Modeling the Input Optics with e2e

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Objectives

- Report status of e2e modeling
- Results
  - Calibrated floor motion
  - Better Mode Cleaner
  - Mode Matching Telescope in Detector.box
- Comments/Suggestions

Contents

- Estimate the table top motion for a given ground motion.

- Make a Small Optic Suspension (SOS) box with local damping, and find optimal gain settings to damp the optic when estimated table top motion is given.

- Create a Mode Cleaner (MC) box, and implement the length control for the mode cleaner cavity.

- Put all the optics (MCs, SM, and MMTs) in order, and create the Input Optic (IO) box.

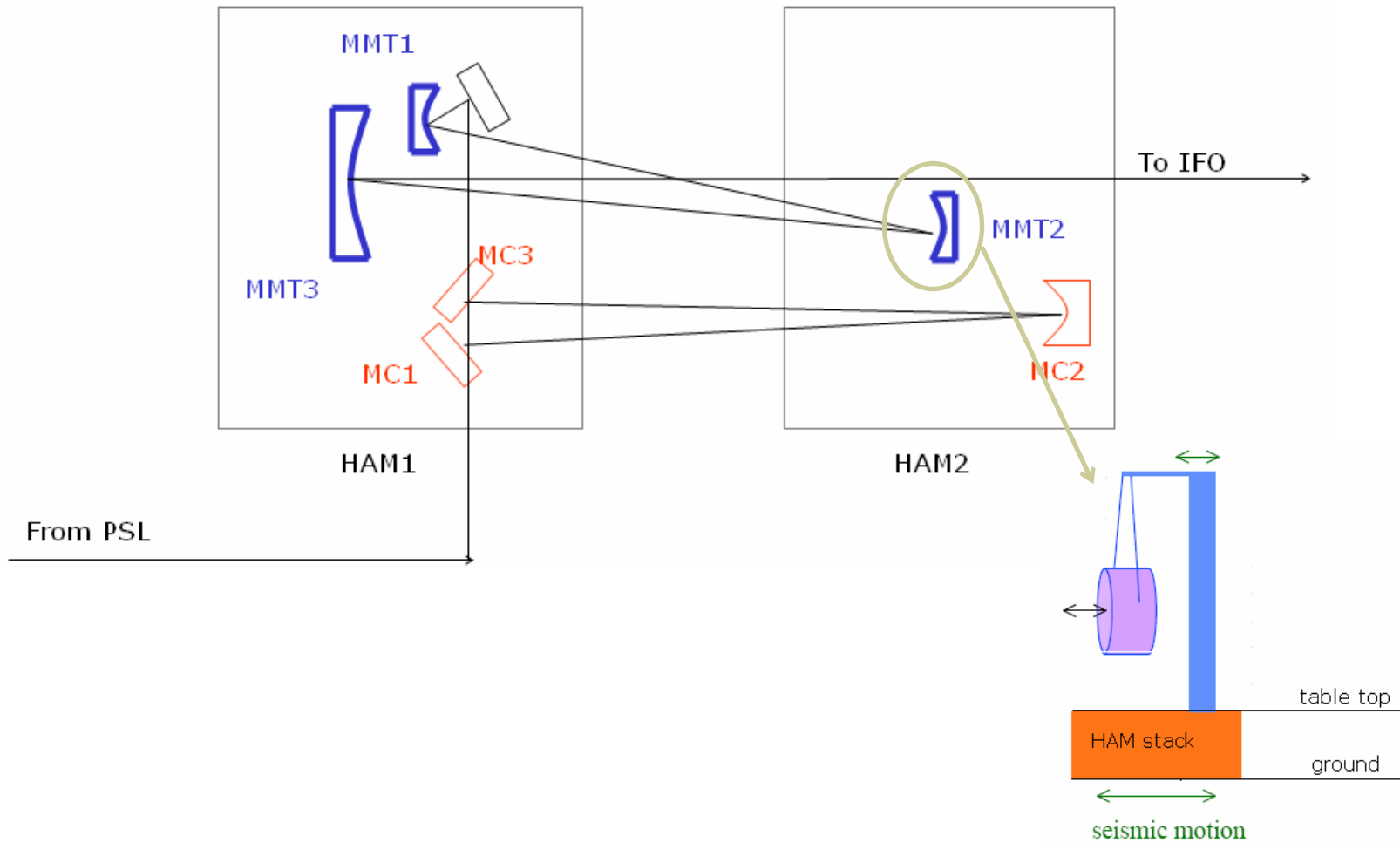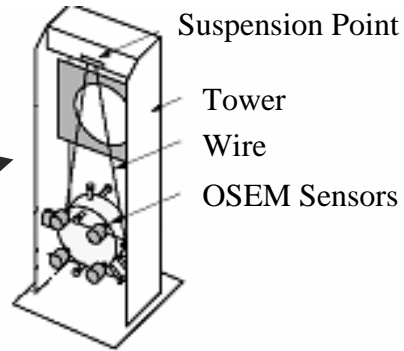- Use the IO box in Simligo, and run the simulation for the entire detector.
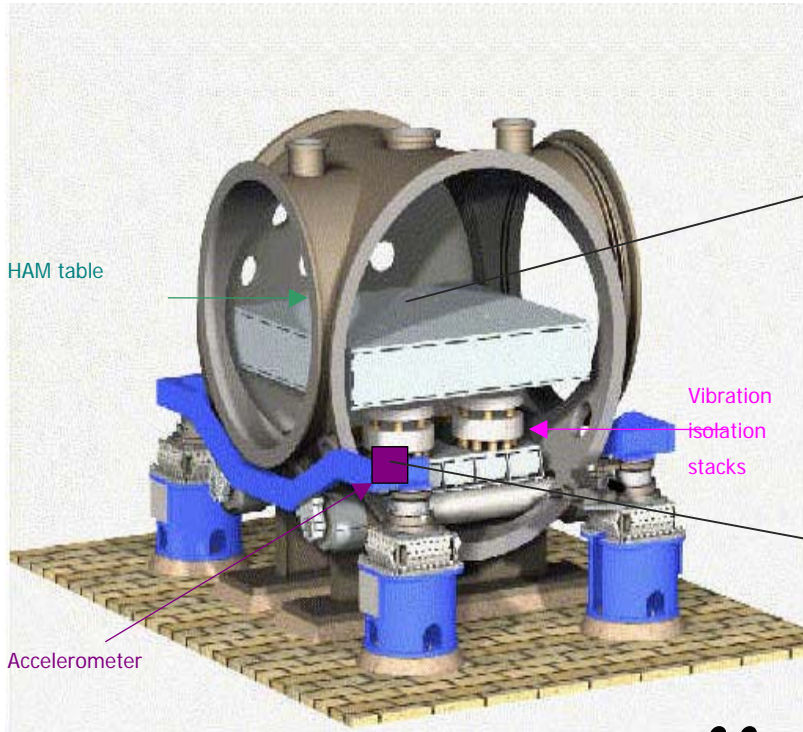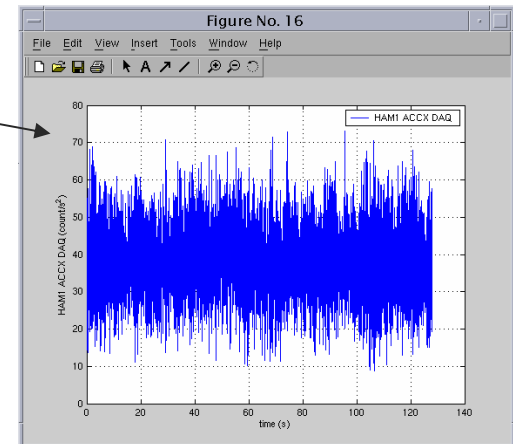
Input Optics

