Study of AdvLIGO Input Mode Cleaner
- effect of HAM correlations on MC length -

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- Effect of HAM1-2 coherence on MC length
- e2e model of Adv MC
  - MC locations on HAM tables
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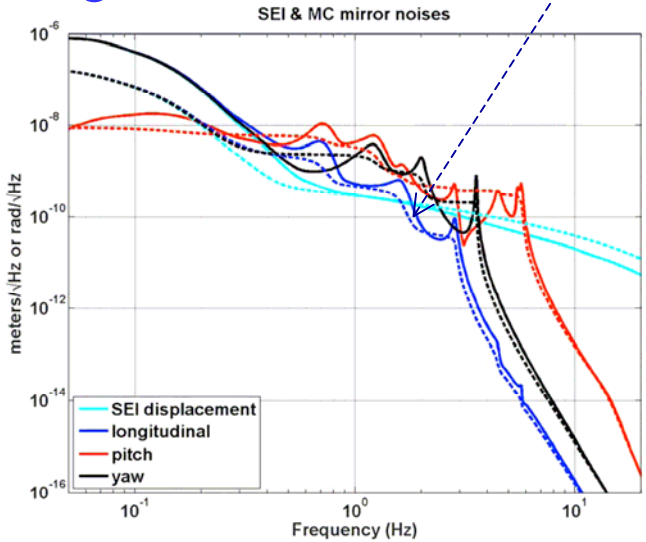
- HAM1 HAM2 coherence measurement
- MC frequency noise due to length fluctuation

MC and arm length fluctuations

MC length noise = MC mirror noise × √3 × (1-coherence) / (1+G) ∝ arm length noise



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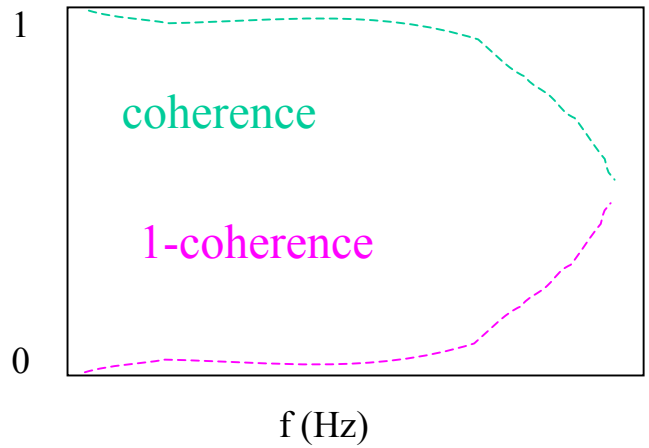

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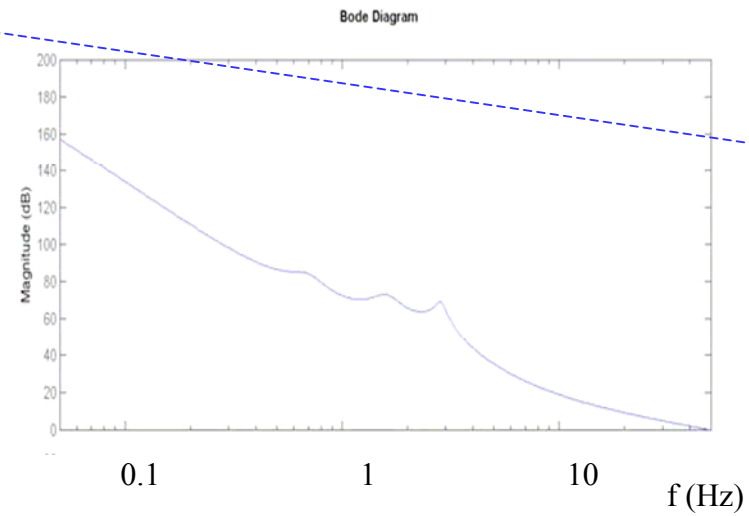

