Status Update of aLIGO Lock Acquisition Simulation

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LIGO-G1400379-v1

ISC modeling meeting Mar/21/2014

Overview

- My homeworks are:
  - Update the ALS noise
  - Close the DARM loop with a realistic QUAD
    either by ALS_DIFF or some IR signals

- Started looking into the latest ALS noise
  see previous update (G1400231-v1)

- Closed the DARM loop with a realistic QUAD
  This is the major update today.

QUAD implementation

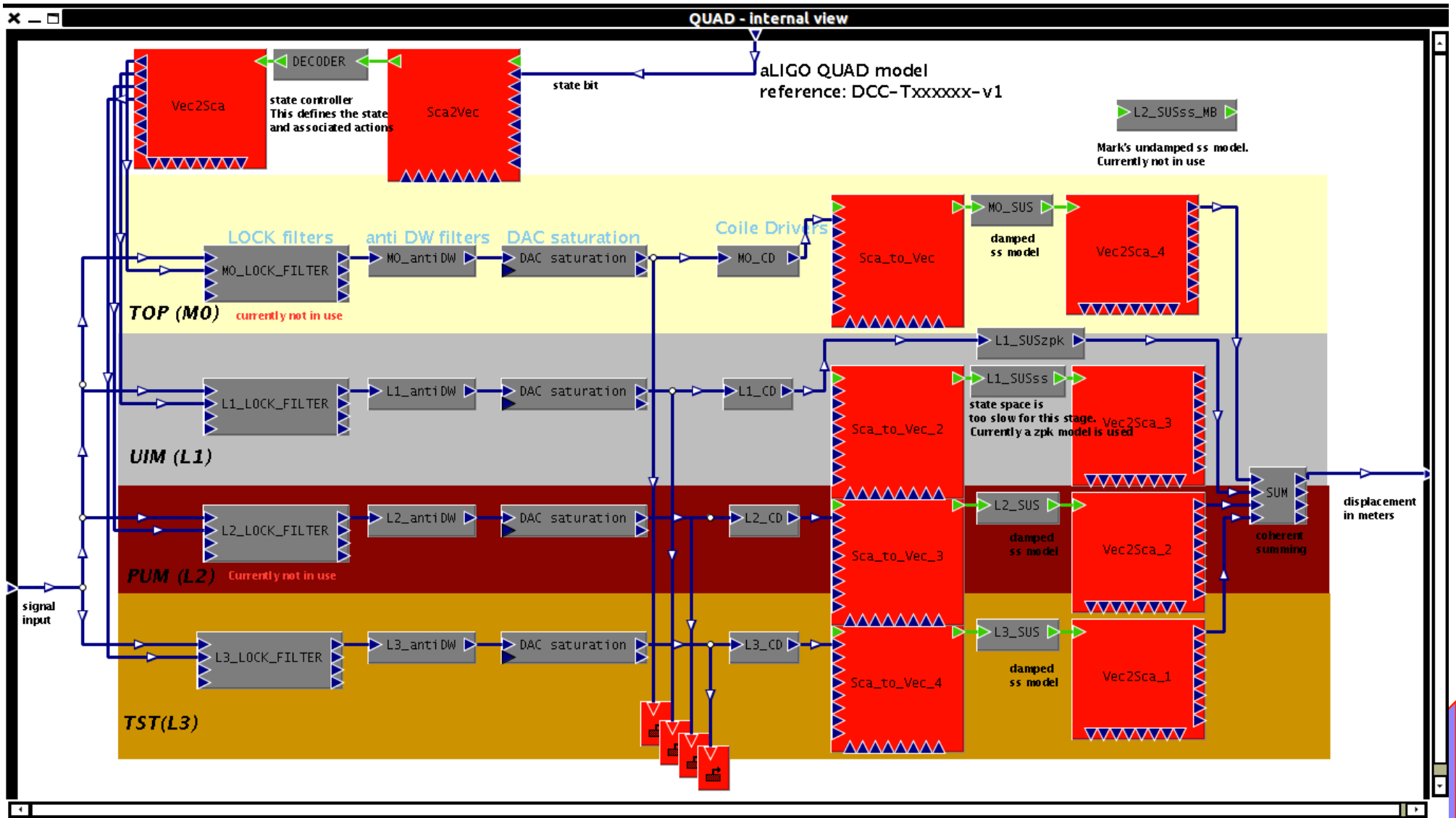
- It uses Kiessel's blending filters[1].
  Only UIM and TST are used. Crossover at 4Hz