Table Motion

Suspension Point

Tower

Wire

OSEM Sensors

HAM table
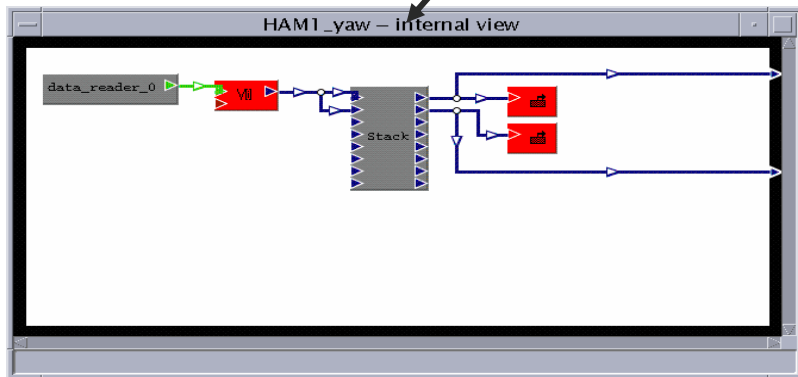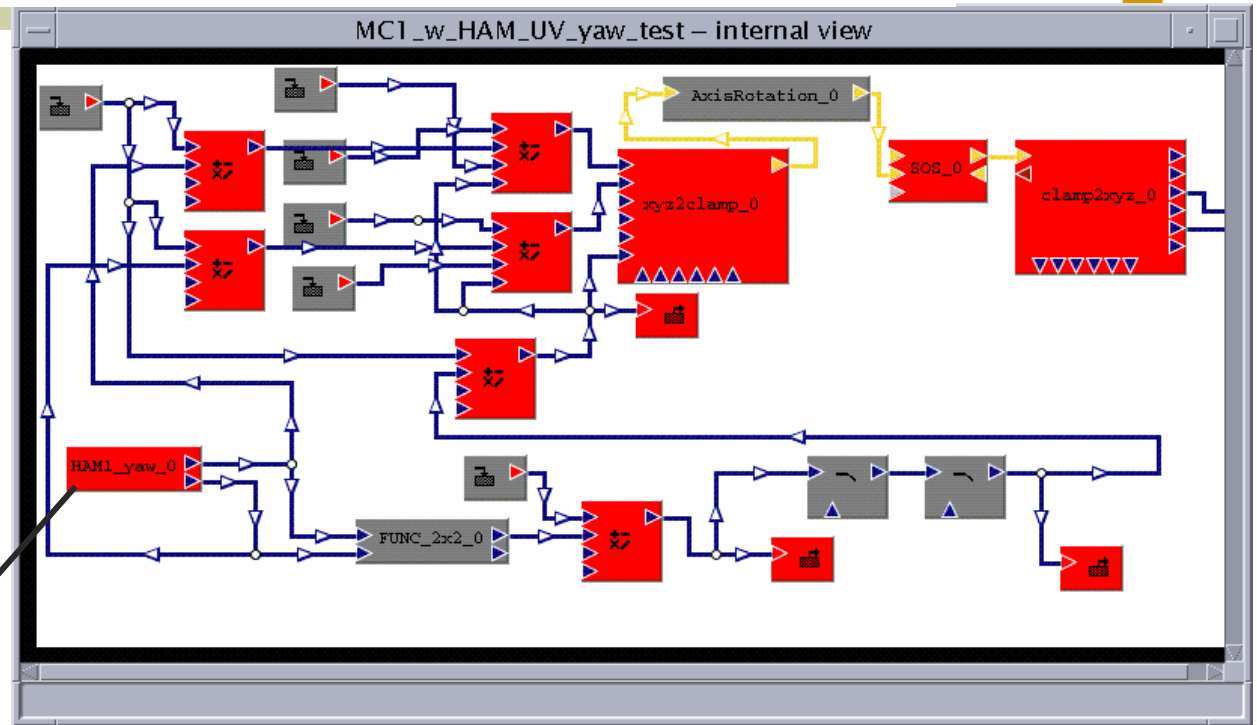
Vibration
isolation
stacks

Accelerometer

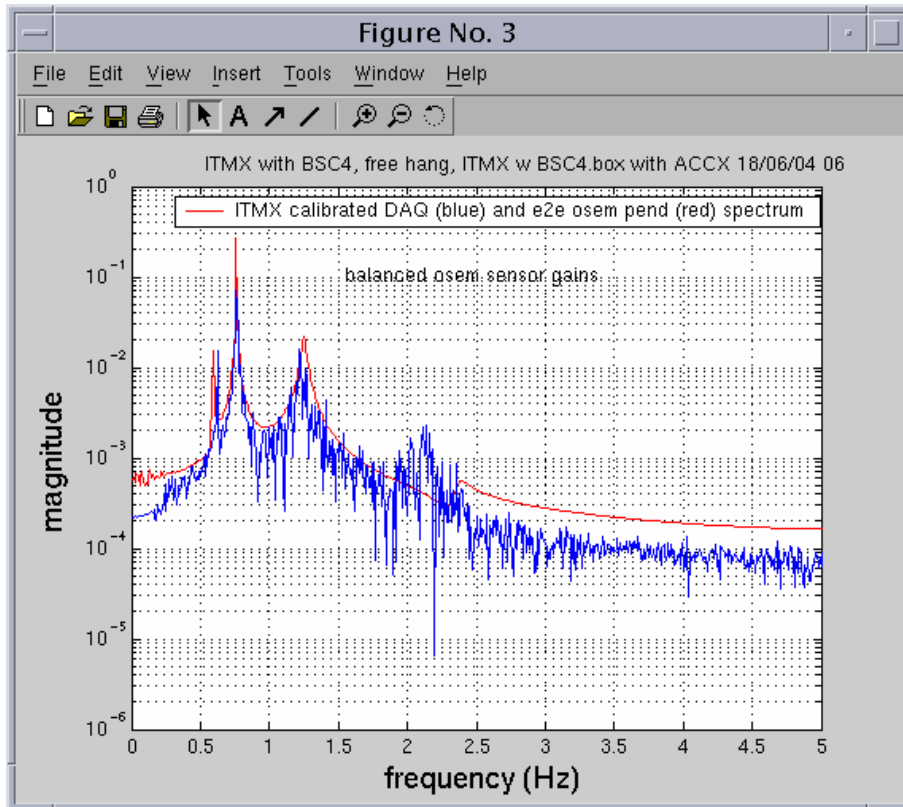$$x(t) = \iint ACCX \, dt \, dt$$
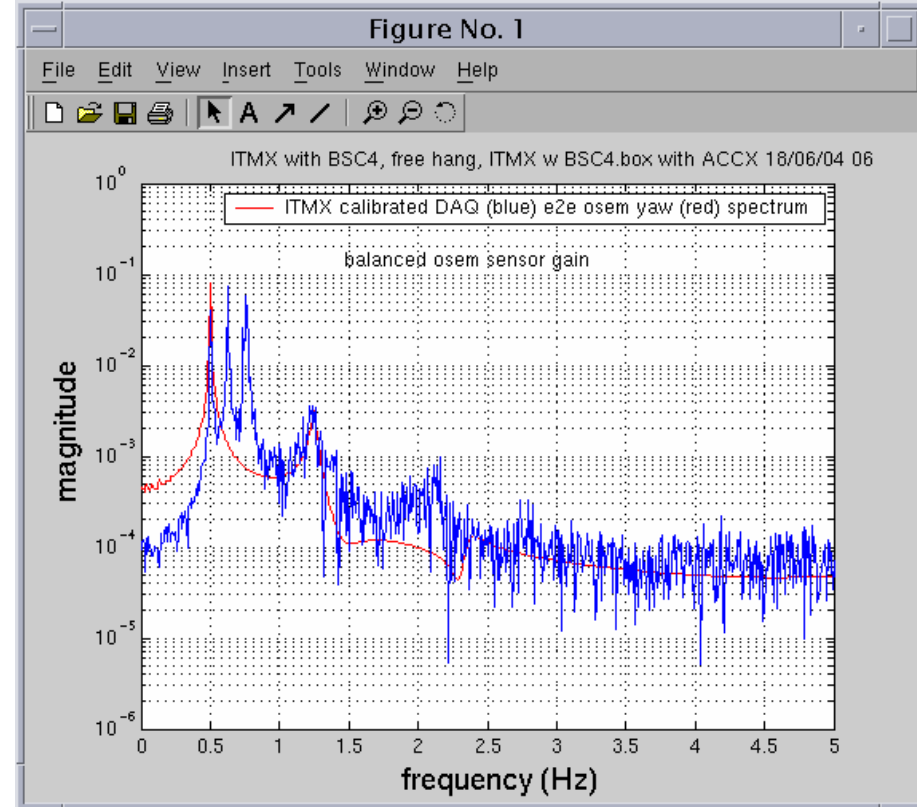
Calibrating the Table Motion

