

# Mode Cleaner Wavefront Servo: Feeding Back to Mode Cleaner Mirrors

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- Future Work

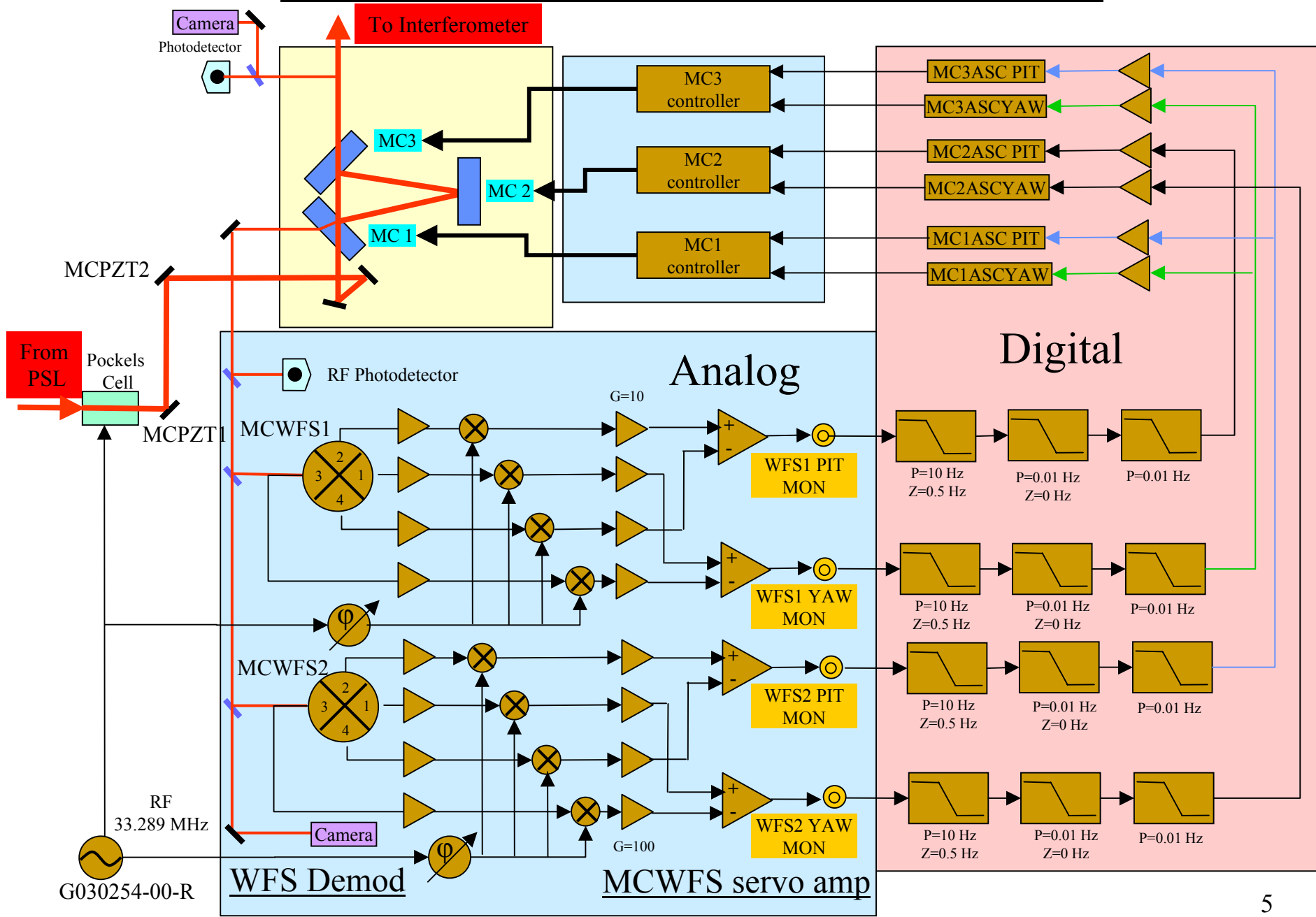
# Old servo

- ❑ Terminology:
  - MCS1 is modecleaner wavefront sensor 1
  - MCS2 is modecleaner wavefront sensor 2
  - Sometimes also MCWFS1 and MCWFS2 is used
- ❑ Actuate on input beam by using M1 and M2 PZT's on periscope on PSL table
- ❑ Low bandwidth ( $<1$  Hz)
  - Does not follow large modecleaner mirror angular motion induced by suspended mirror dynamics and stack modes
  - Causes MC output to have intensity fluctuations
- ❑ Hysteresis in PZT's causes any bad settings in servo to make realignment into MC difficult
- ❑ At LLO, servo has not been used

