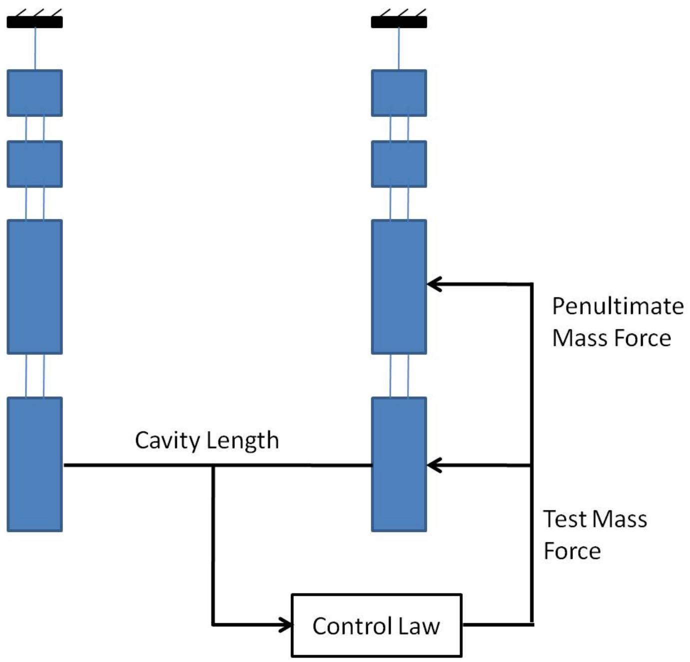
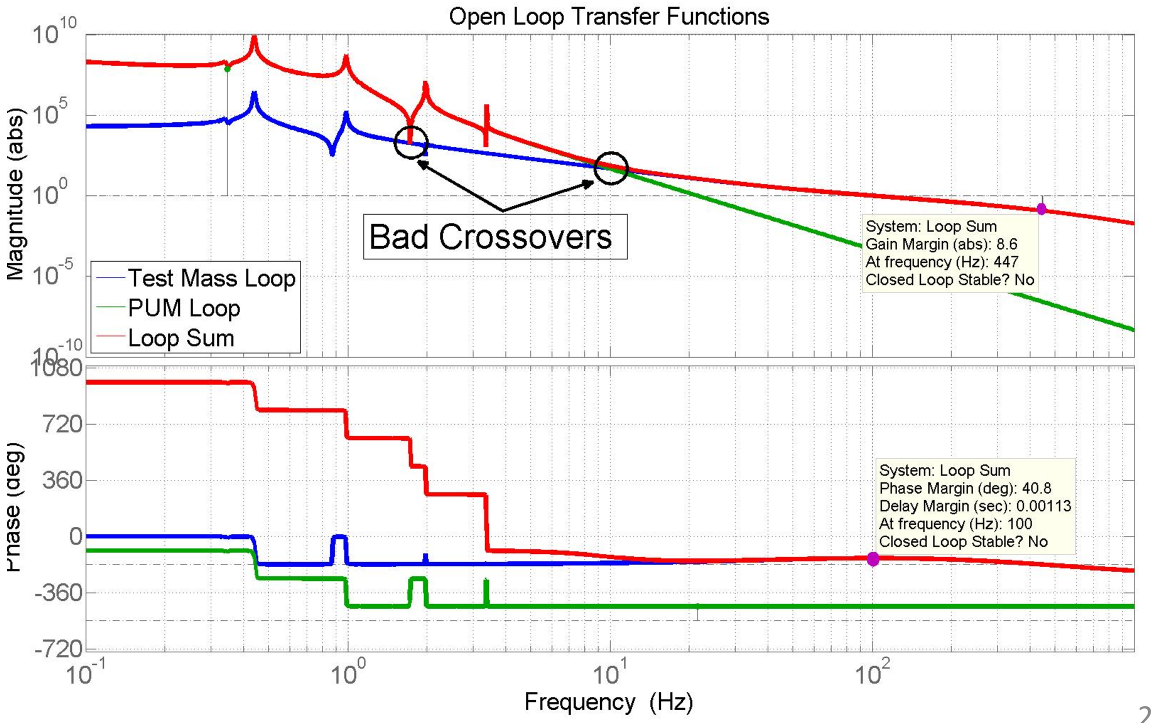
Towards aLIGO Heirarchical Control Scheme

J. Kissel

The History

- Brett's Doc T1000242
  - Pros and cons of distributed vs. heirarchical control
  - Points out how/why cross-overs are important
  - Describes, in general, the right math
  - Developed for/on the Noise-Prototype QUAD at LASTI