[1] https://redoubt.ligo-wa.caltech.edu/svn/sus/trunk/QUAD/Common/FilterDesign/HierarchicalControl/DARMmodel_ALS_20140313.m

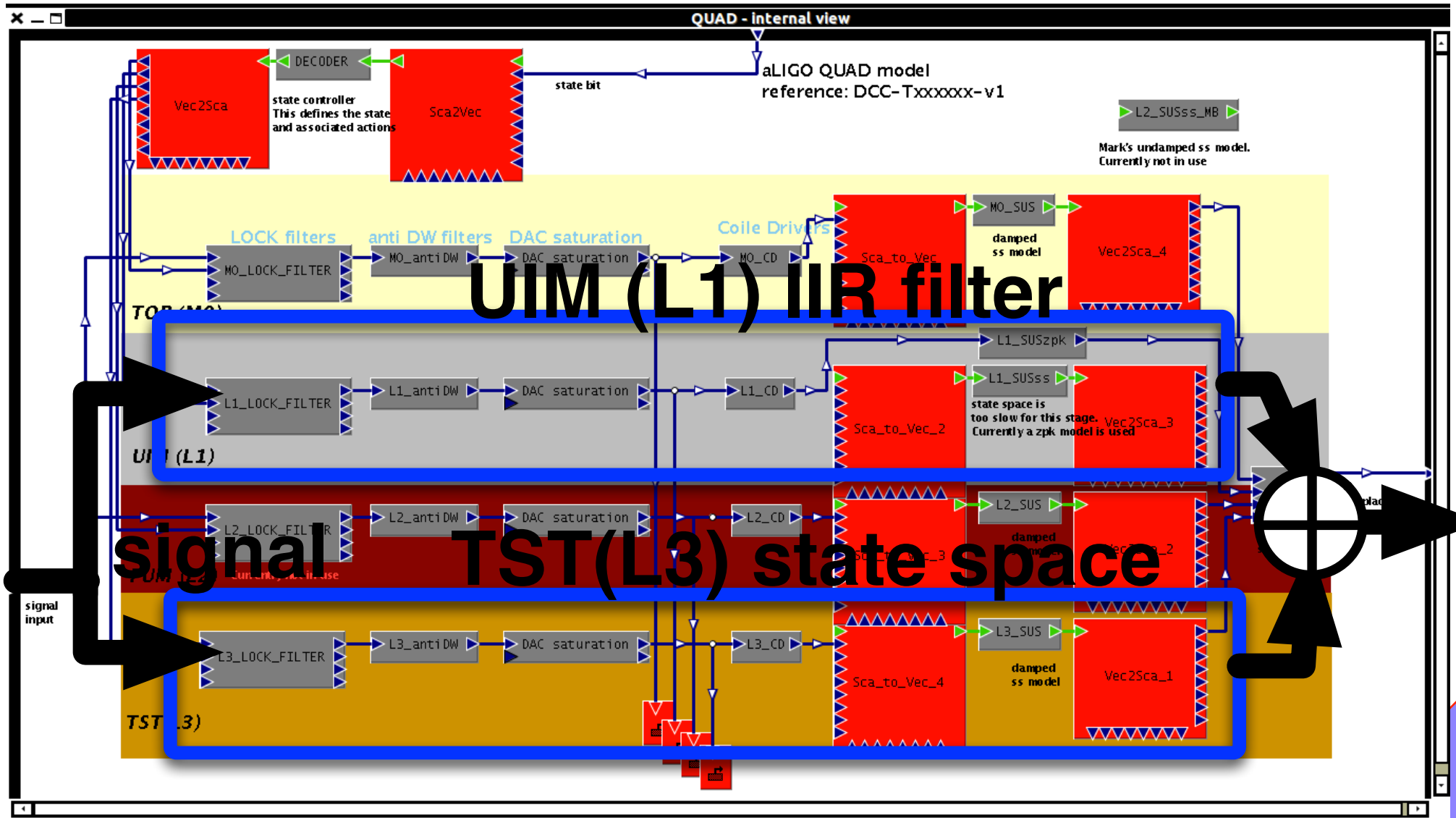
- Attempted a full state space model
  => it turned out that I had to sacrifice the computation time to accurately simulate all the stages.