# New Servo

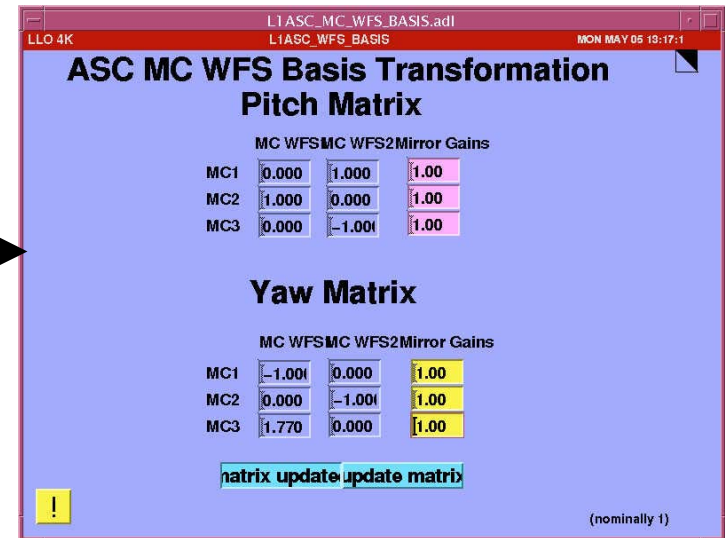
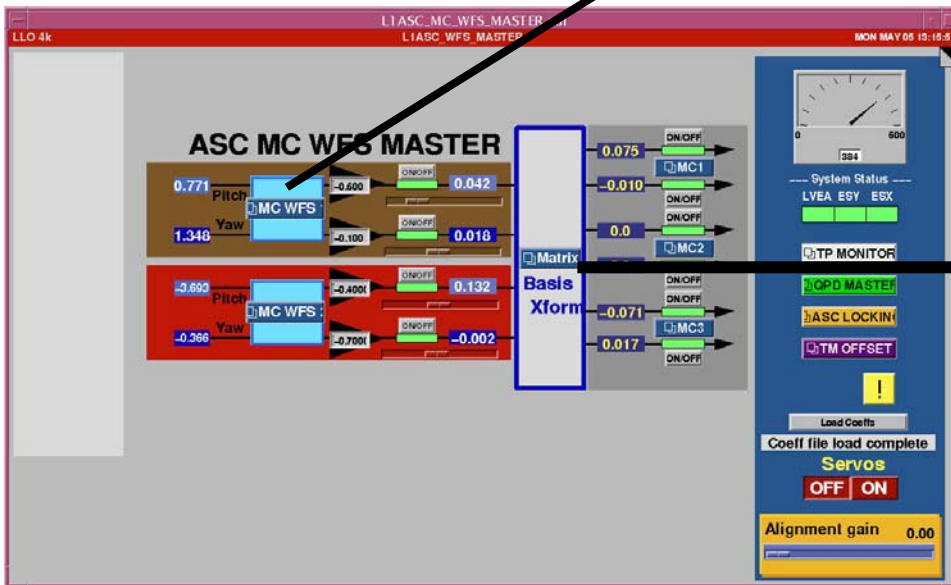
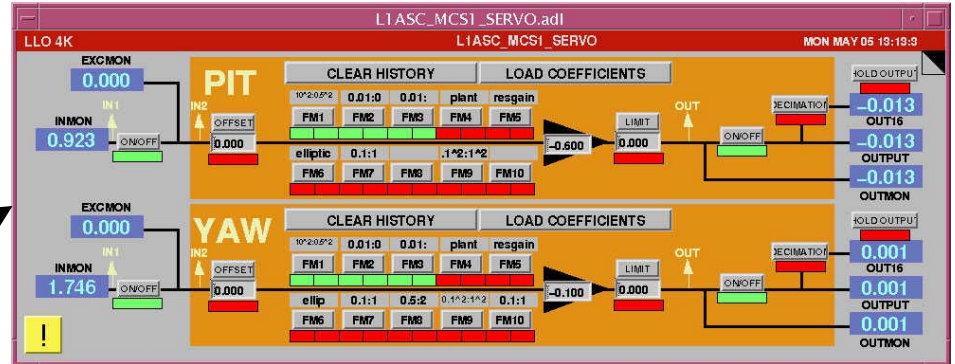
- ❑ Actuate on MC mirrors instead of input beam
  - Input beam more stable than MC at resonances of stack and mirror suspensions
  - Easy to do with digital suspension and ASC code
- ❑ Input to interferometer should have less angular motion
  - May hold lock better
- ❑ MC output intensity should be more stable at low frequencies
  - Less demand on post-MC ISS