MC1 box
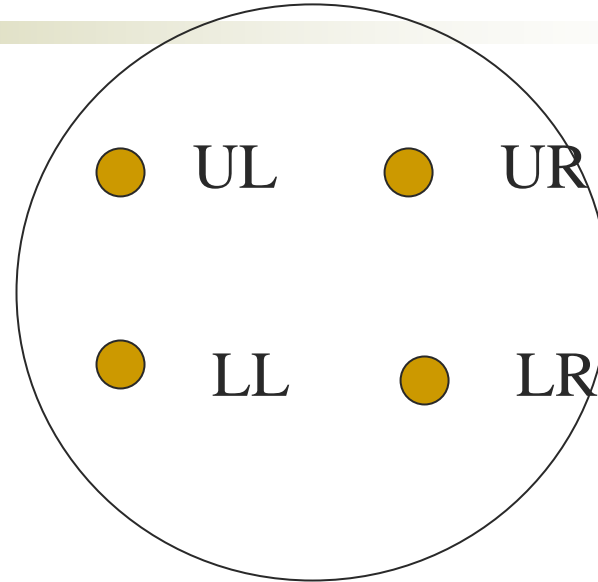
HAM box

ITMX pend/yaw with balanced OSEMs

Pendular

Yaw

OSEM sensor imbalance

$UR = (P + Y + T) g_1$

$UL = (P - Y + T) g_2$

$LL = (P - Y - T) g_3$

$LR = (P + Y - T) g_4$

$OSEM\ P = UR + UL + LL + LR$

$\quad = (P+Y+T)g_1 + (P-Y+T) g_2 + (P-Y-T) g_3 + (P+Y-T) g_4$

$\quad = (g_1+g_2+g_3+g_4)P + (g_1-g_2-g_3+g_4)Y + (g_1+g_2-g_3-g_4)T$

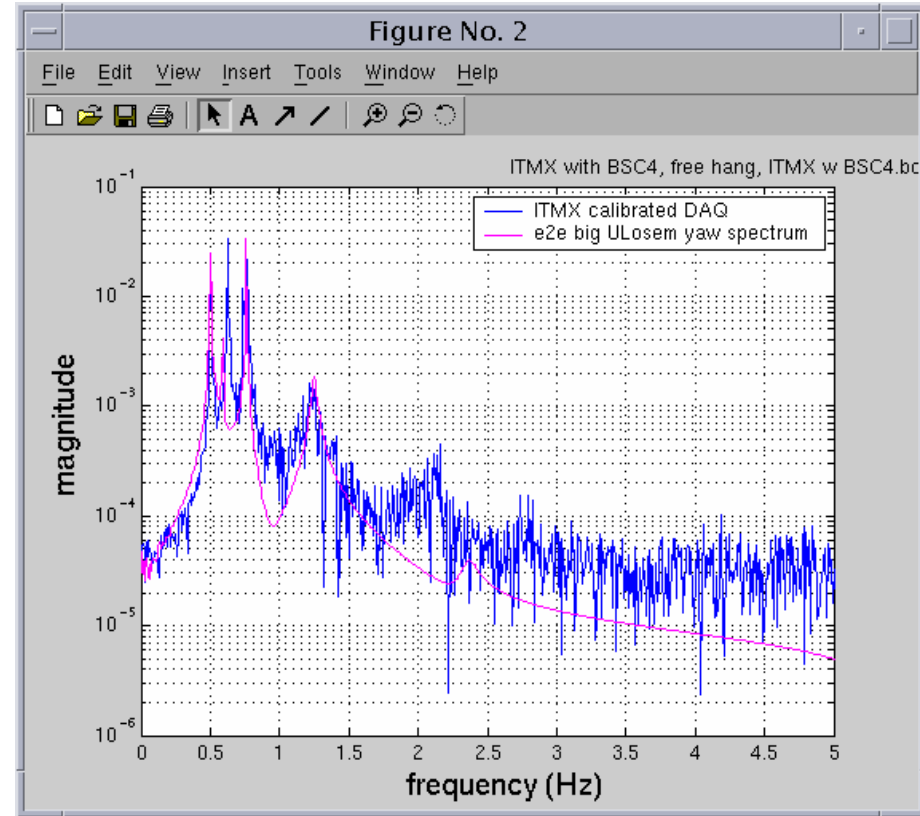$= 0$, if $g_1=g_2=g_3=g_4$

If $g_1=1.05$, $g_2=g_3=g_4=0.95$

$OSEM\ Y = UR - UL - LL + LR$

$\quad = 0.1P + 3.9Y + 0.1T$

ITMX pend/yaw
with pend/yaw ratio = 0.023
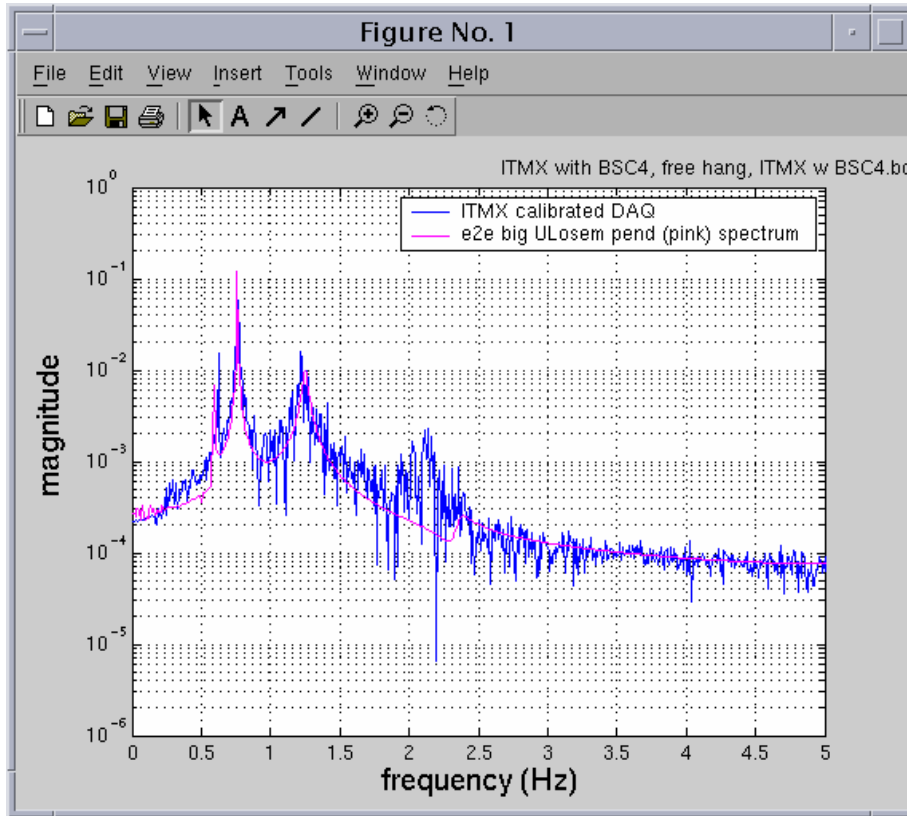
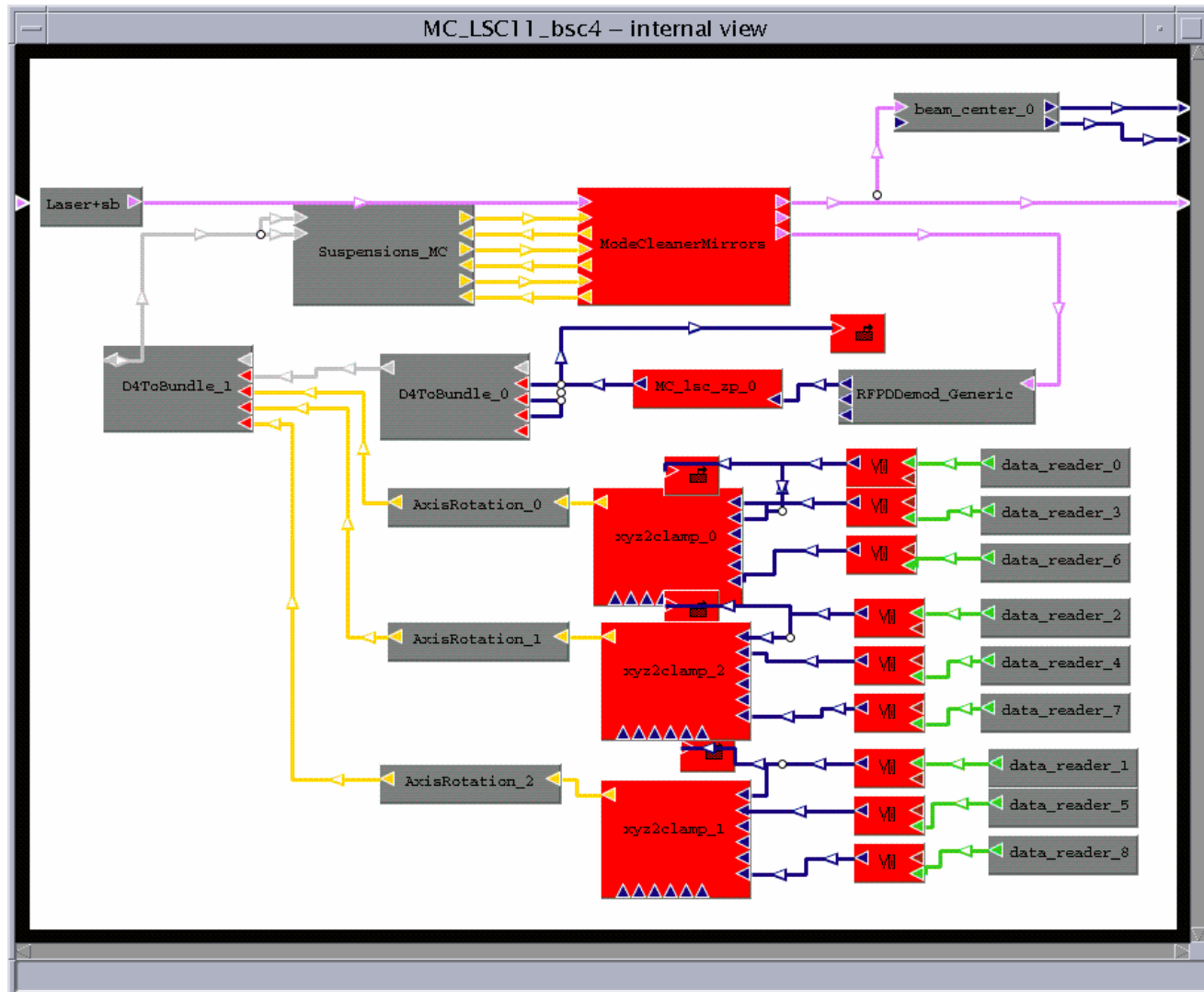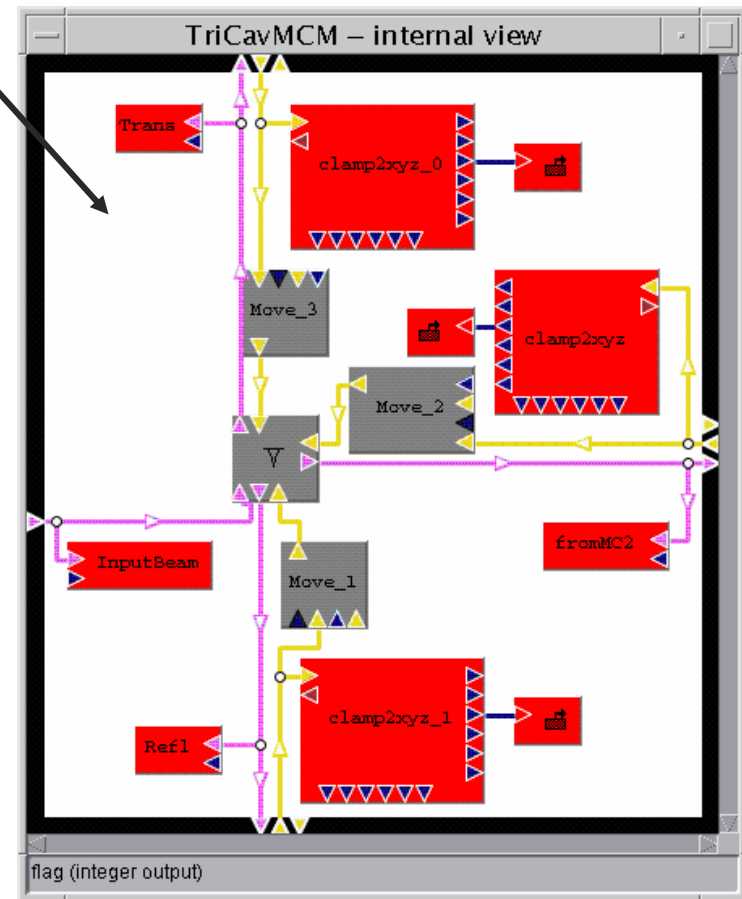Pendular