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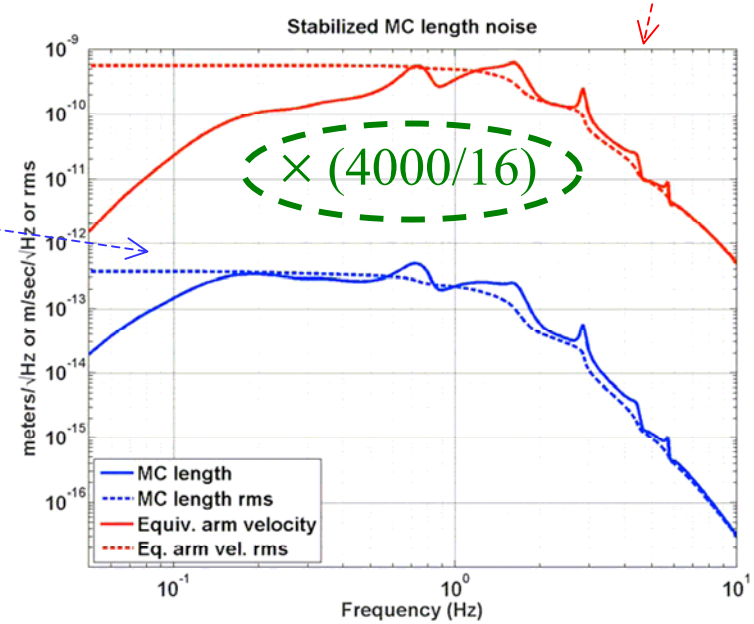
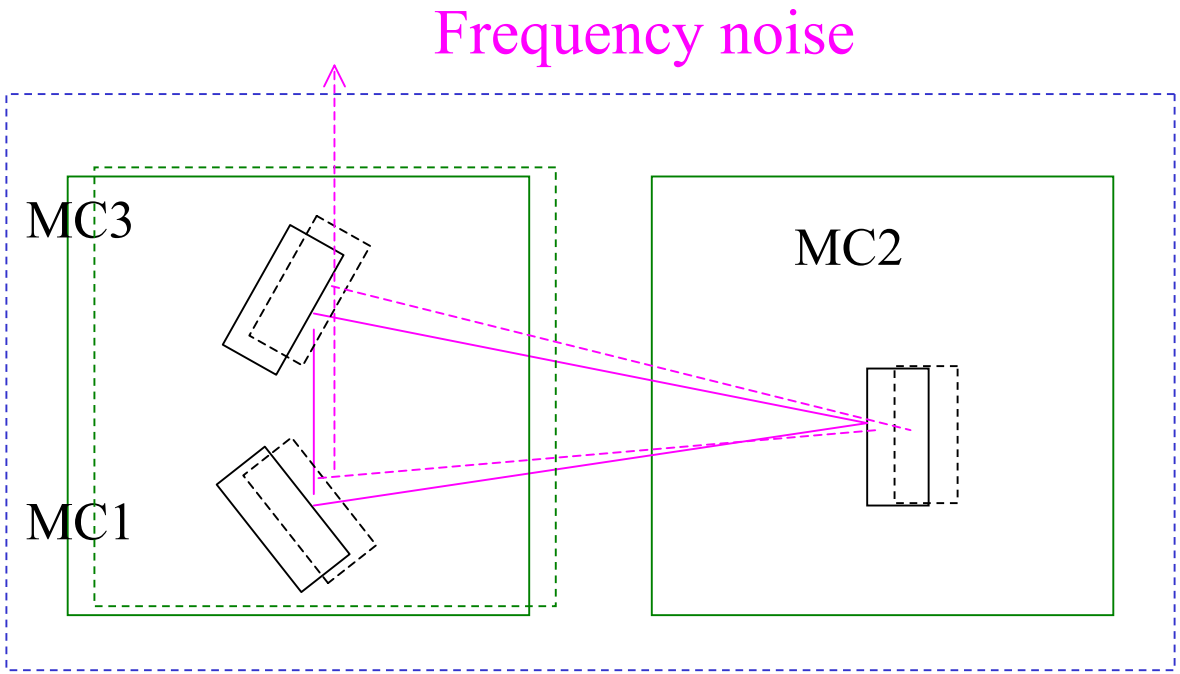