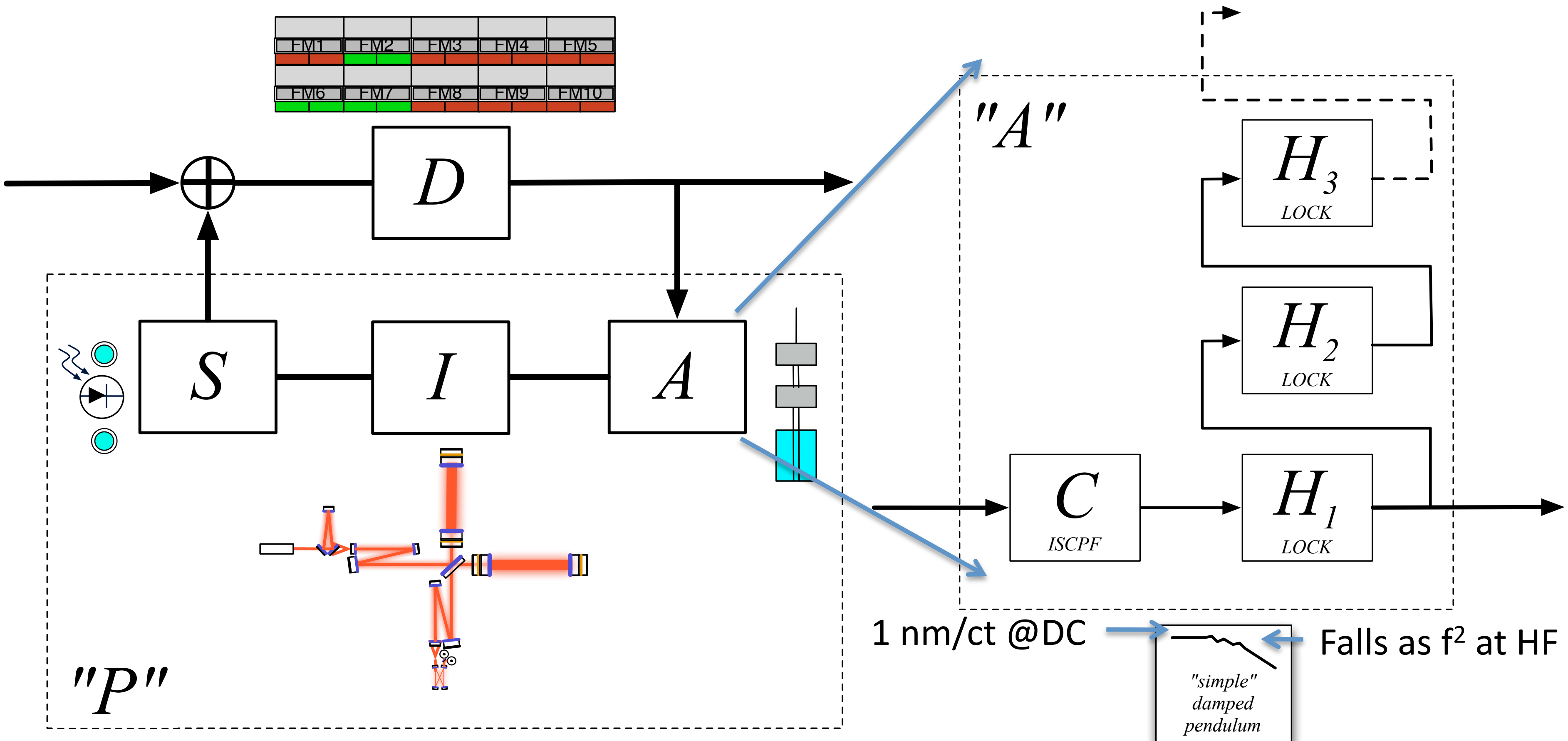


Why the aLIGO Scheme Will be Different than what Brett did

- Different electronics (frequency response will be compensated, but gains are different)
- Several cavity signals vs. just one
- Control signals sent to several different types of suspensions
- Better (?) sensing
- More complete model(s) / new understanding

Why the aLIGO Scheme Will be Different than what Brett did

- Artifically separate the global control “plant”