Yaw

Mode Cleaner

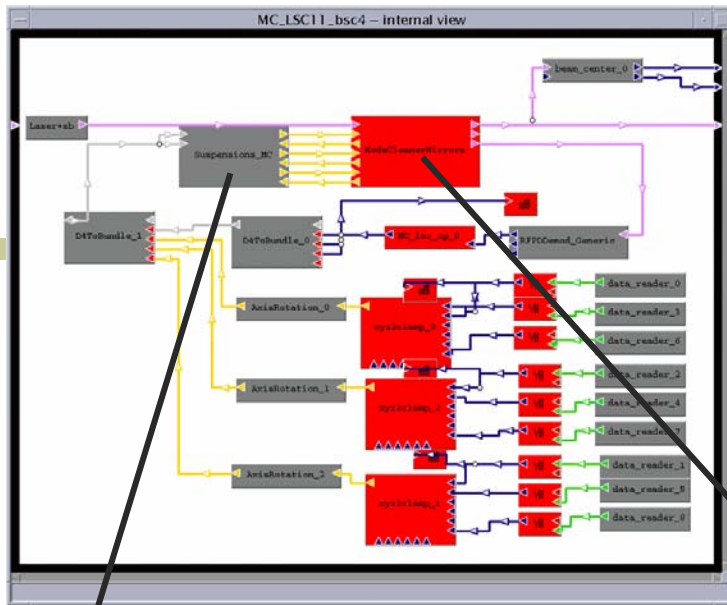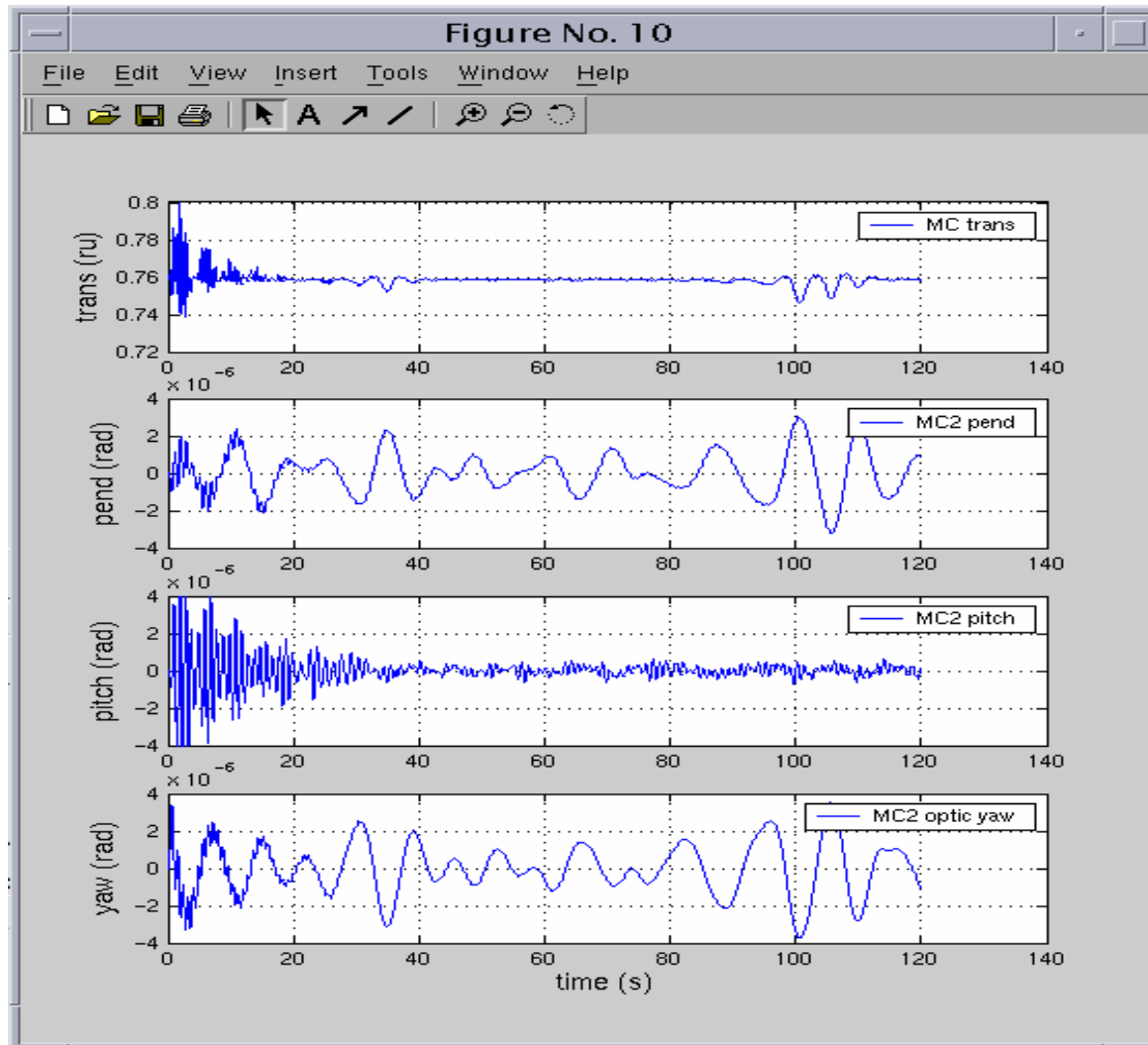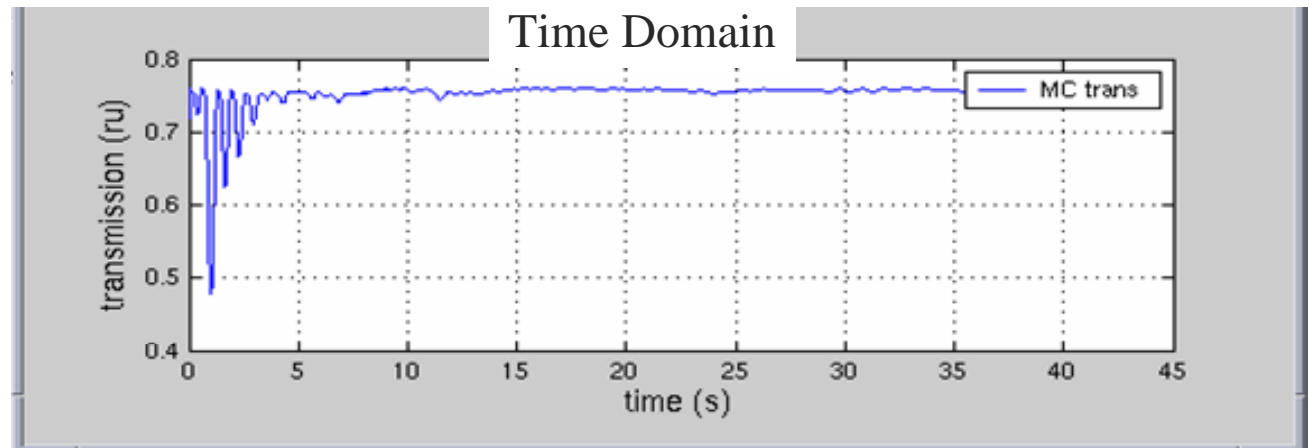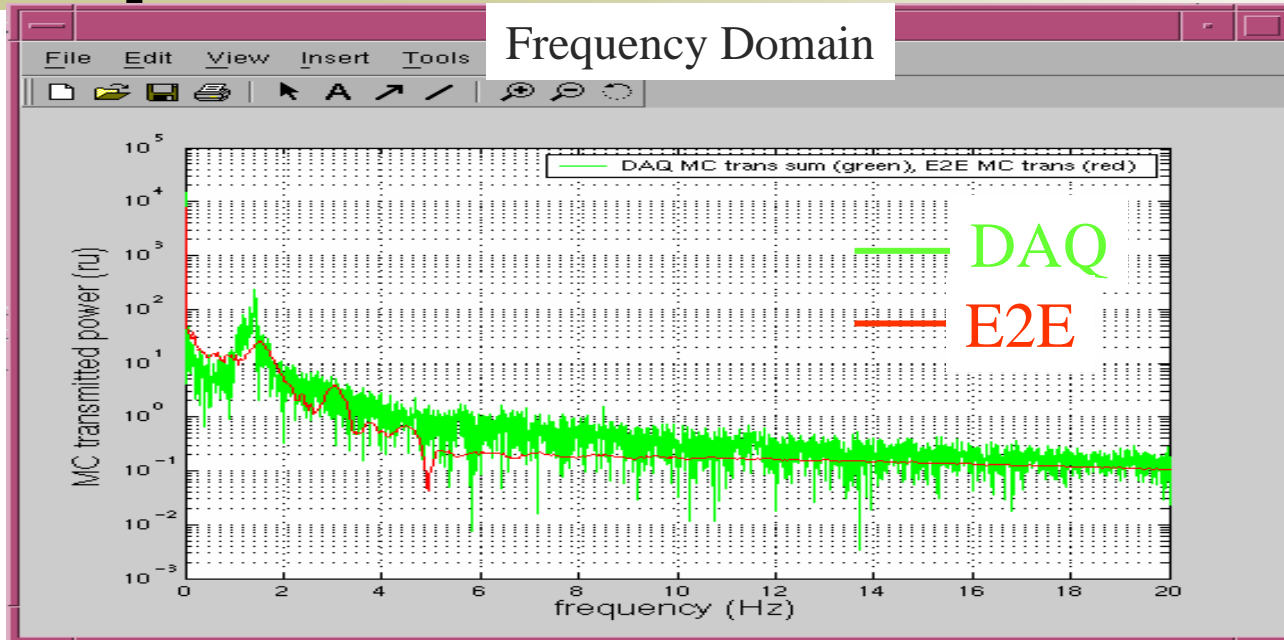