P. Fritschel, LIGO-T060075

HAM1 – HAM2 correlation and MC frequency noise

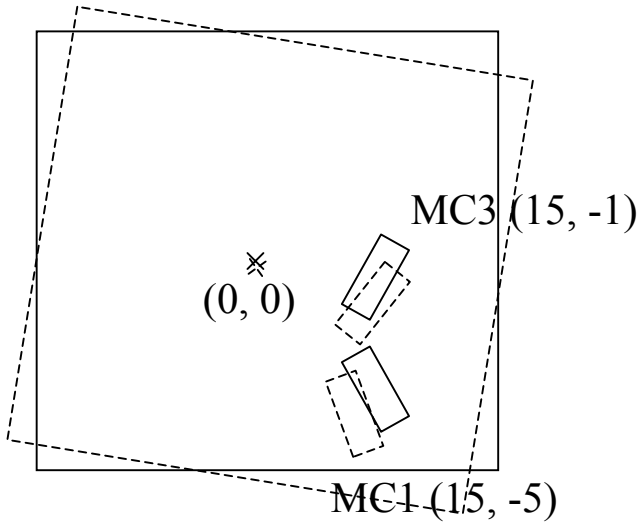


Gnd motion
at HAM1

Gnd motion
at HAM2

e2e model MCs on HAMs

horizontal



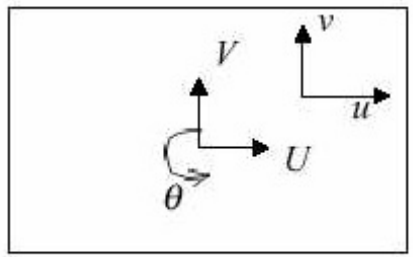
$u = U - x\theta$

$v = V + y\theta$