# Mode Cleaner Wavefront Sensor Servo



## MEDM Screens

- ❑ Extra screens in WFS master
  - Not affected by overall gain or on/off
- ❑ Usual filter modules



# Response Matrix

- ❑ Excite pitch and yaw for MC1, MC2 and MC3
- ❑ Measure response of MCS1 pitch and yaw and MCS2 pitch and yaw
- ❑ Off-axis terms small

	MCS1 Pitch	MCS2 Pitch
MC1 Pitch	0.026	0.174
MC2 Pitch	0.368	0.048
MC2 Pitch	0.074	-0.157

	MCS1 Yaw	MCS2 Yaw
MC1 Yaw	-0.428	0.06
MC2 Yaw	0.365	-0.389
MC2 Yaw	0.242	0.08

Sensing Matrix

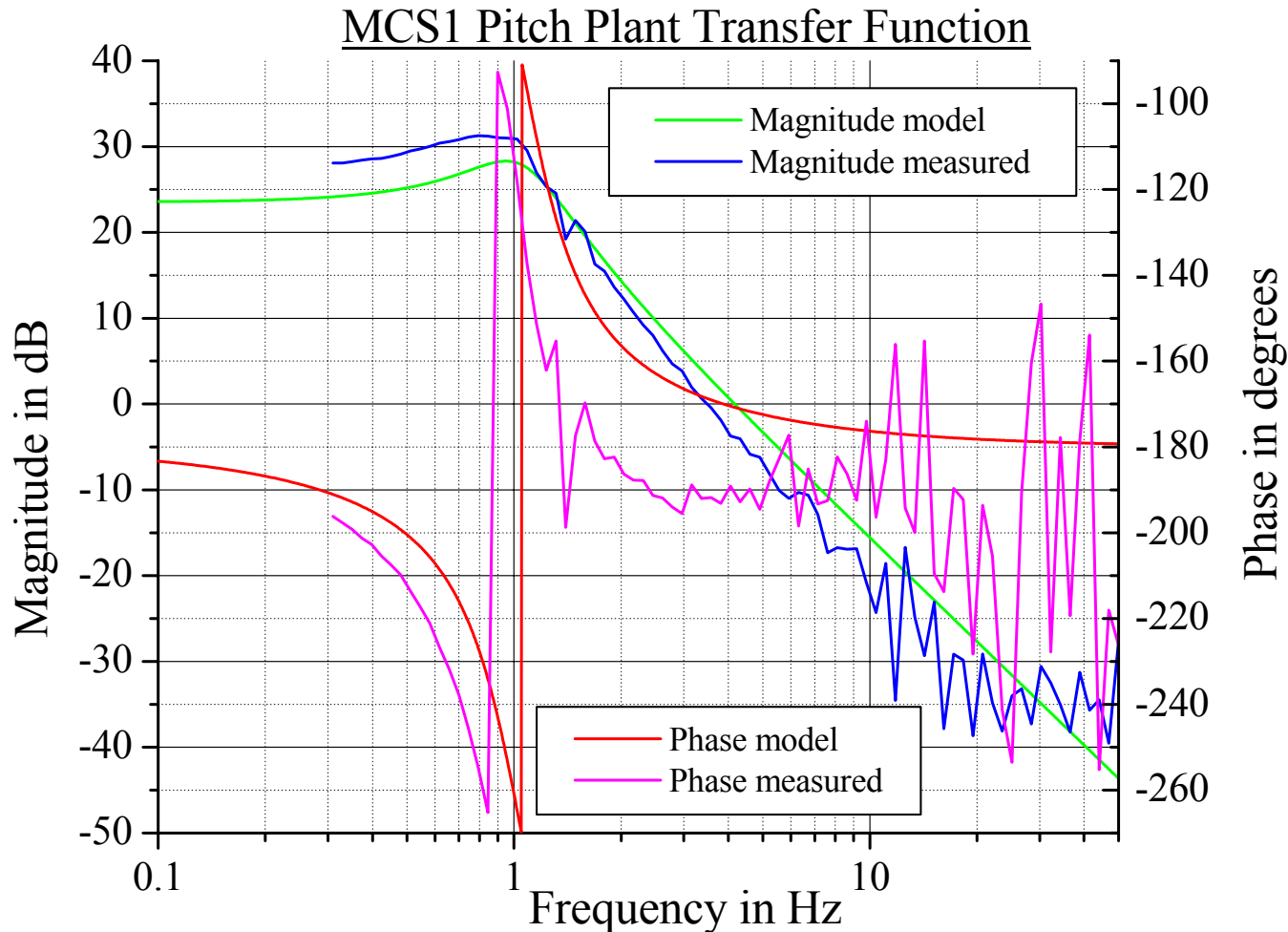
	MC1 Pitch	MC2 Pitch	MC3 Pitch
MCS1 Pitch	0	1	0
MCS2 Pitch	1	0	-1