- It ended up with a half state-space and half IIR filter to keep the simulation not so slow.

QUAD in e2e


QUAD - internal view
aLIGO QUAD model
reference: DCC-Txxxxxx-v1
Vec2Sca
DECODER
state controller
This defines the state
and associated actions
Sca2Vec
state bit
L2_SUSss_MB
Mark's undamped ss model.
Currently not in use
LOCK filters
anti DW filters
DAC saturation
Coile Drivers
MO_LOCK_FILTER
MO_antiDW
DAC saturation
MO_CD
Sca_to_Vec
MO_SUS
damped
ss model
Vec2Sca_4
TOP (M0)
currently not in use
L1_SUSzpk
L1_LOCK_FILTER
L1_antiDW
DAC saturation
L1_CD
L1_SUSss
state space is
too slow for this stage.
Currently a zpk model is used
Sca_to_Vec_2
Vec2Sca_3
UIM (L1)
SUM
displacement
in meters
coherent
summing
L2_LOCK_FILTER
L2_antiDW
DAC saturation
L2_CD
L2_SUS
damped
ss model
Sca_to_Vec_3
Vec2Sca_2
PUM (L2)
Currently not in use
signal
input
L3_LOCK_FILTER
L3_antiDW
DAC saturation
L3_CD
L3_SUS
damped
ss model
Sca_to_Vec_4
Vec2Sca_1
TST(L3)