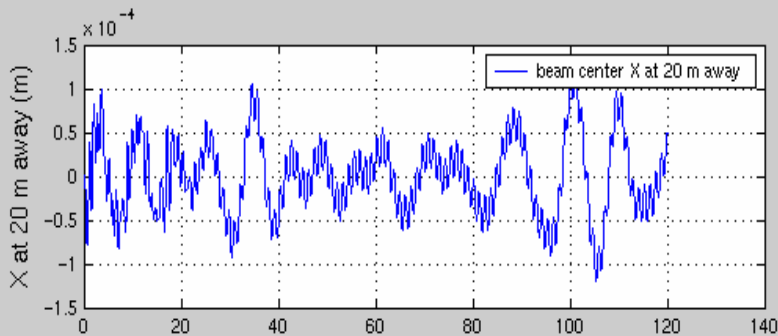# Mode Cleaner Continued
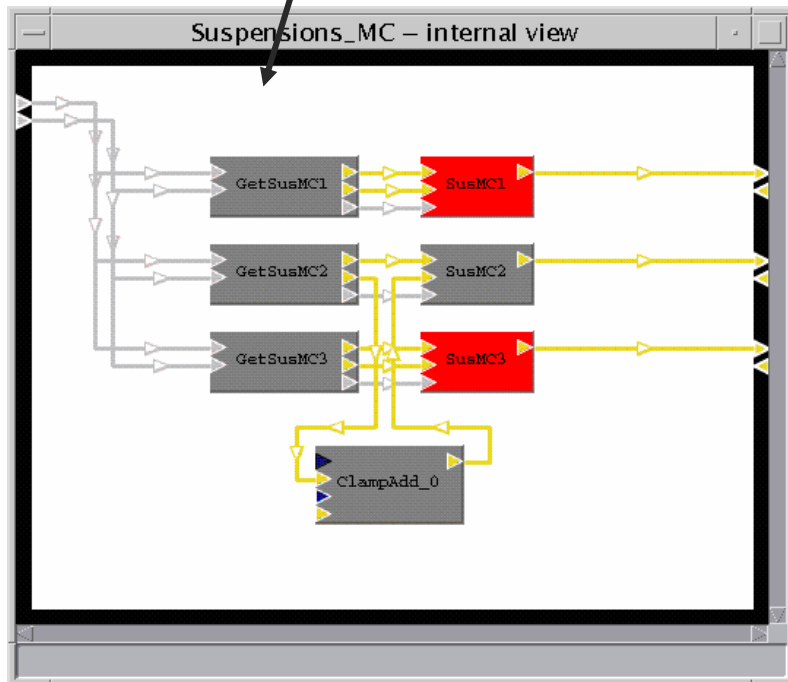
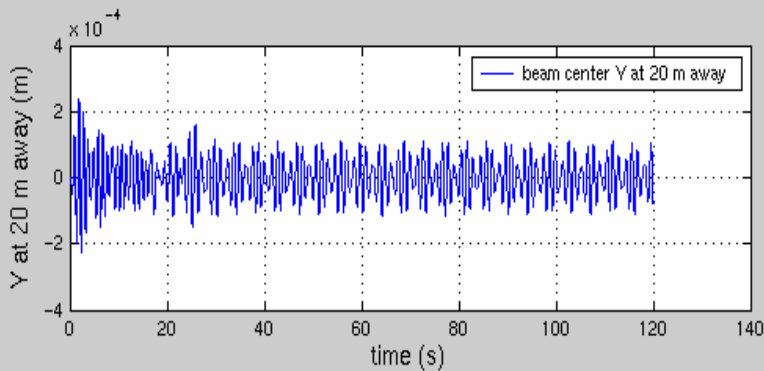# MC Transmission and MC2 motion