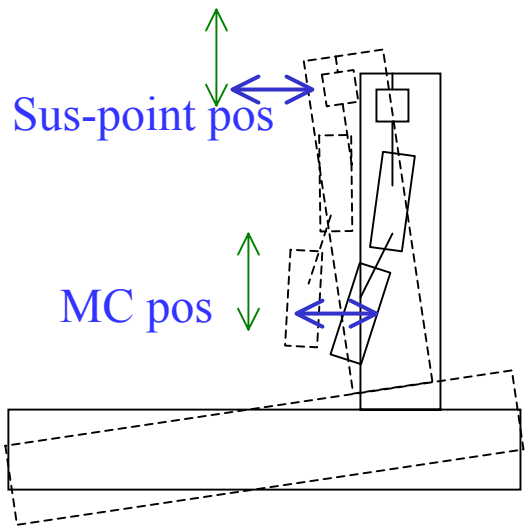
U : Table's center of mass motion

V : Table's center of mass motion

θ : Table's yaw motion



vertical



HAM table pitch/z

↓

Suspension point horizontal displacement

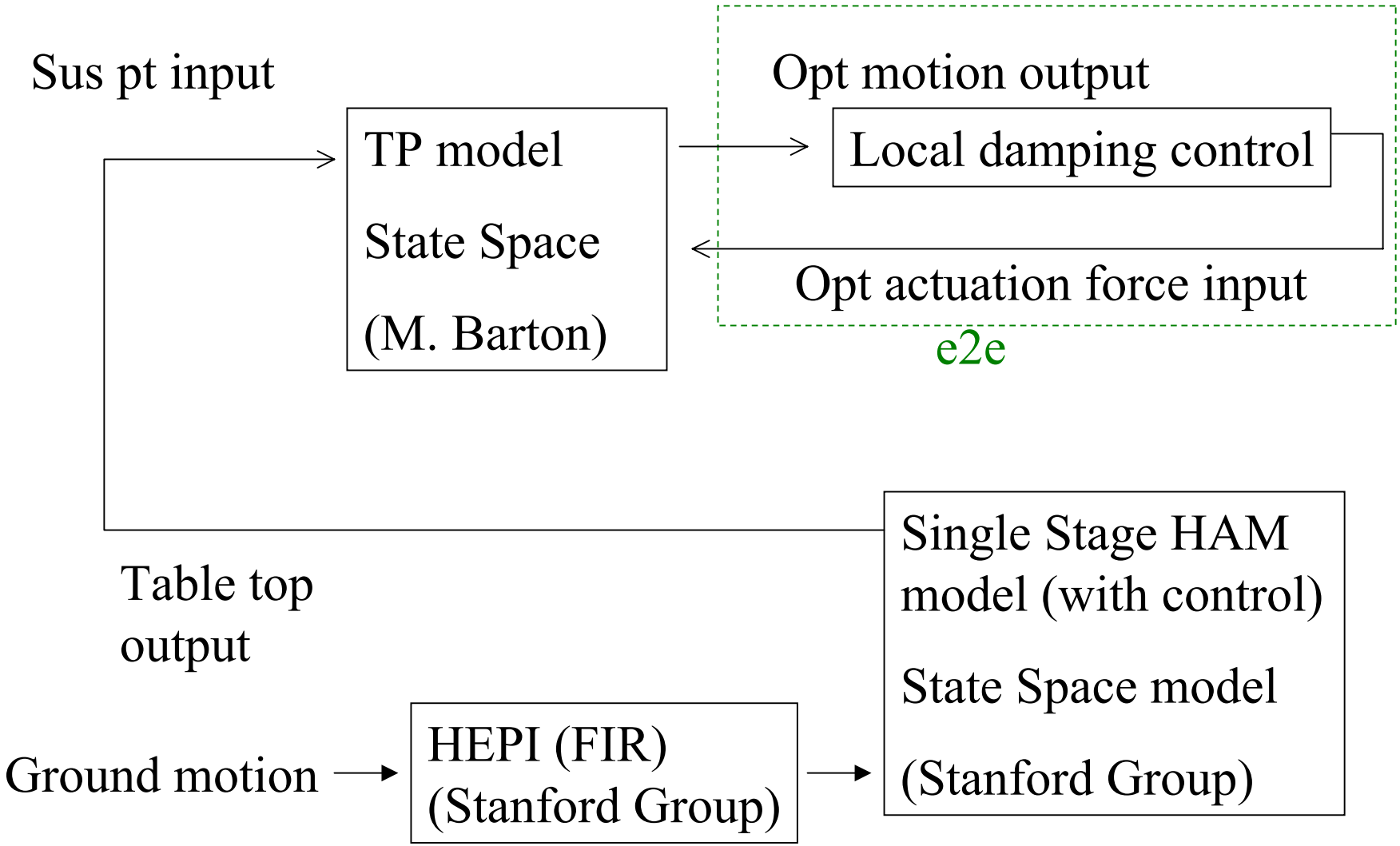
↓

Optic's pos, yaw and z

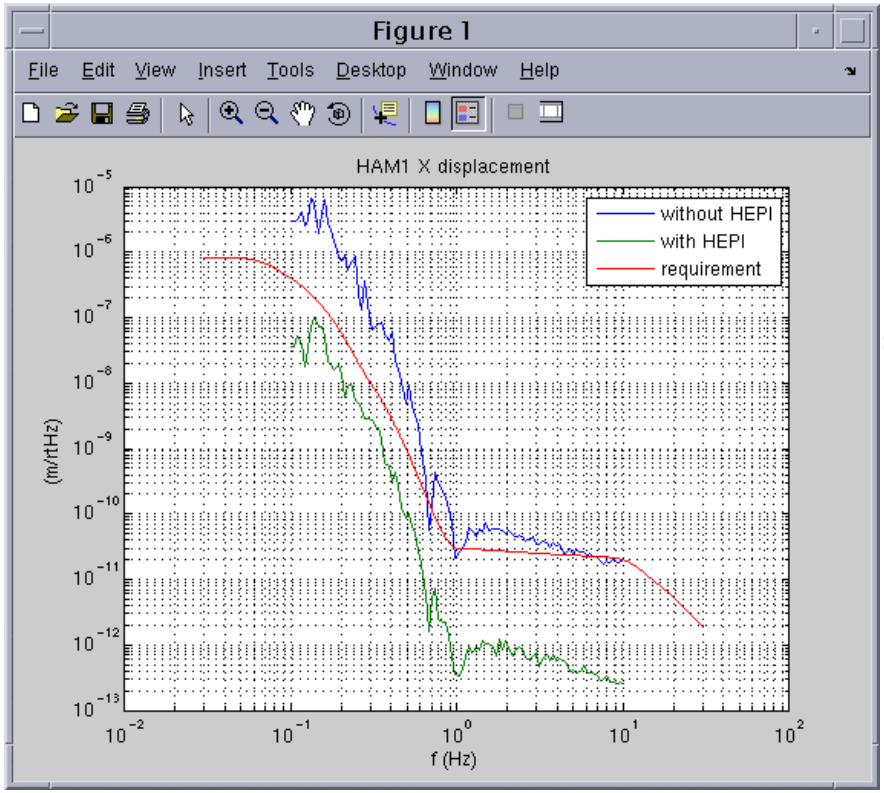
