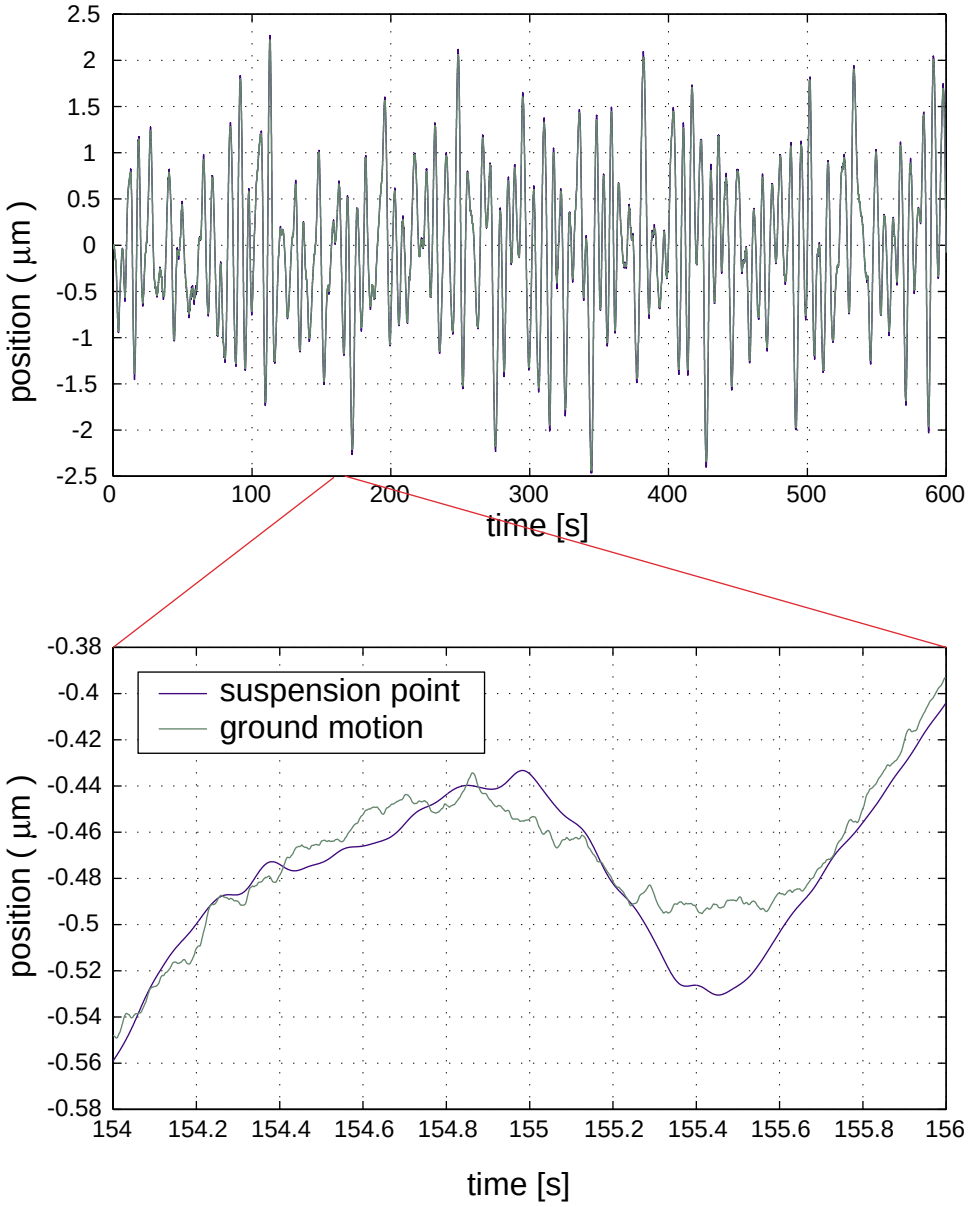
X motion

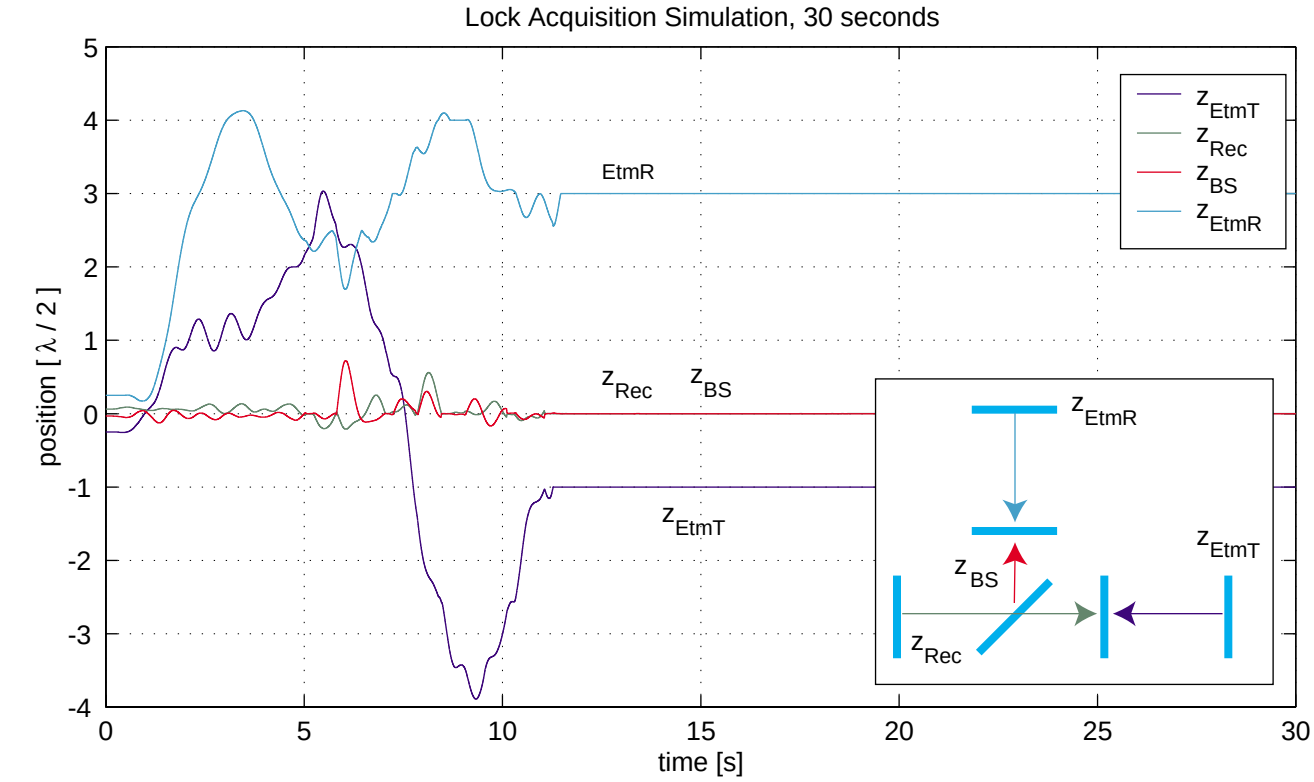

Translation
Tilt
Translation,D1
Tilt,D1
Translation,D1+D2
Tilt,D1+D2
L5=22.3
L6=31.0
L1=2.7
L2=9.7
L3=11.1
L4=12.2
1×10^0
1×10^−4
1×10^−8
0,1
1
10
100
1000