MC Transmitted Power

Frequency Domain

Time Domain

MC Beam Motion

Time Domain

Frequency Domain

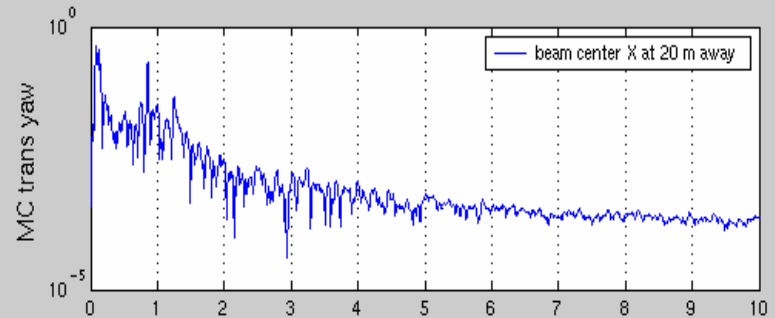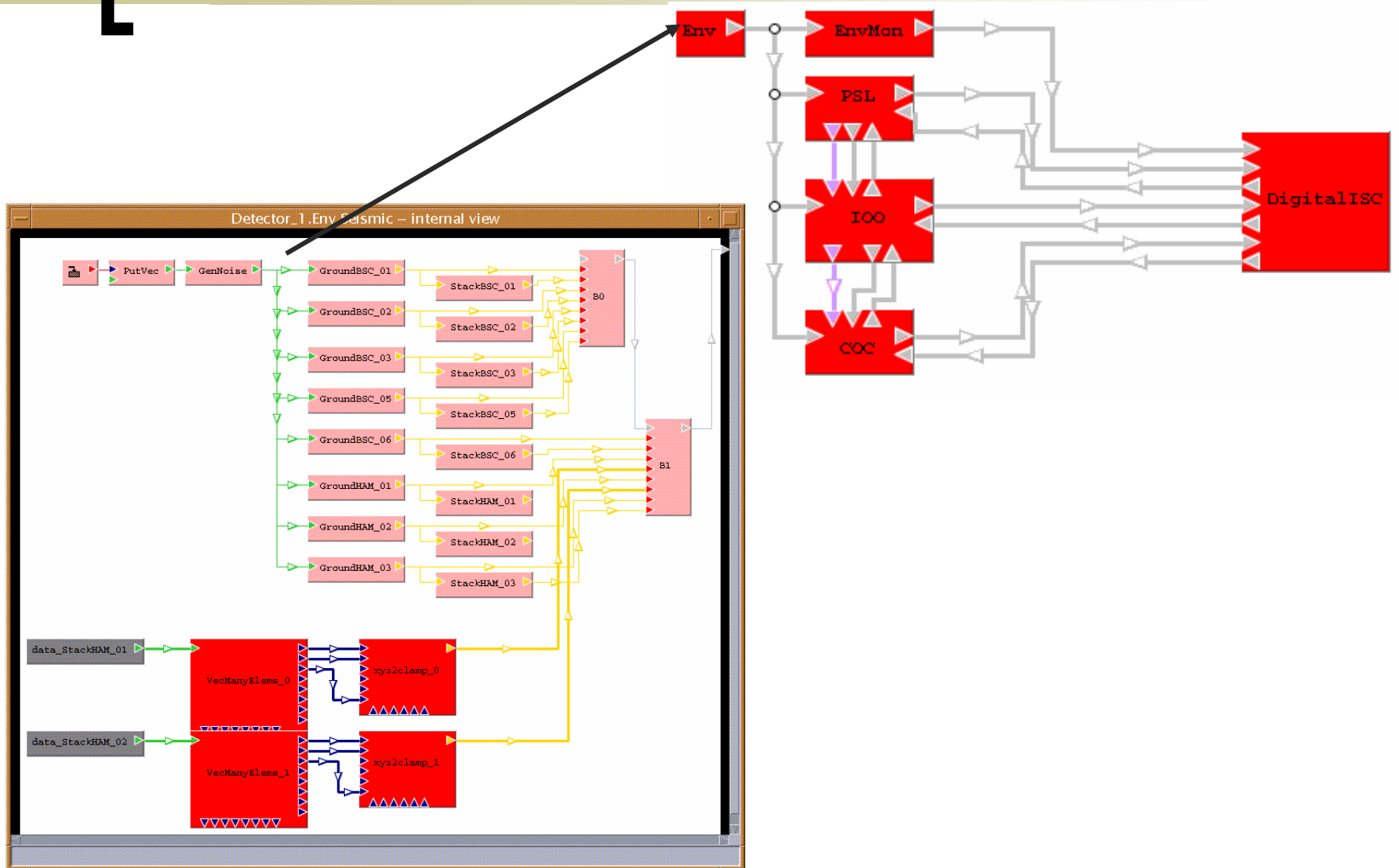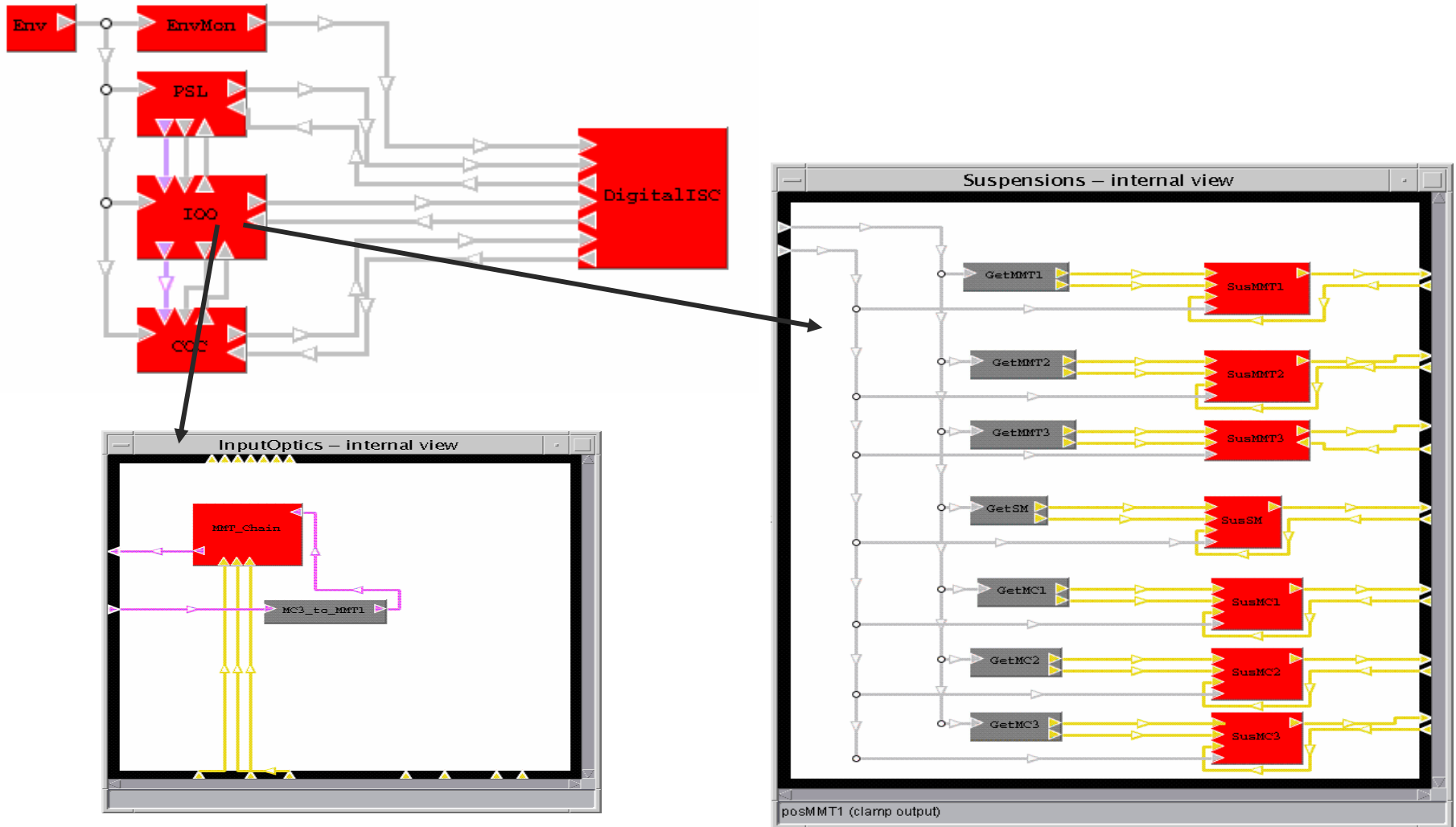yaw
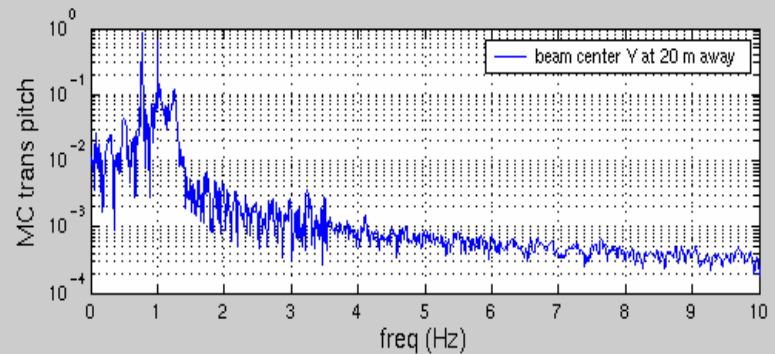
pitch