QUAD in e2e


QUAD - internal view
DECODER
Vec2Sca
state controller
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DAC saturation
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MO_CD
Sca_to_Vec
MO_SUS
damped
ss model
Vec2Sca_4
UIM (L1) IIR filter
L1_SUSzpk
L1_LOCK_FILTER
L1_antiDW
DAC saturation
L1_CD
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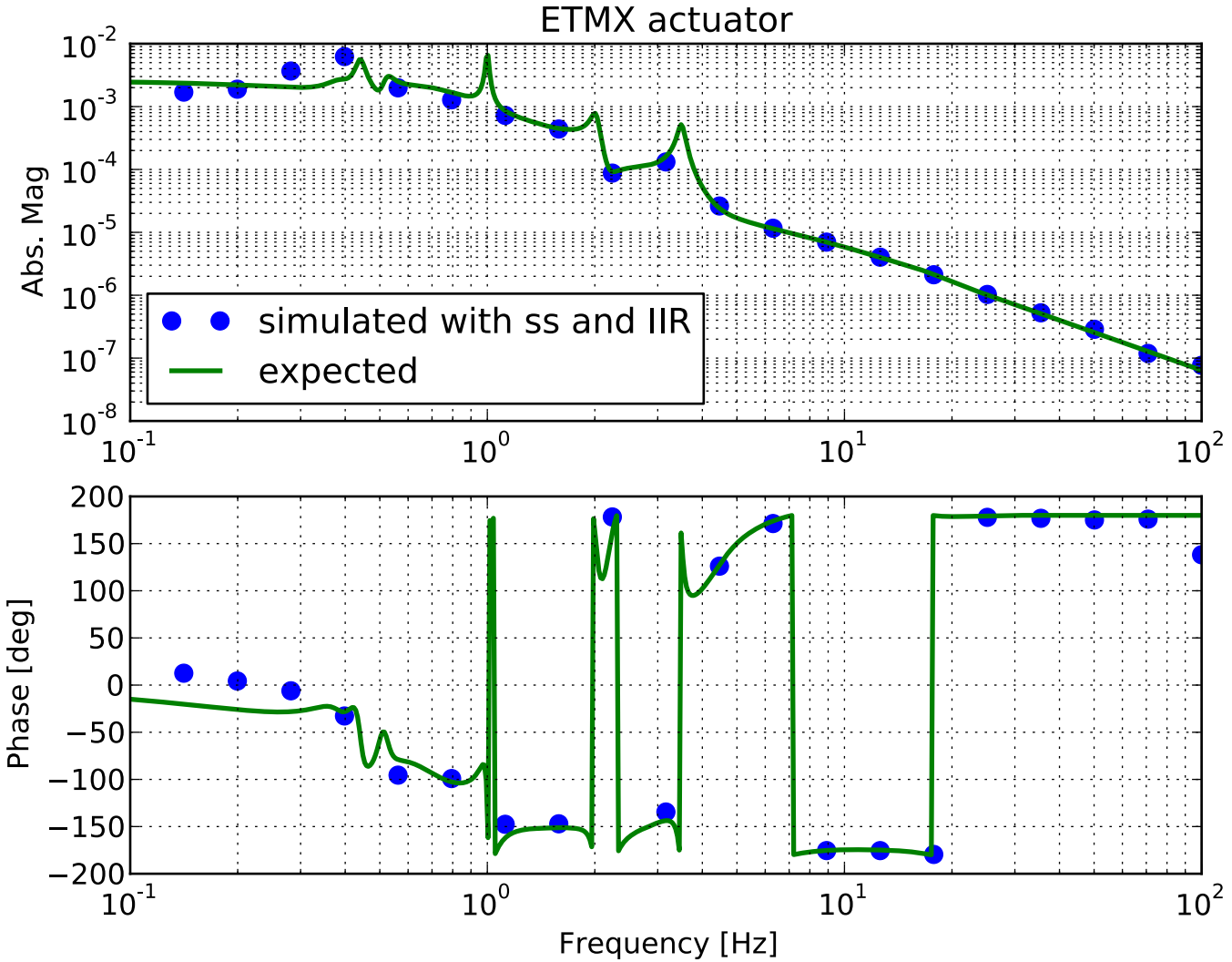
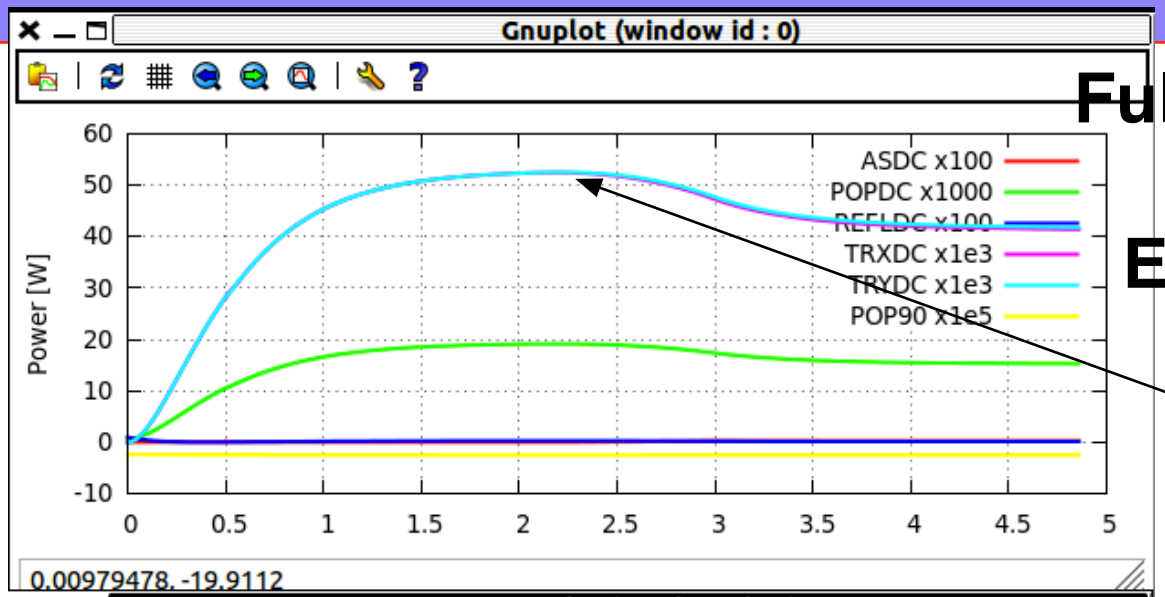
Sca_to_Vec_2
Vec2Sca_3
UIM (L1)
signal
TST(L3) state space
L2_LOCK_FILTER
L2_antiDW
DAC saturation
L2_CD
L2_SUS
damped
signal
input
L3_LOCK_FILTER
L3_antiDW
DAC saturation
L3_CD
L3_SUS
damped
ss model
Sca_to_Vec_4
Vec2Sca_1
TST (L3)