	MC1 Yaw	MC2 Yaw	MC3 Yaw
MCS1 Yaw	-1	0	1.77
MCS2 Yaw	0	-1	0

Actuation Matrix

# Plant Transfer Function

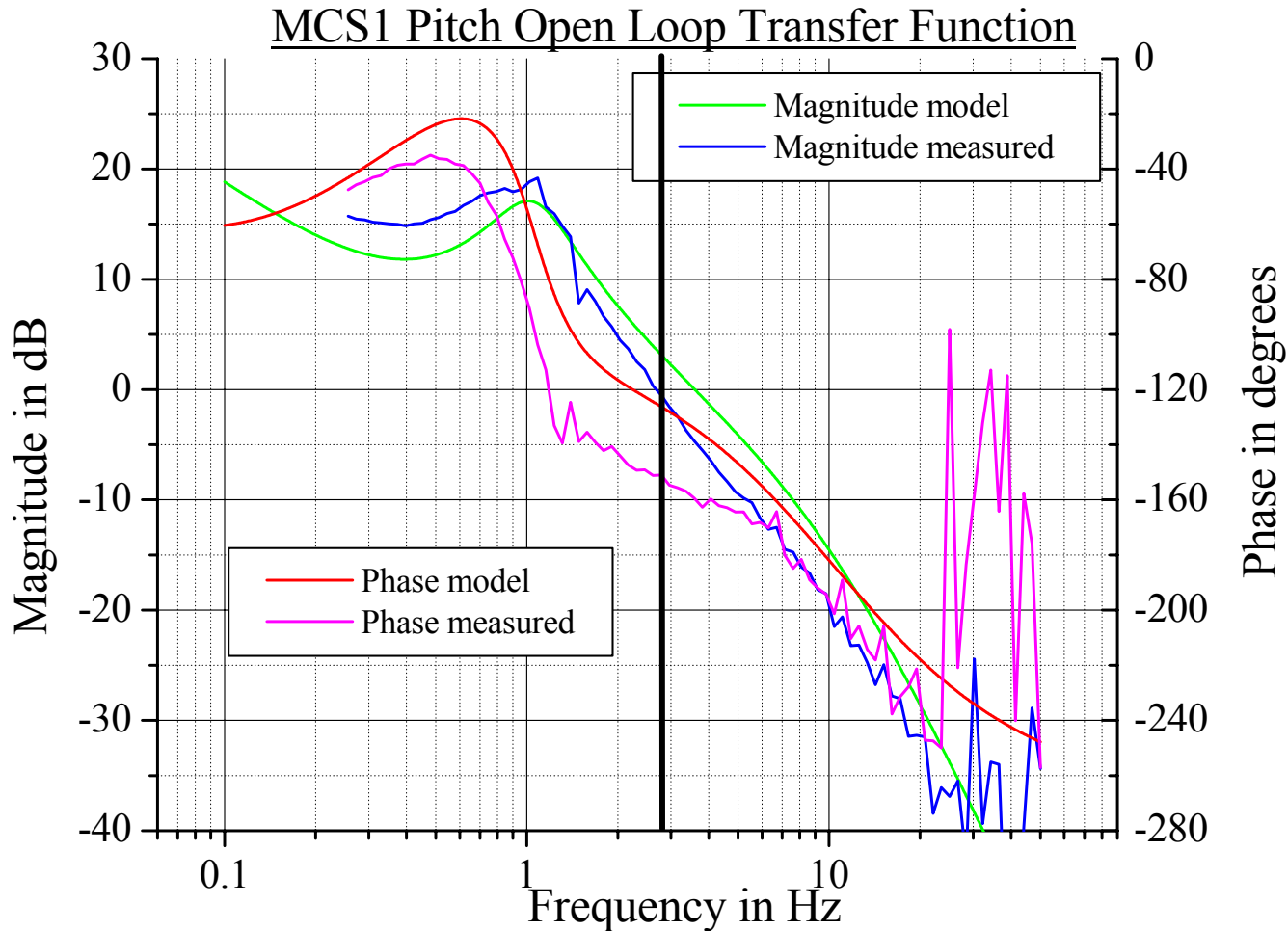
- Resonance with low Q near 1 Hz





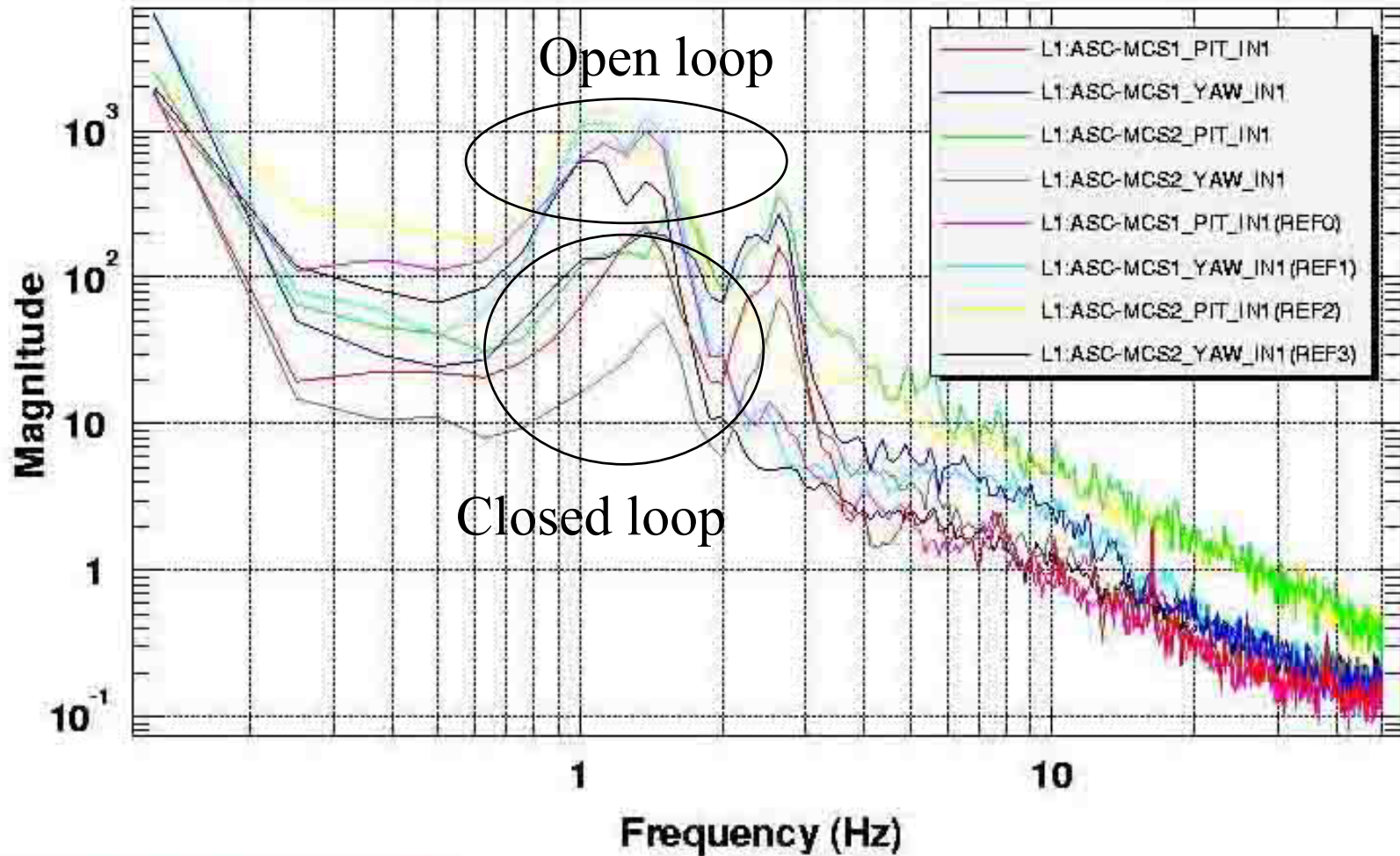