0 deg phase at DC, -180 deg phase above resonances

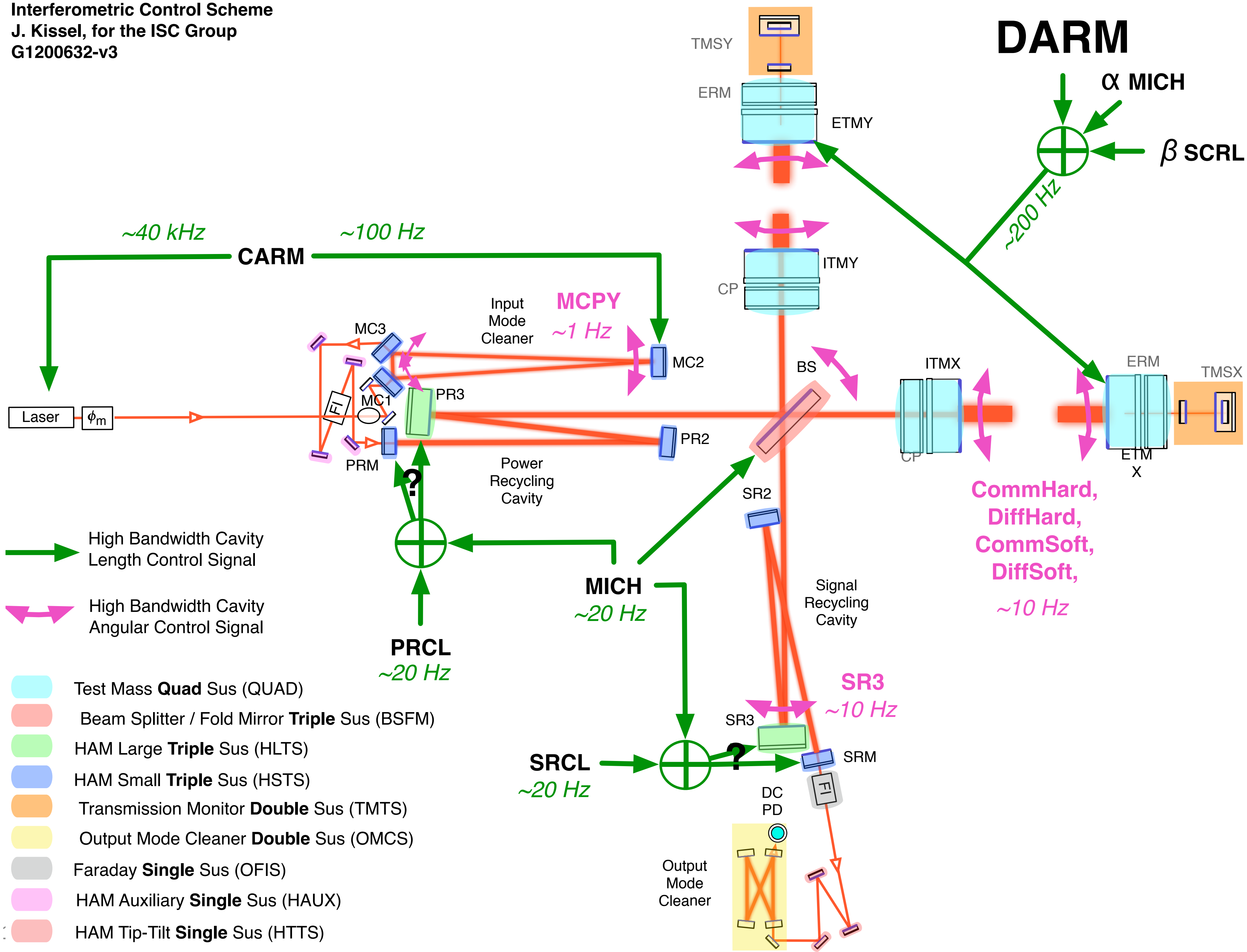
The “For starters” aLIGO Scheme

- Science mode configuration of aLIGO control scheme from the ISC FDR (and discussions with Peter & M. Evans)
  - See T1000298 (ISC, LSC), T070247 (ISC,) and T0900511 (ASC)

- Diagram is covered with grains of salt, since it depends on what we get from SEI+SUS, what SNR we get from the various optical ports, power level, the balance between coupling and control strength, etc., etc.

- The point of me showing it is merely to
  - Give you a feel for what signals go where, to which suspensions
  - Give you a feel for the bandwidth of each of the loops
  - Point out that we won’t have to control “every optic”
  - Point out that **optics will often be receiving more than one cavity signal**