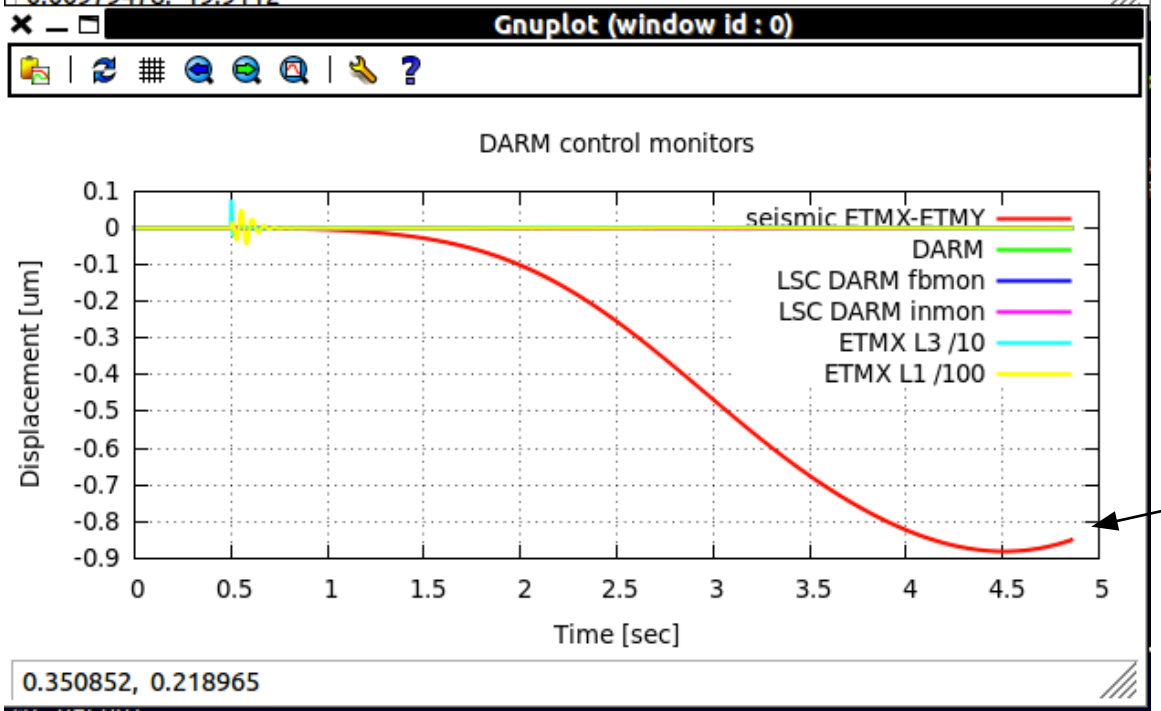
Overall response (UIM+TST)

- Good agreement above 1 Hz.
- Not great below 1 Hz => Under investigation.



DARM closed with the QUAD





Fully locked configuration. AS_RF45 fedback to ETMX-ETMY via QUADs

Cavity power stays at high value (drop after t=2 is due to a intentional offset in DARM)

seismic noise acting on DARM

Summary

- QUAD suspension was implemented.

- Not great agreement below 1 Hz
  => need to understand why
  => this could screw up impulse responses

- As a test, the DARM was closed with the QUAD successfully.