Beam center 20 meters away from MC pitch (lower)

Detector box

Status of IO box:
Contains MMT optics only

MMT1 motion effect on CARM and DARM error signals
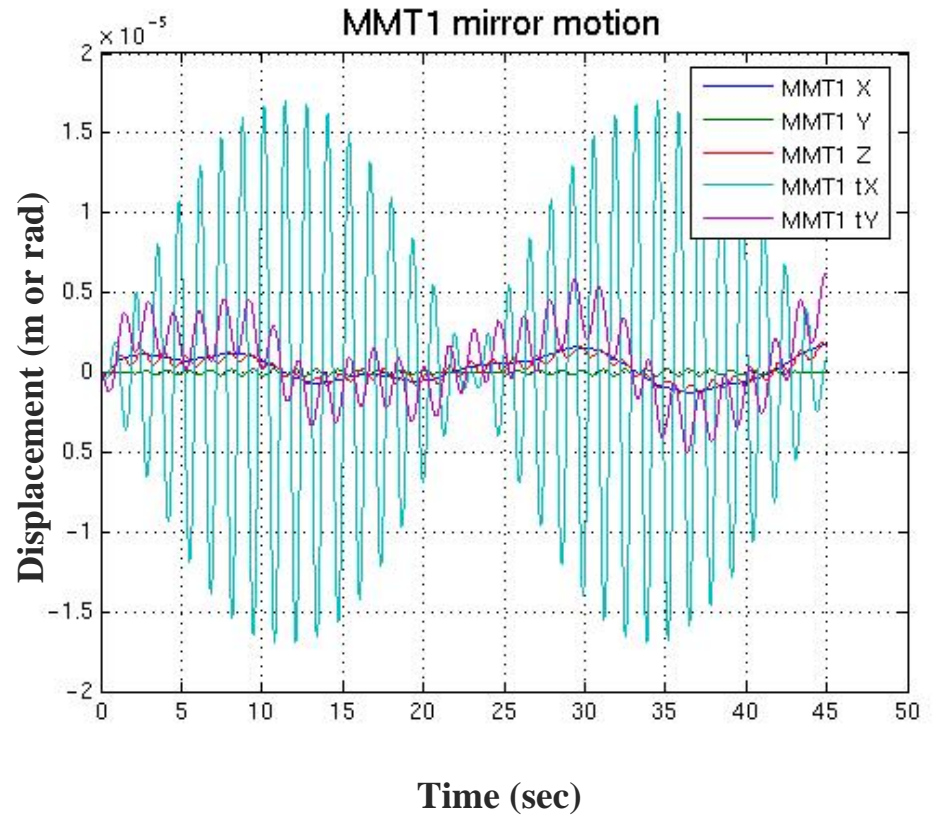
MMT3 motion effect on CARM and DARM
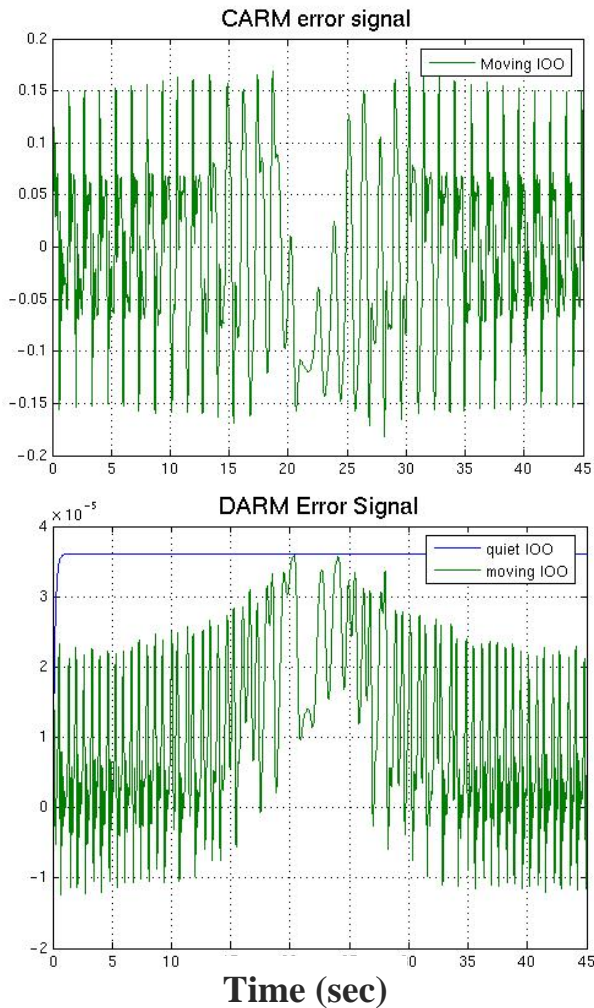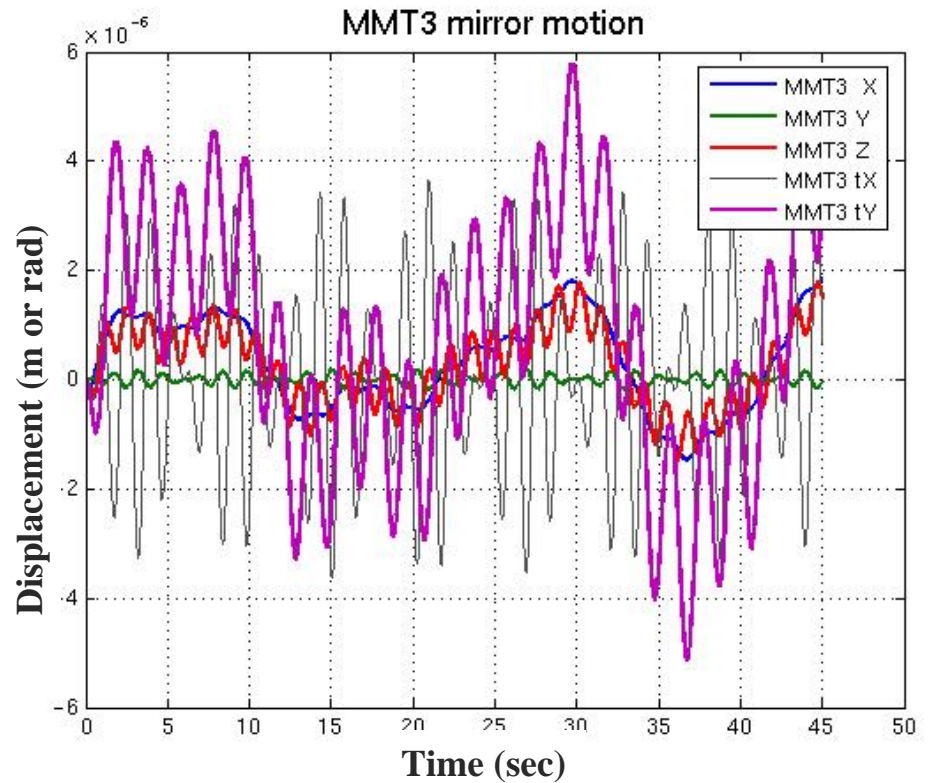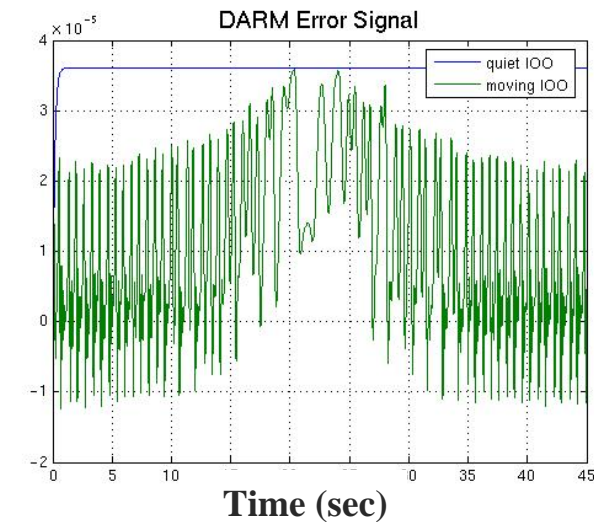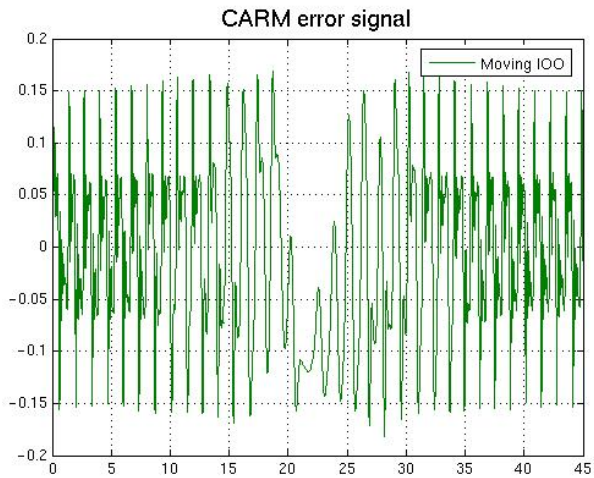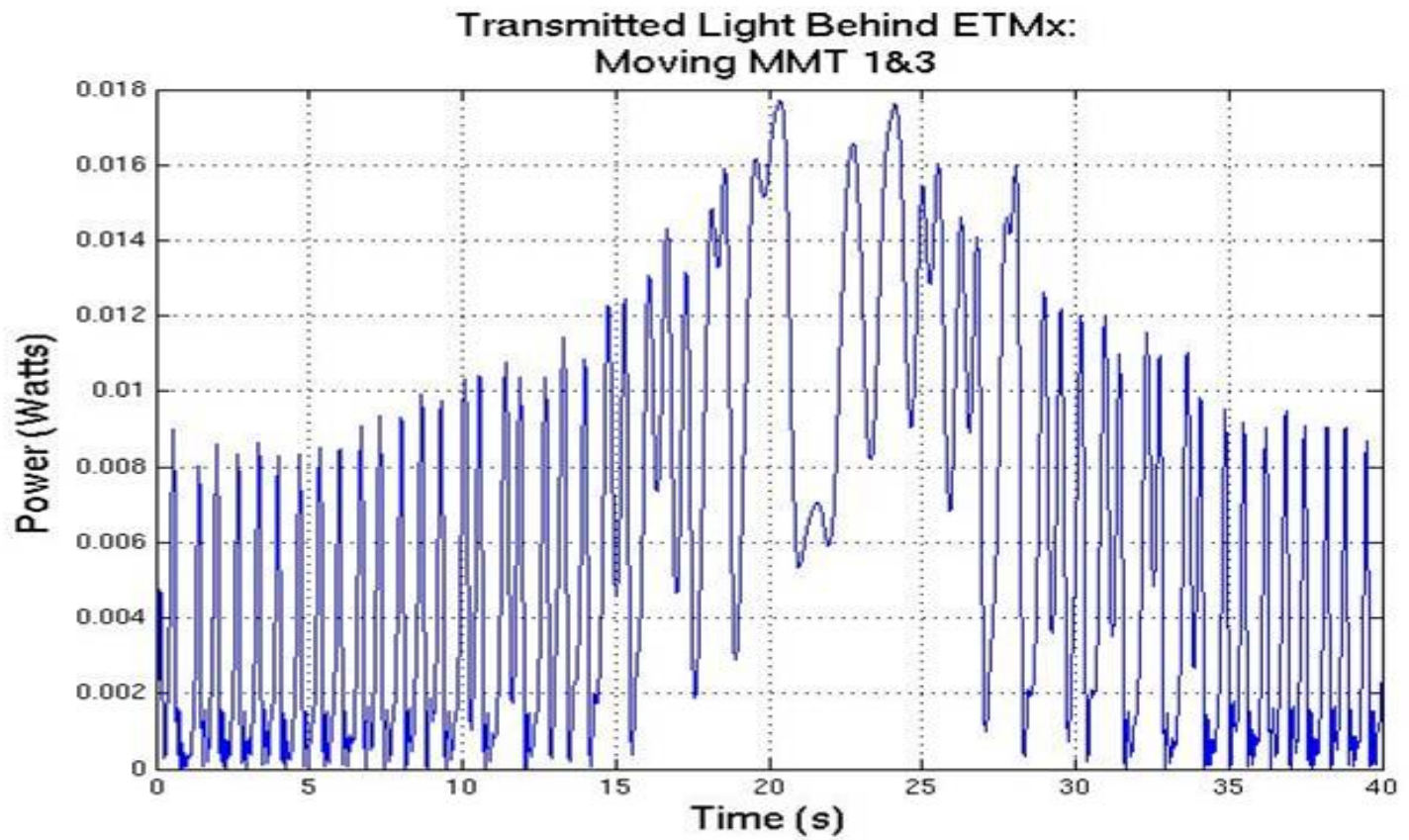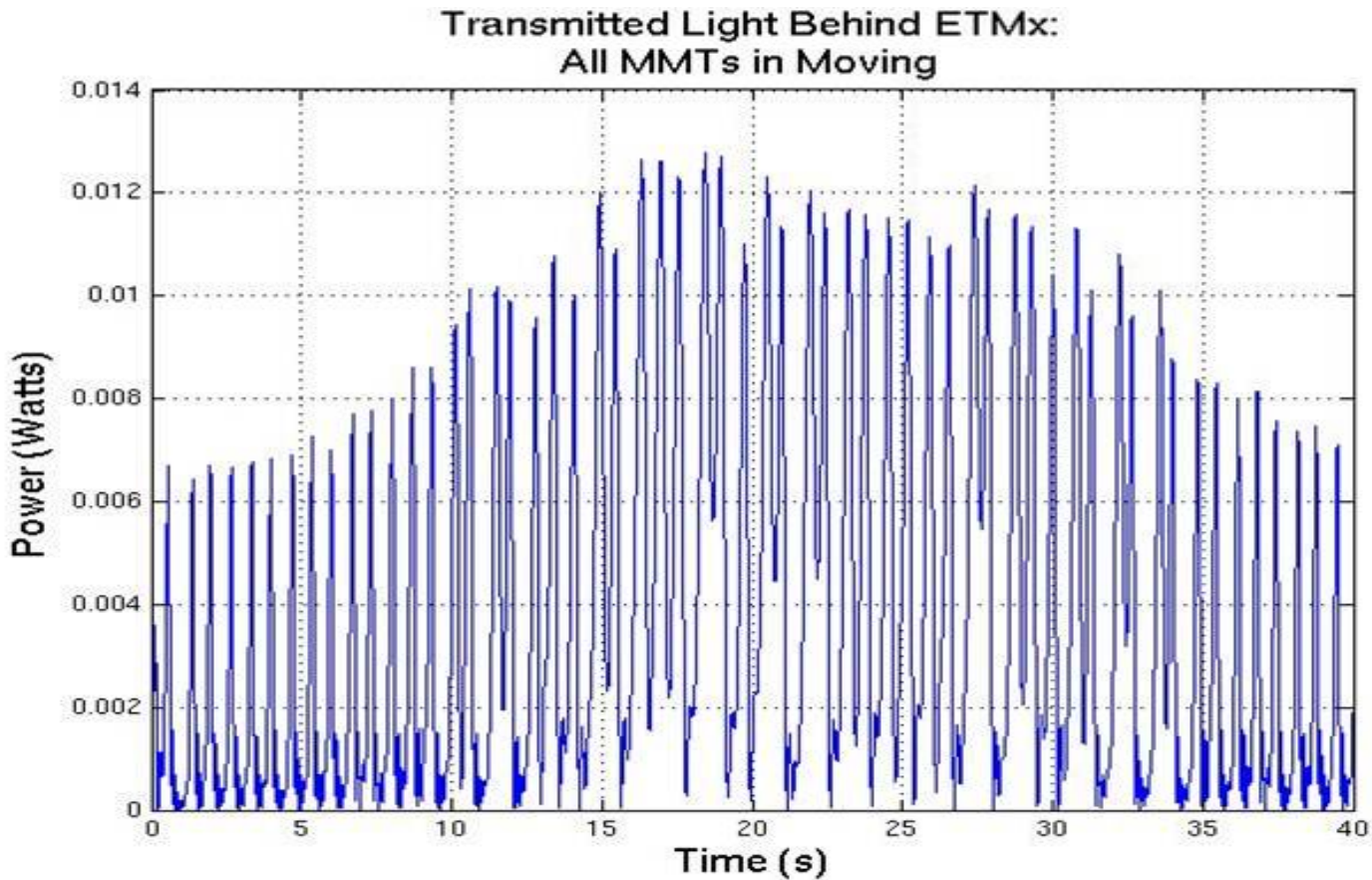
Power Behind ETMx due to MMT1 and MMT3 motion

Power Behind ETMx due to MMT optics motion

Summary

- Produced a better representation of the table translational and yaw motion
- Created a Mode Cleaner box with Length Sensing Control
- Put the Mode Matching Telescope into Detector box
- Will continue investigating the effect of table motion on the optic and the resultant beam motion
- Will include Mode Cleaner box in Detector box

Acknowledgements

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  - M. Evans
  - H. Yamamoto
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  - Southeastern Louisiana University