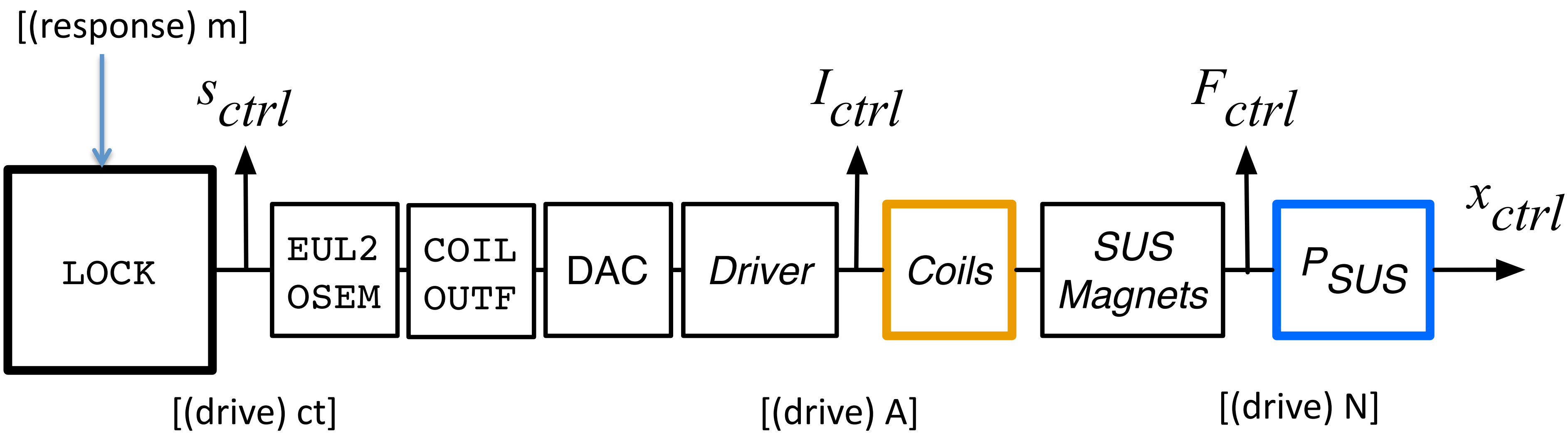
Advanced LIGO
Interferometric Control Scheme
J. Kissel, for the ISC Group
G1200632-v3



The puzzle

- Need lots of complicated pieces:
- A closed-loop SUS model one can trust to be accurate (since we can't sense the plant before we get started); measurements, if possible
- A model of the input motion (HPI + ISI), projected to SUS point
- Complete understanding of control signal chain (hard be cause each SUS layer is different) and its possible states