- QUAD is ready for the full lock simulation

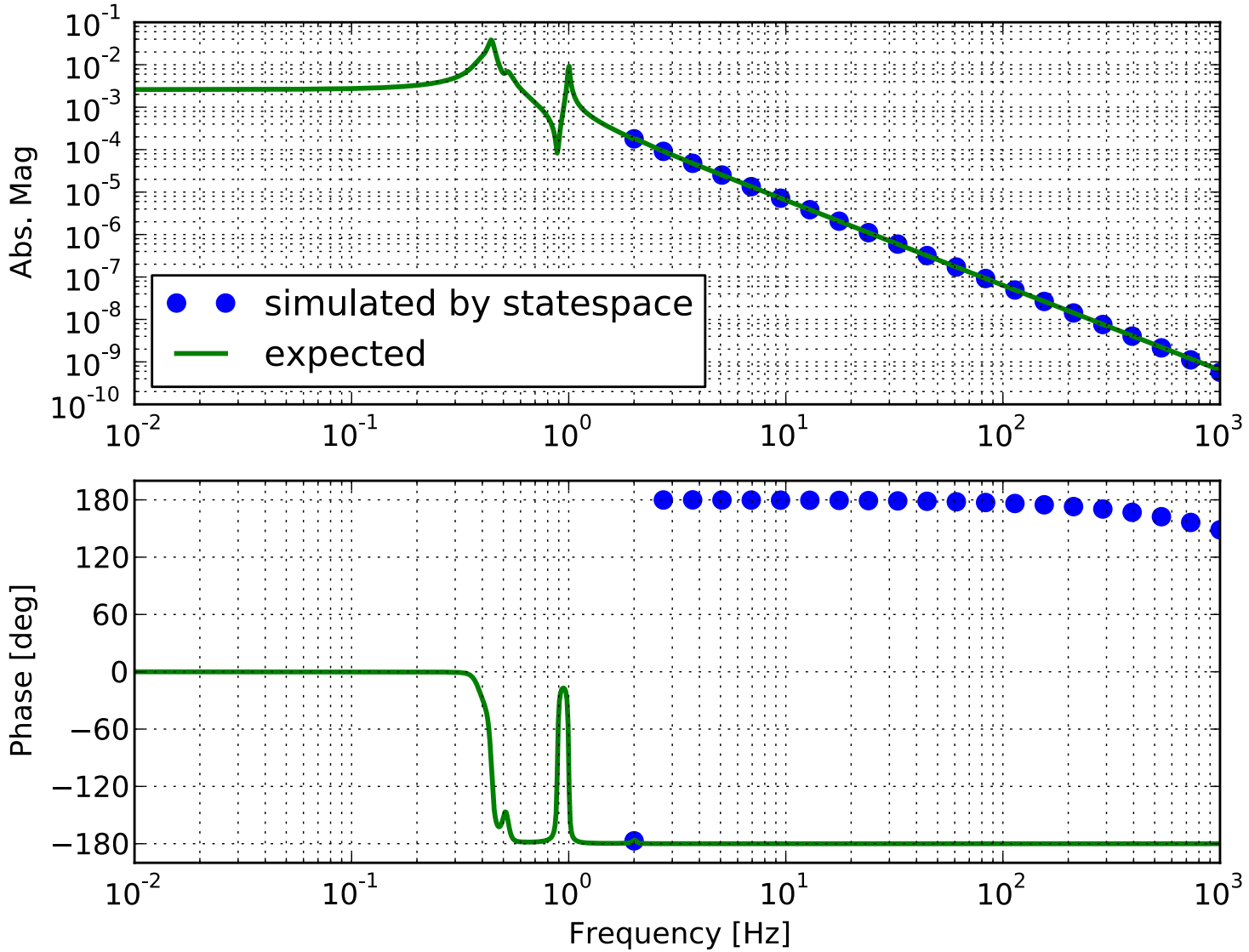
Next moves

- Close the DARM loop with TRX/TRY signals

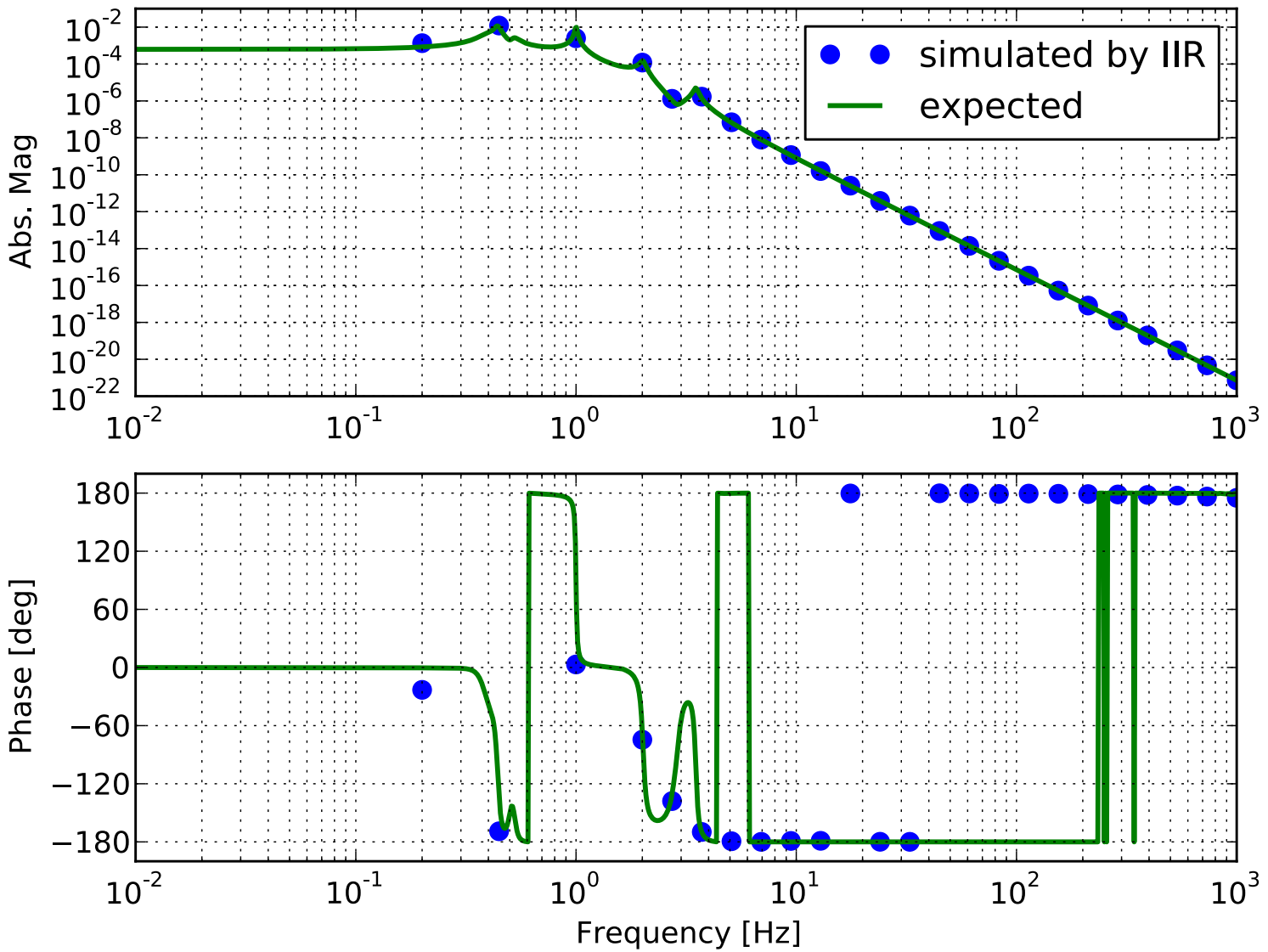
- Since I am already controlling the fully locked IFO, I will try a backward transition (bring IFO to initial state without loosing lock) to figure out good steps.