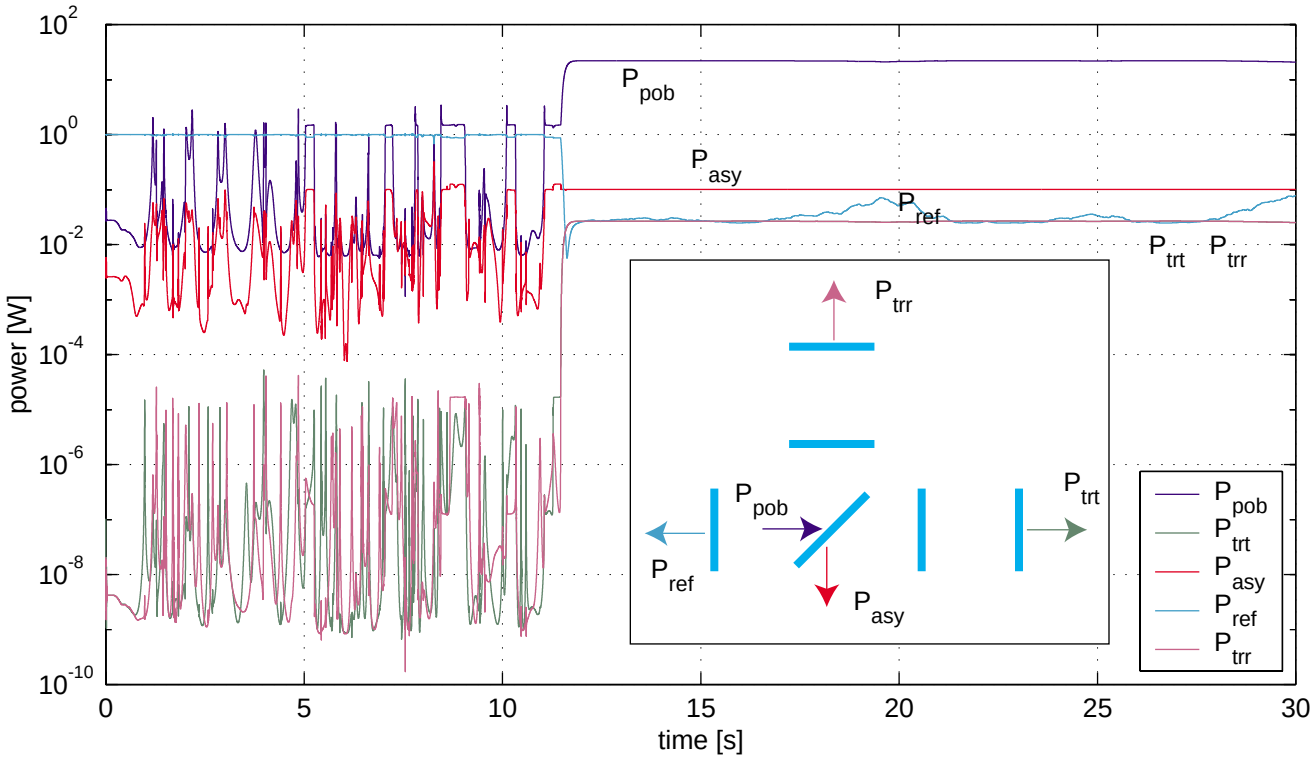
Measured vs. Simulated Seismic Spectra



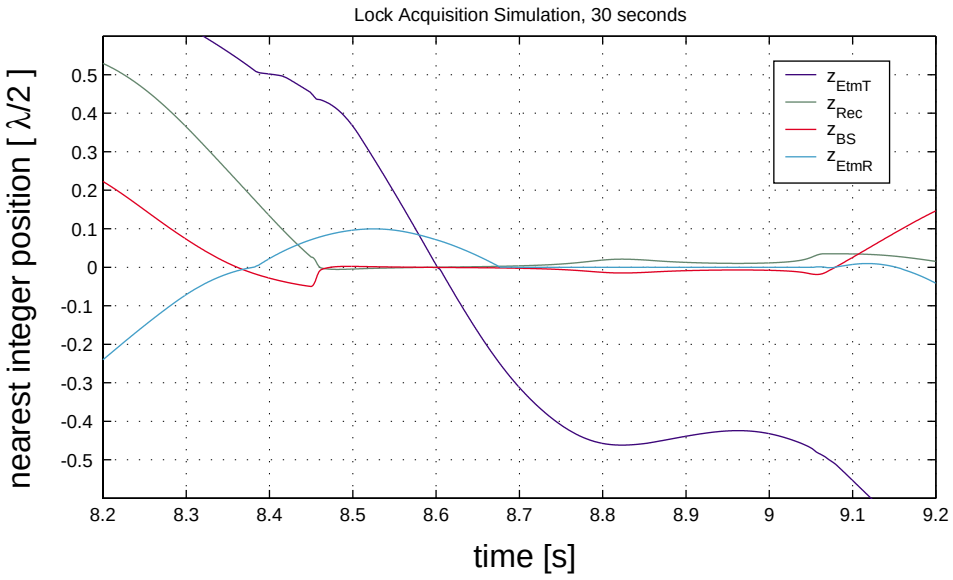
Simulated Seismic and Suspension Point Motion