# Servo Transfer Function

- ❑ Need to roll gain off below stack resonances that start near 9 Hz



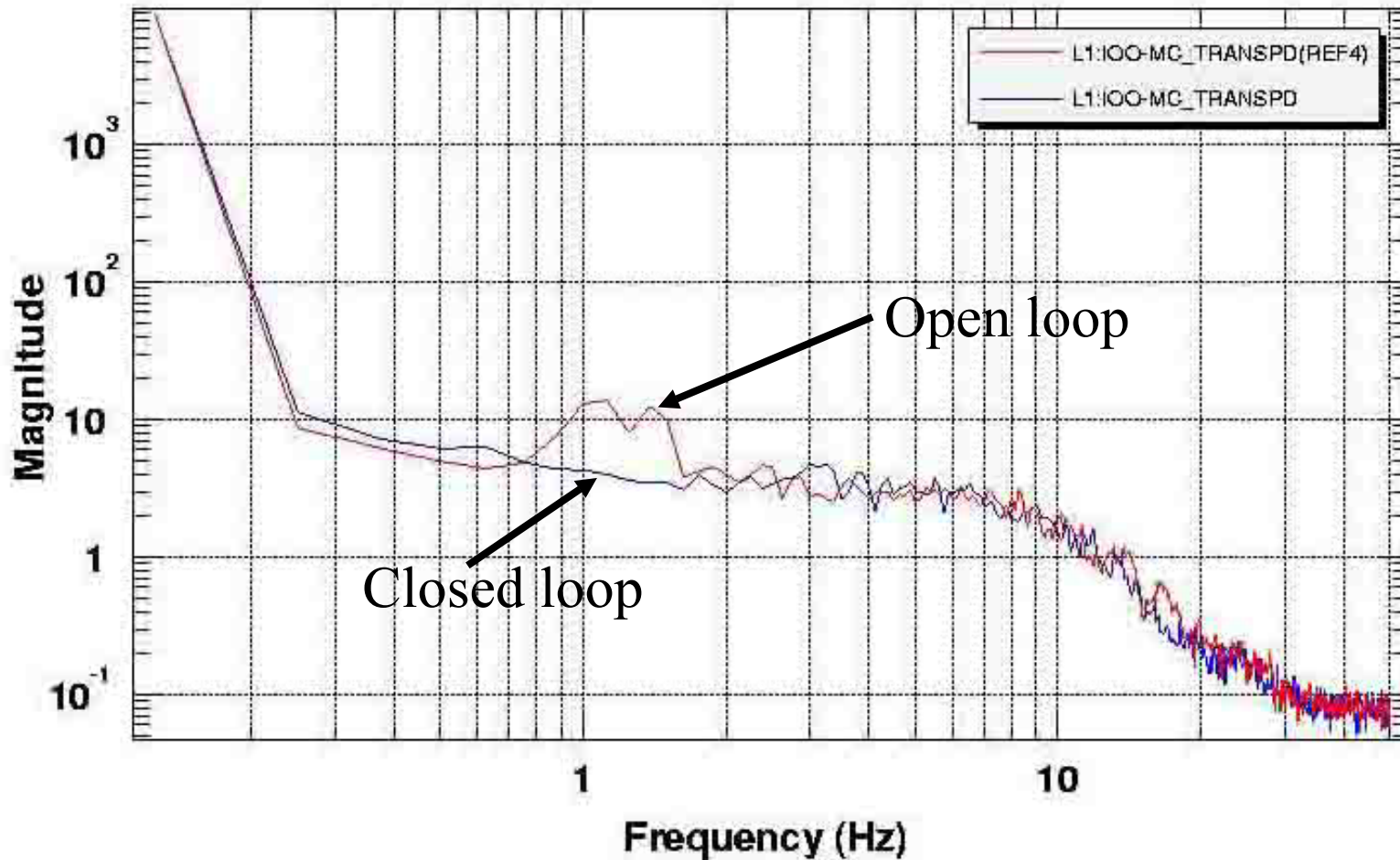
# In Loop Suppression

□ Open and closed loop error point signals

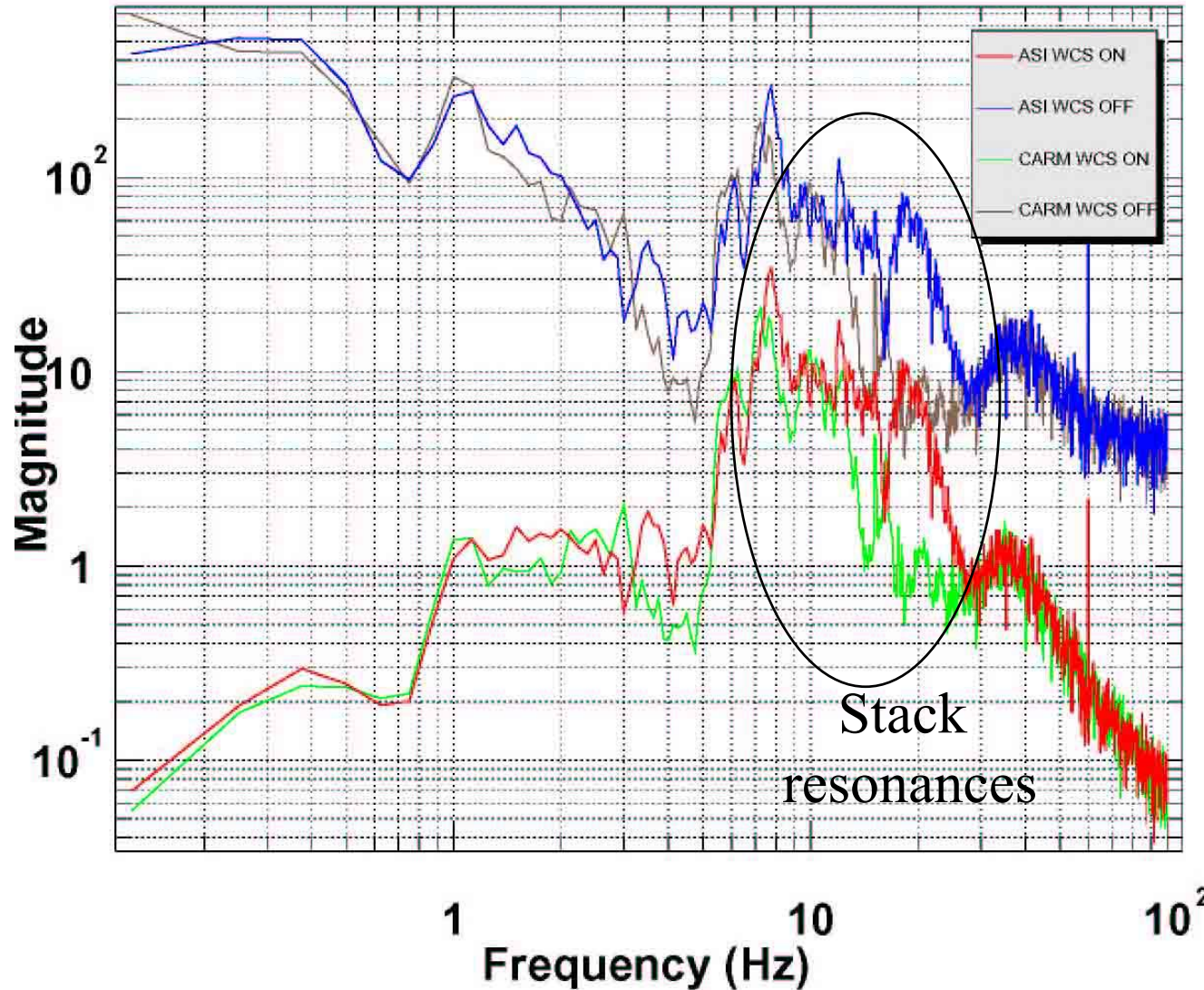