Gallery

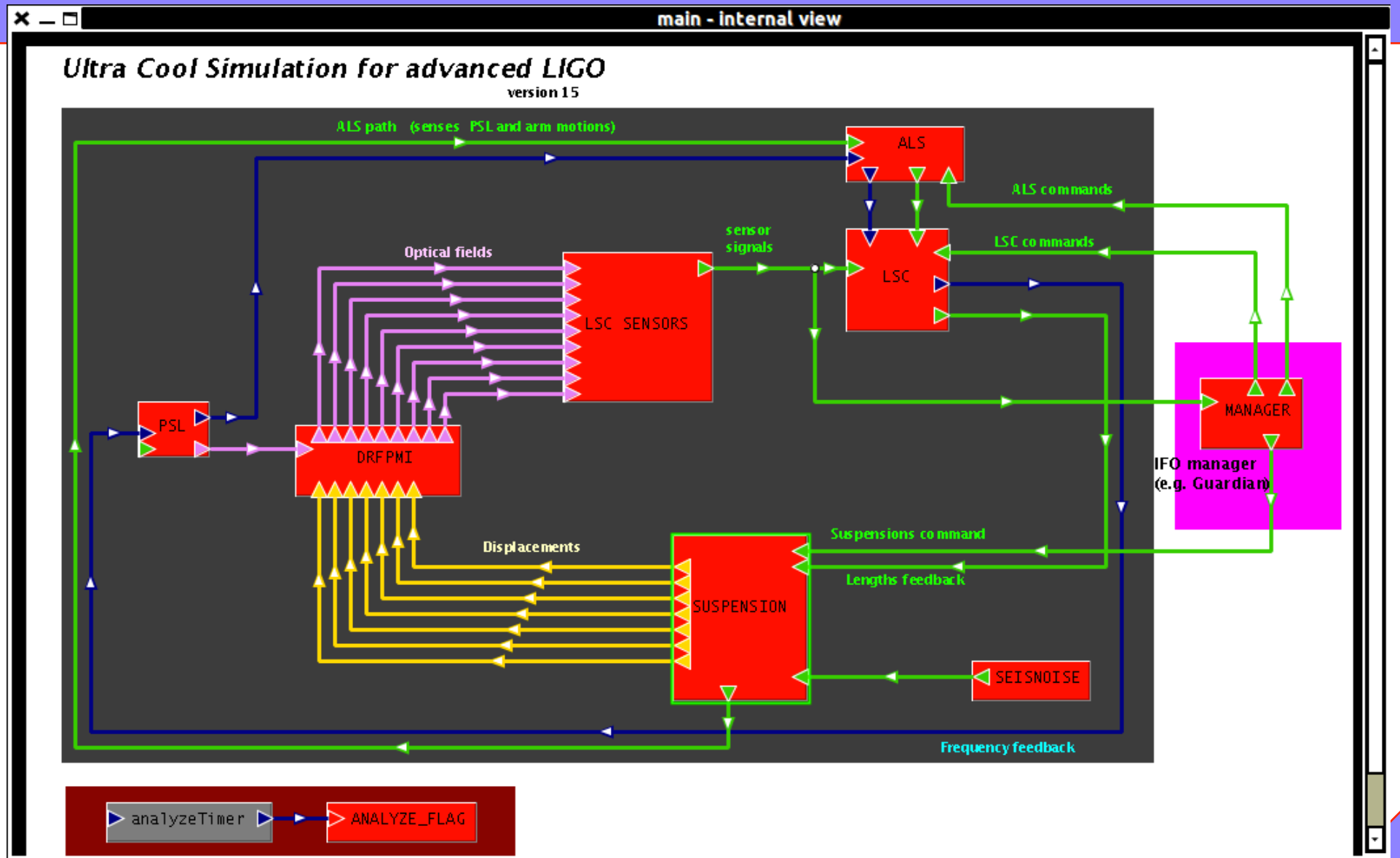
TST(L3) -> TST(L3)


Abs. Mag
simulated by statespace
expected
Phase [deg]
Frequency [Hz]

UIM(L1) -> TST(L3)



Main blocks


main - internal view
Ultra Cool Simulation for advanced LIGO
version 15
ALS path (senses PSL and arm motions)
ALS
ALS commands
sensor signals
Optical fields
LSC
LSC commands
LSC SENSORS
PSL
DRFPMI
MANAGER
IFO manager (e.g. Guardian)
Displacements
Suspensions command
Lengths feedback
SUSPENSION
SEISNOISE
Frequency feedback
analyzeTimer
ANALYZE_FLAG