↓

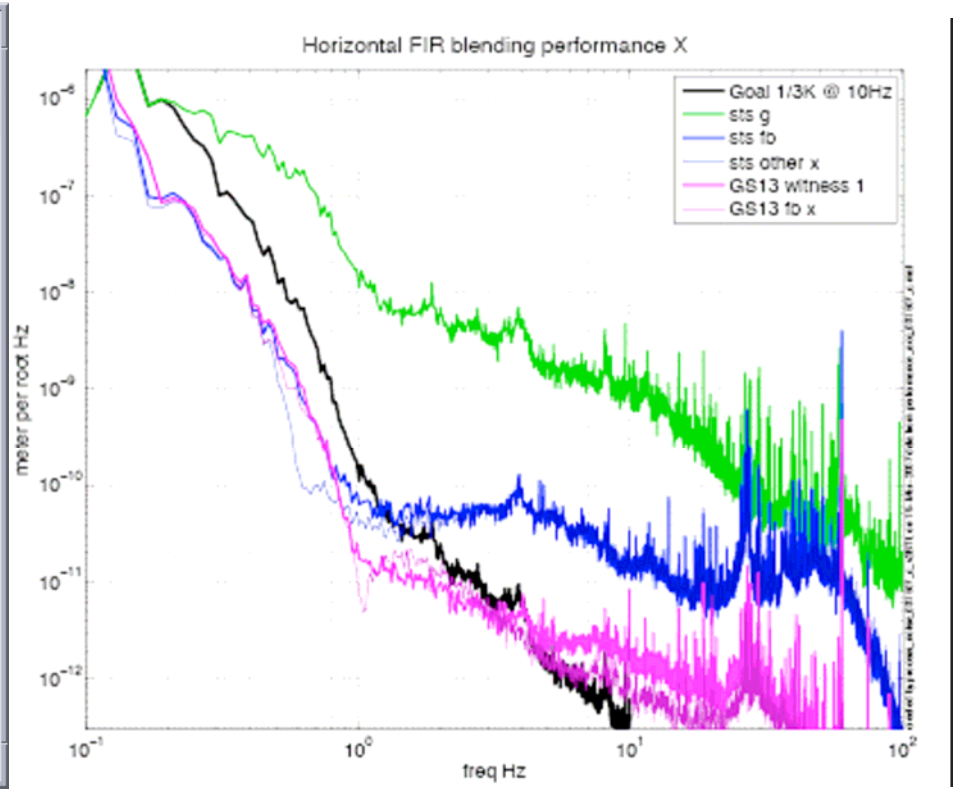
MC length change

e2e model of Triple suspension on HAM



HAM1 X with/without HEPI

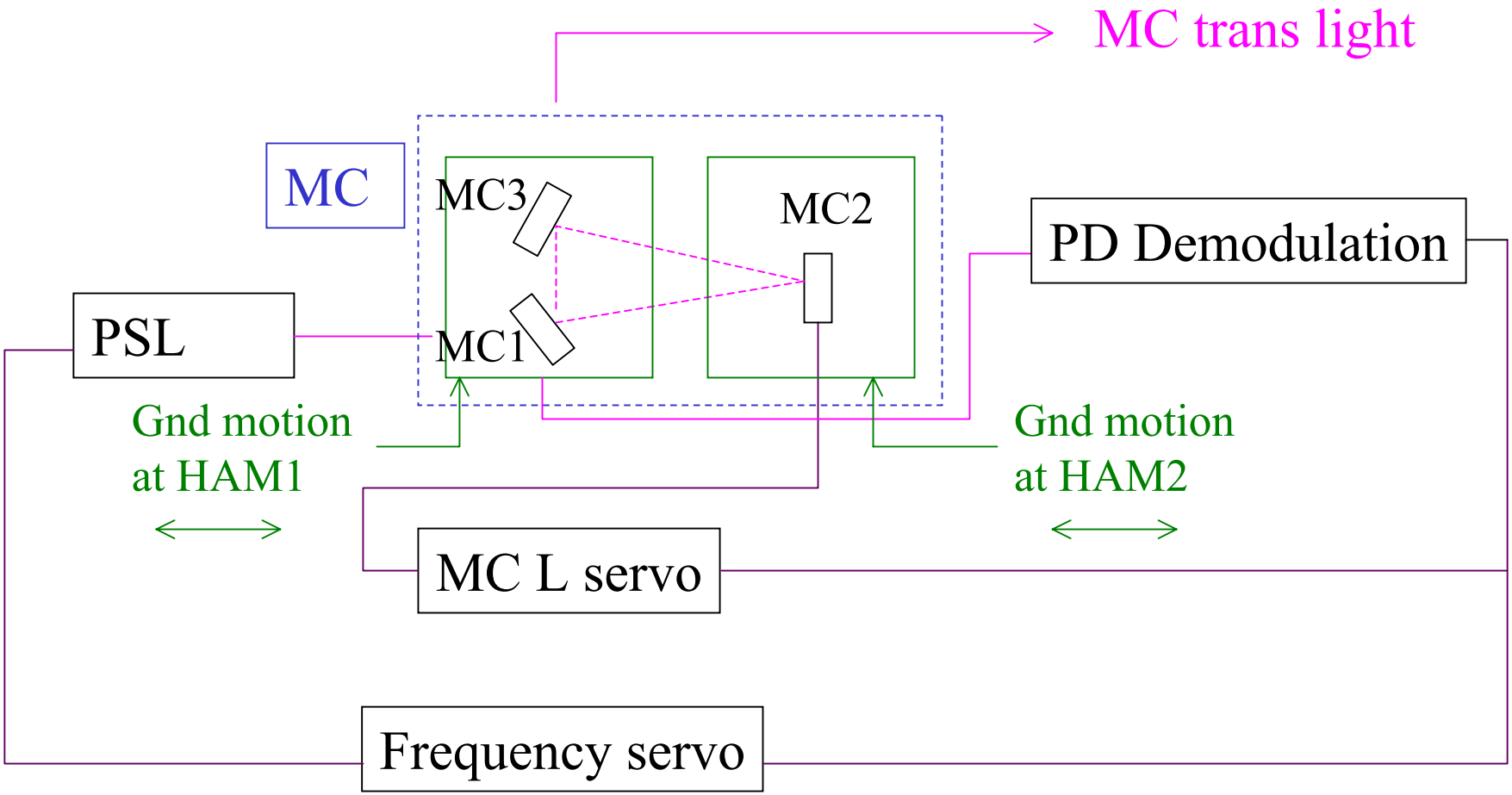




e2e result

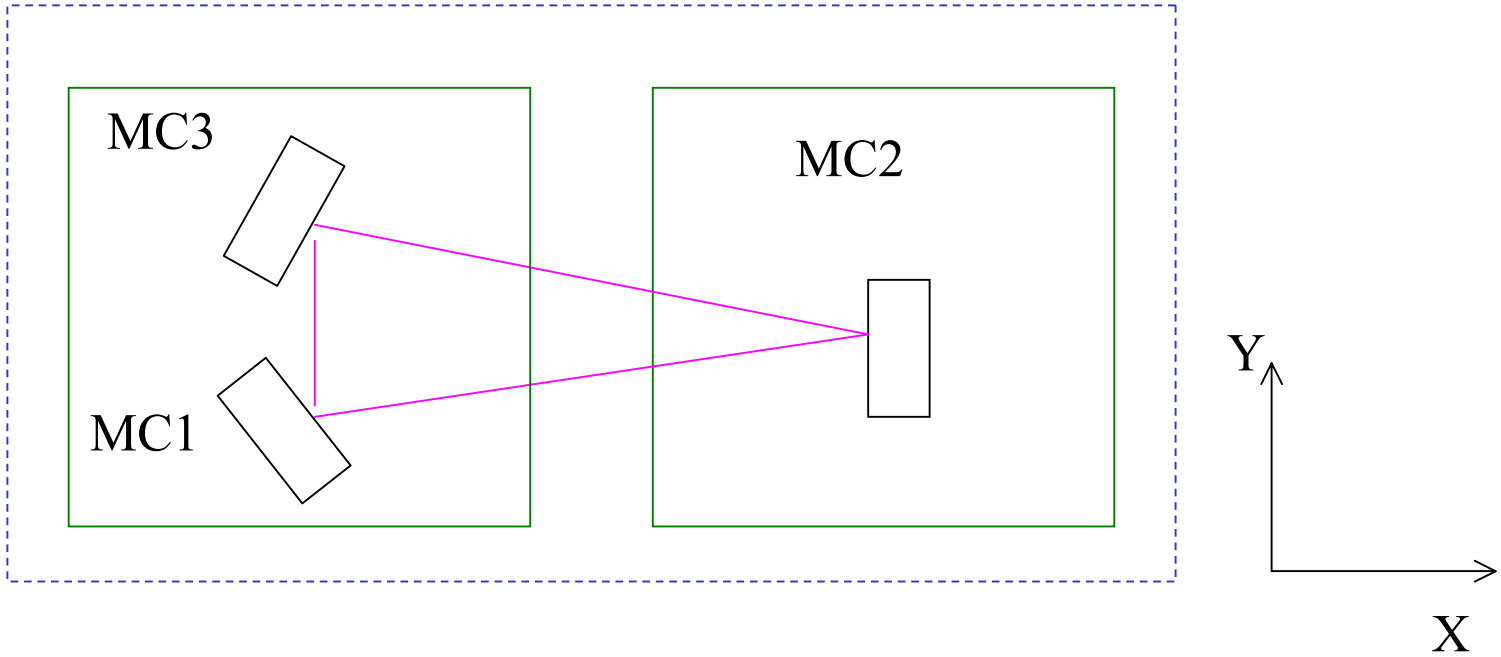
SWG result (LSC March 2007 meeting)
G-070110-00.pdf