# MC Transmitted Light

- ☐ Sunday spectrum so quieter than normal



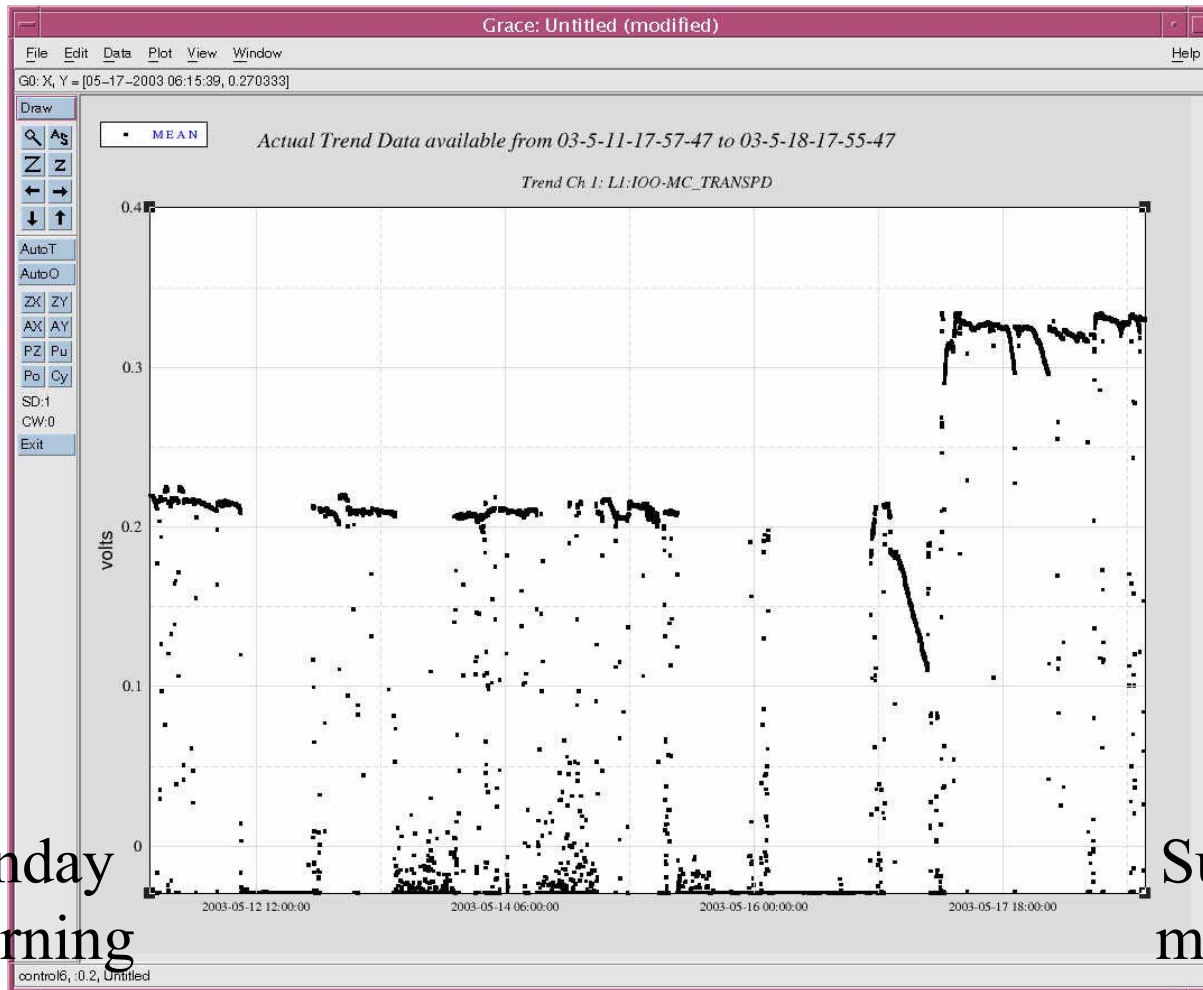
# One Arm Test



□ ASI and CARM signals

# Locking Difficulties

- Logging and construction interfering with daytime mode cleaner locking



Sunday morning

Sunday morning

- Increase servo gain near 1 Hz
- Turn off local damping
- Blend in MC PZT's
- Look at effect on full interferometer
  - Noise spectrum
  - Look at loss lock statistics
  - Look at lock acquisition times
  - Look at interaction with main ASC WFS
- Look at interaction with ISS using post-MC photodiode
- Study noise limit of servo
- Make installation permanent
  - Update MC auto locker
  - Make cabling permanent