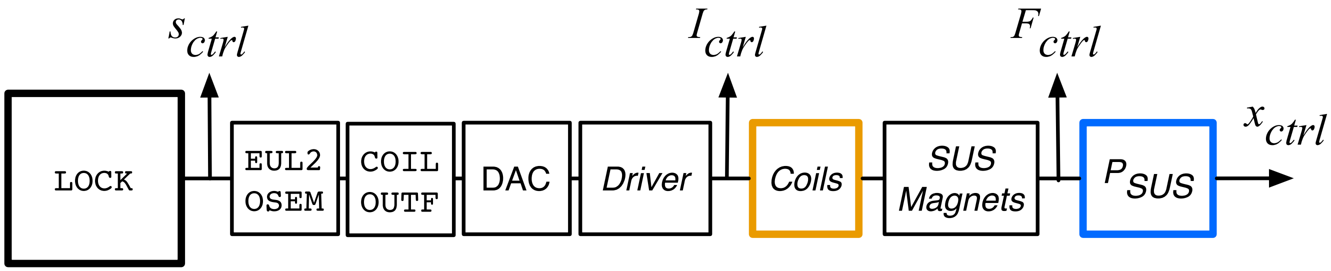
The output path

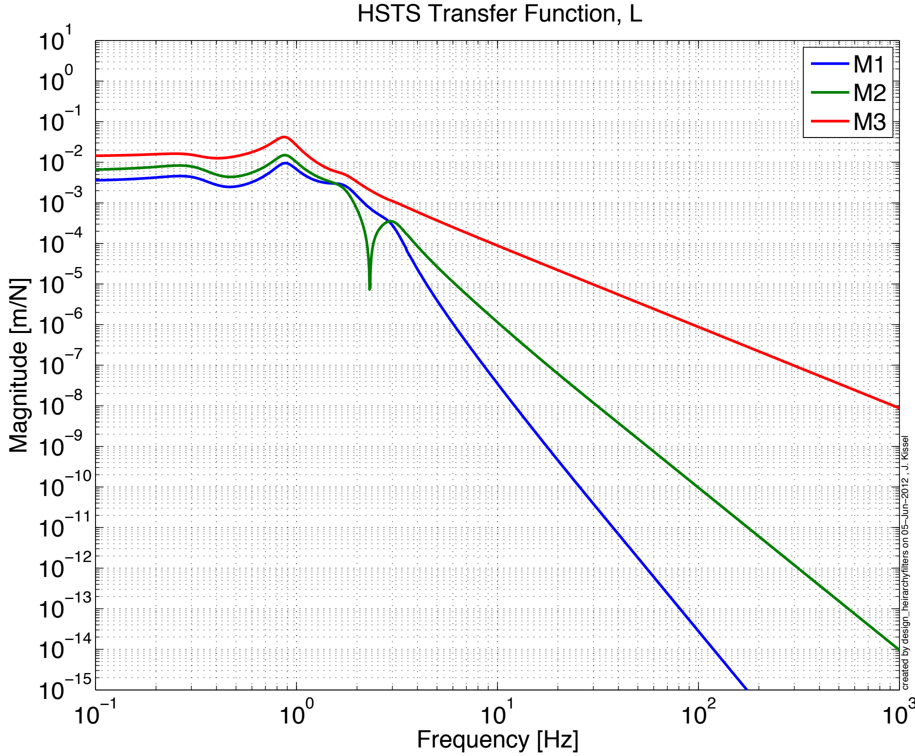


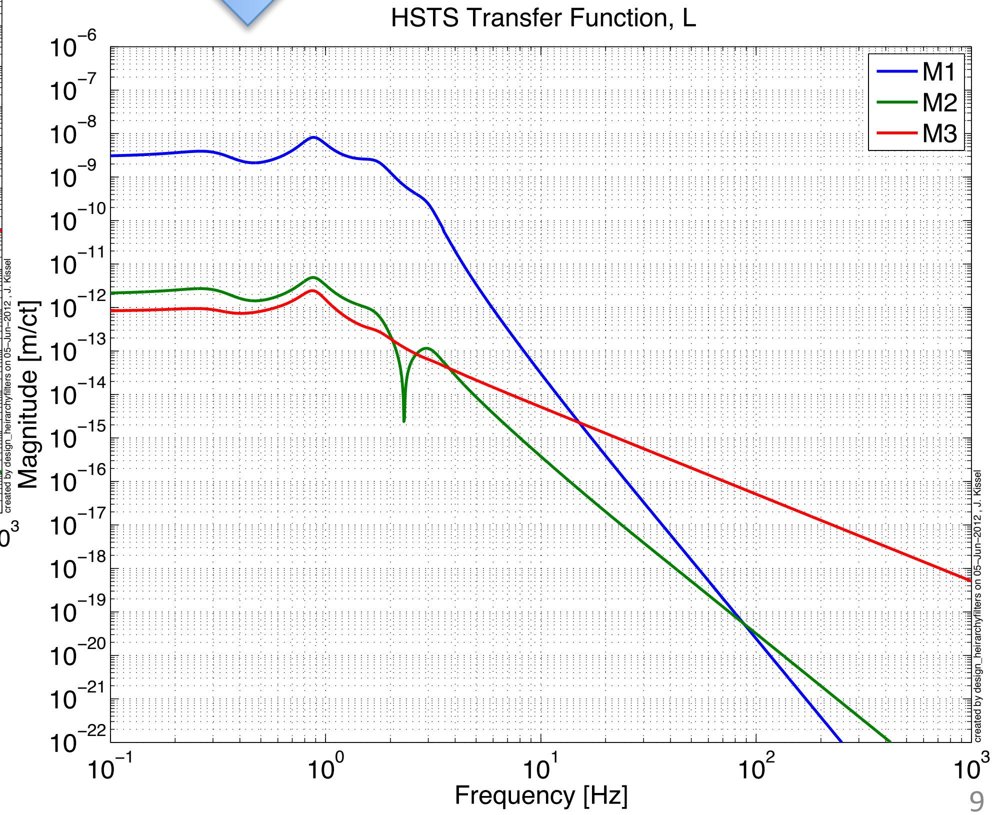
- The Barton models of transfer functions come in terms of [m (response)] / [N (drive)]
- The "plant" for the control system is (drive at the LOCK filters to the displacement of test mass) or [m (response) / ct (drive)]
- Frequency response of analog electronics in drive chain is compensated, EUL2OSEM matrix preserves units, so we only need DC gains of all components

- ${SusSVN}/sus/trunk/Common/MatlabTools/make_OSEM_filter_model.m

The output path







The remaining To-Do list

- Complete assessment of output path for all suspensions
- Get the latest input motion models
- Design appropriate locking filters
- Show stability / compatibility of design, show open loop gains and crossovers
- Get infrastructure up and running to push these filters out in a reasonably automated fashion

- Starting with HSTSs (for IMC control) because they're more simple then moving on immediately to QUADs (for single arm control)