e2e model of Adv MC



MC Length fluctuation → Frequency noise of MC trans light

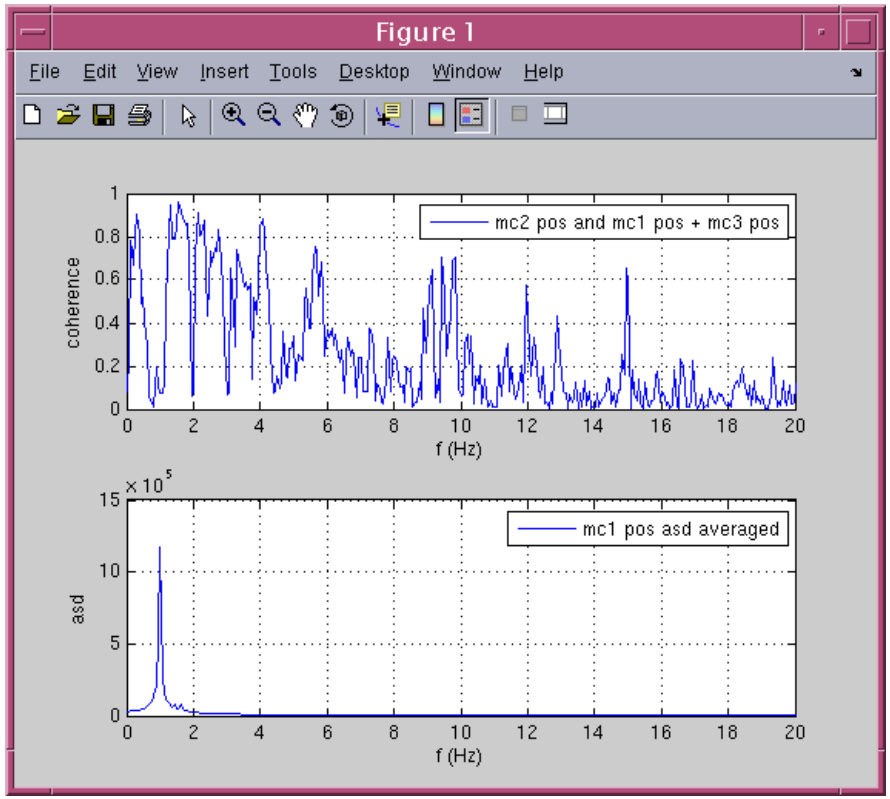
HAM1 – HAM2 correlation measurement



S_1 = MC1 DAQ pos + MC3 DAQ pos $\propto$ HAM 1 table X
S_2 = MC2 DAQ pos $\propto$ - HAM 2 table X

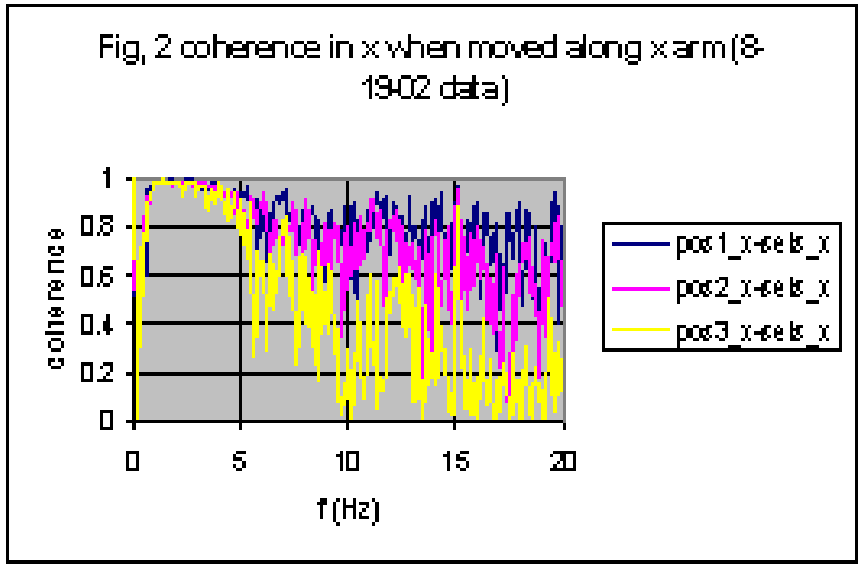
S_1 - S_2 coherence $\propto$ HAM1 - HAM2 coherence

MC OSEM sensor coherence
(recorded June 2004 at LLO with MCs free hanging)