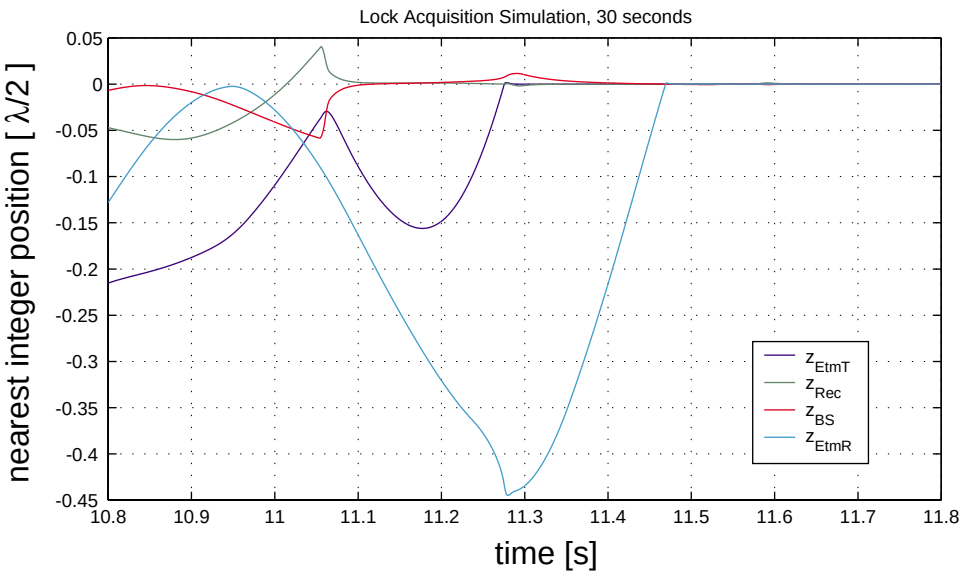


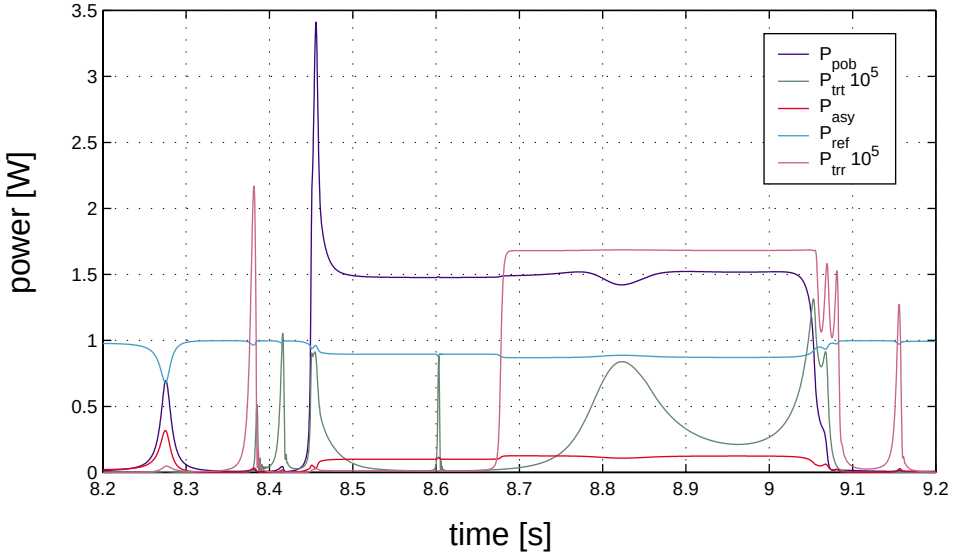


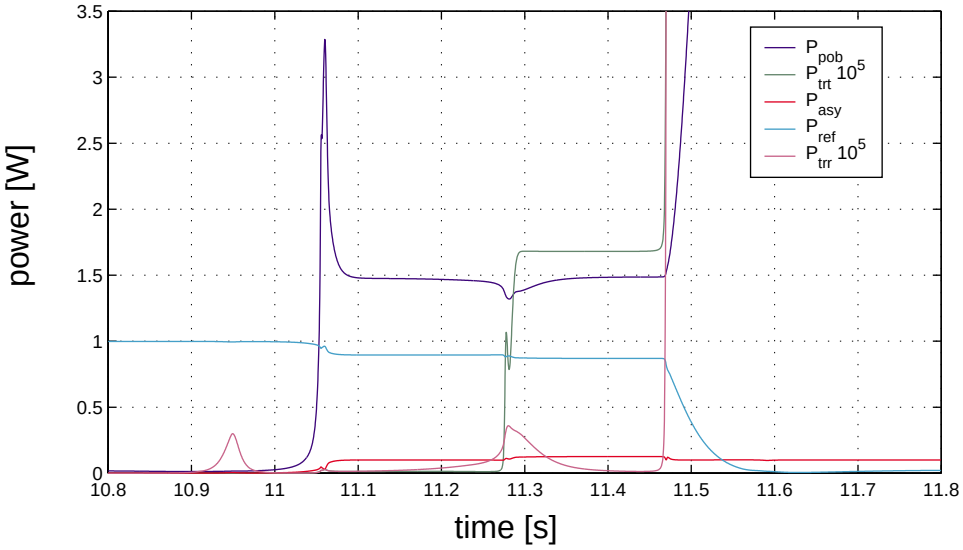


Matt Evans on March 14, 2000









Lock fails

Lock succeeds

Matt Evans on March 14, 2000