Upper: (mc1 pos + mc3 pos) vs mc2 pos coherence

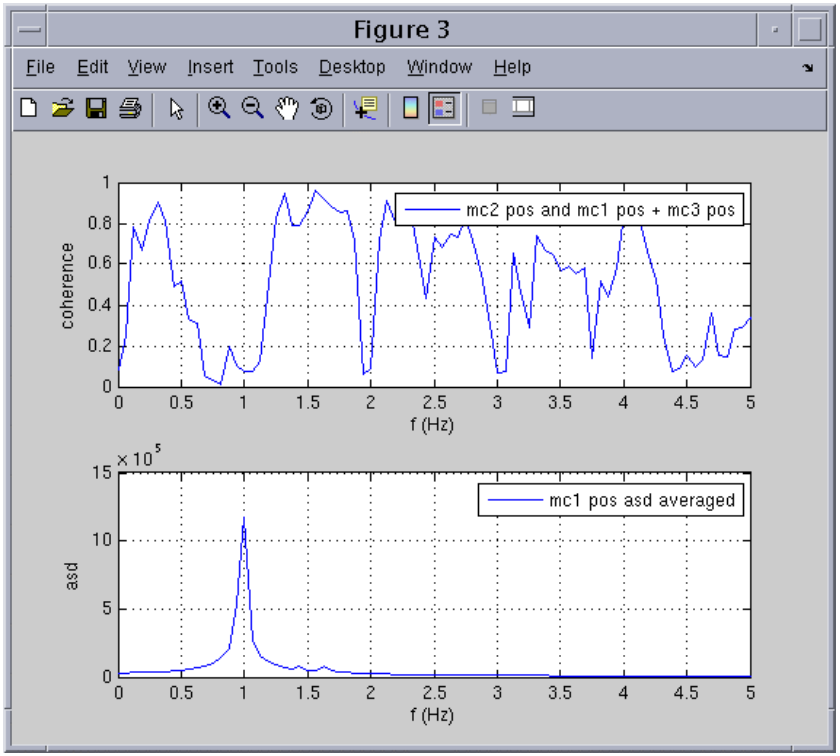
Lower: mc 1 pos spectrum

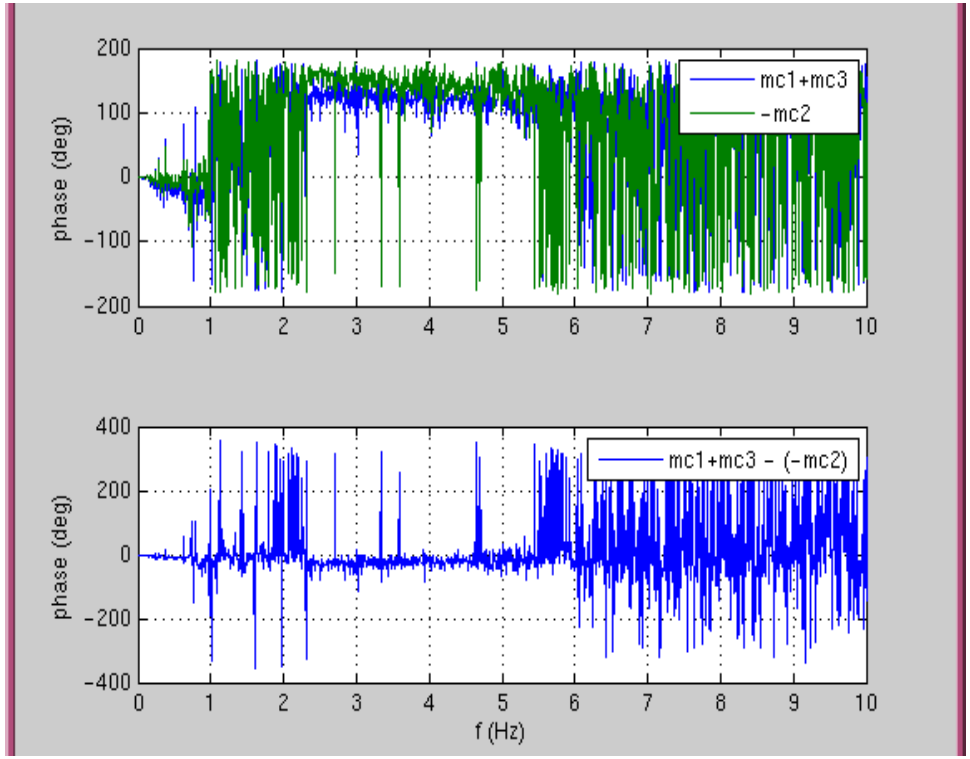


LLO floor coherence measured with two seismometers (sensitive to x component), d (m) apart along X-axis

d = 0 (m)
d = 2.7 (m)
d = 5.4 (m)

MC OSEM sensor phase
(recorded June 2004 at LLO with MCs free hanging)



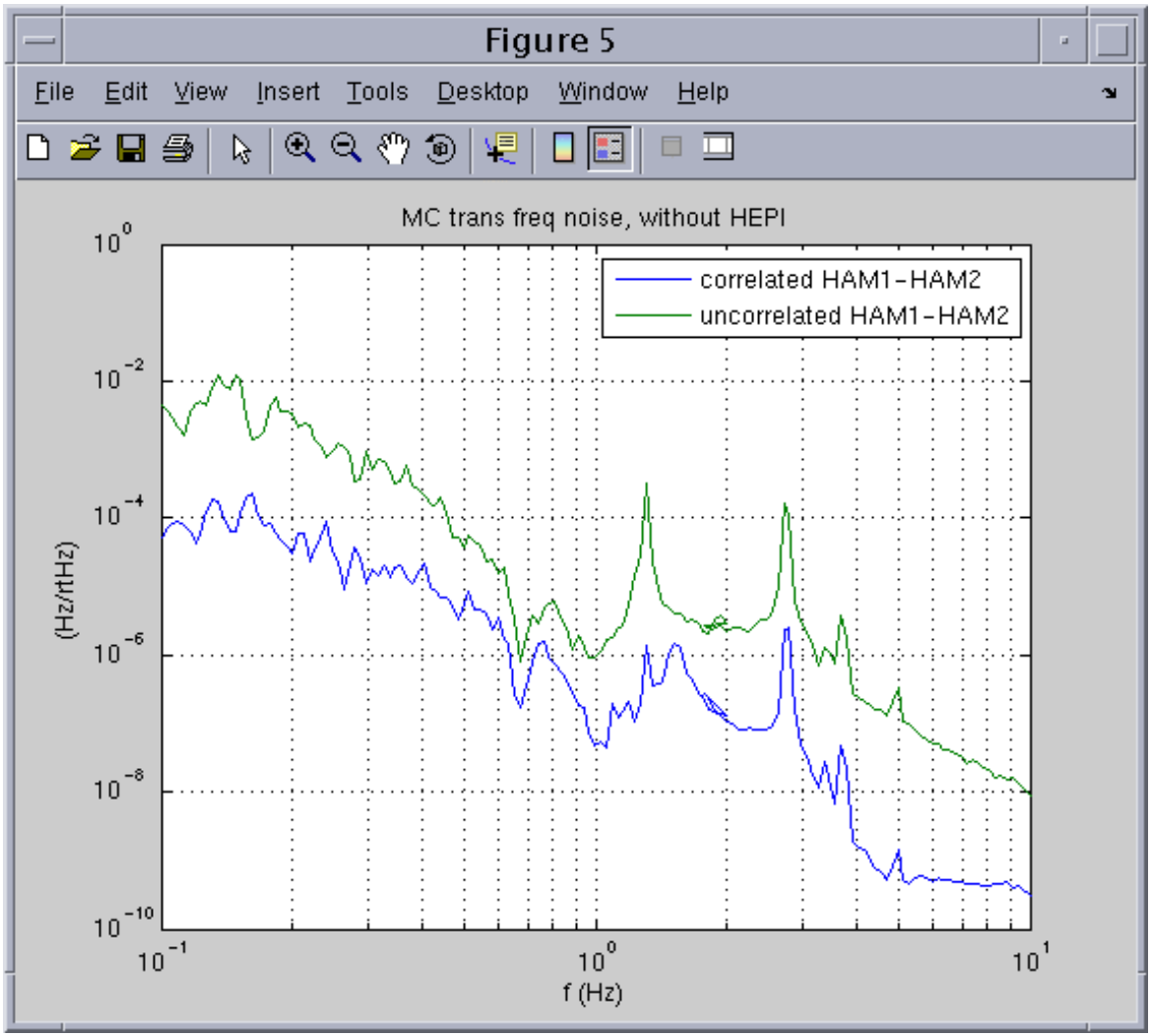


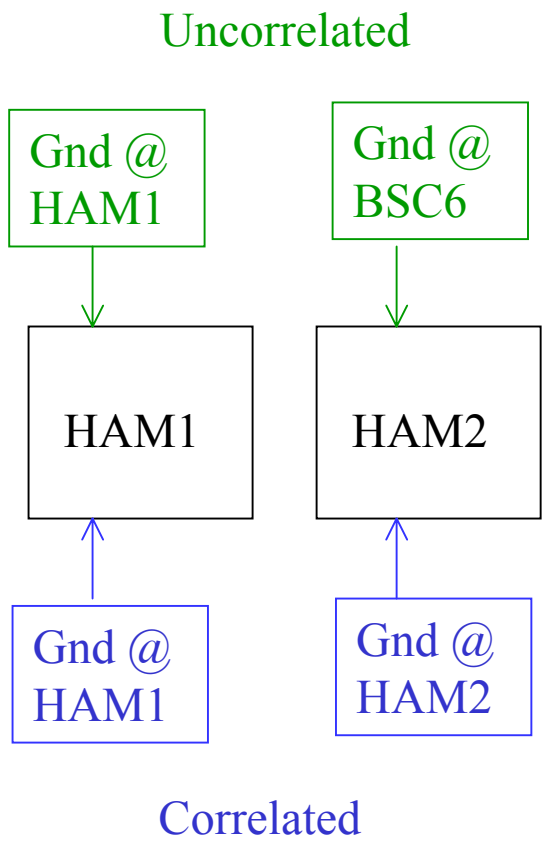
Upper: (mc1 pos + mc3 pos) vs mc2 pos coherence

Lower: mc 1 pos spectrum

DAQ (mc1+mc3) pos and –mc2 pos phase (upper) and phase difference (lower).
Note: DAQ positive defined reference to suspension, mc2 suspension facing negative ground X, MC1 & MC3 facing ground+X.

Effect of coherence on MC length fluctuation





Frequency noise due to length fluctuation

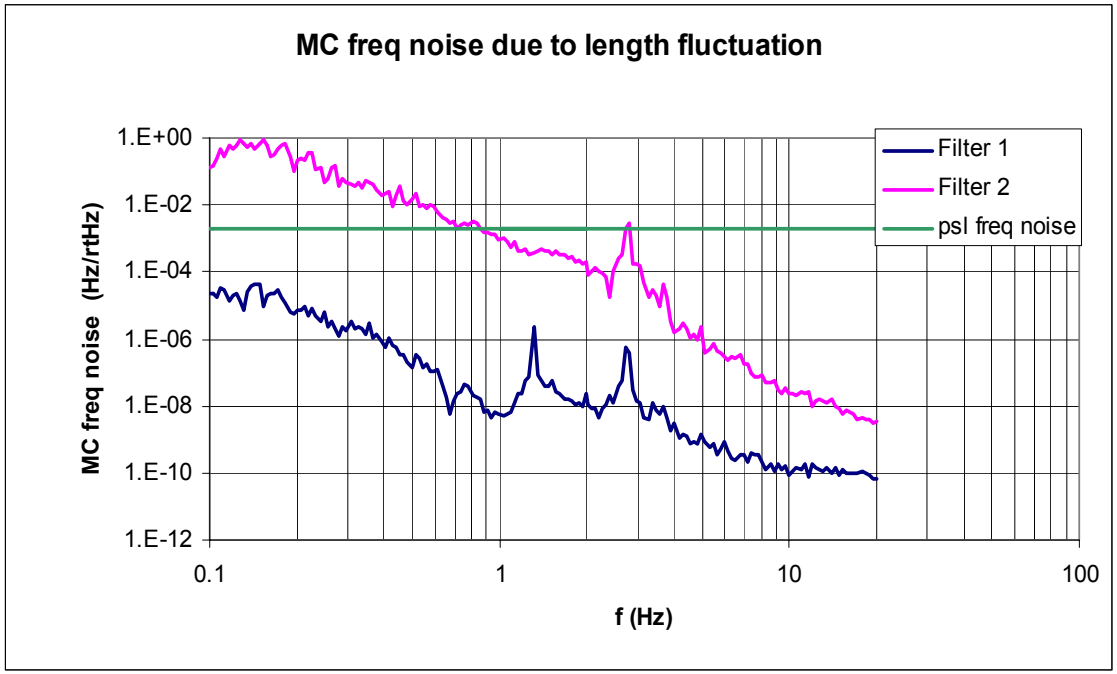


Fig.5 Sample e2e computation of AdvMC frequency noise due to length fluctuation

Summary

- MC locations on HAM table, HEPI model included in e2e Adv MC model
- Substantial effect of HAM1 - HAM2 correlation on MC length fluctuation

Acknowledgment

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Southeastern Louisiana University alumni association