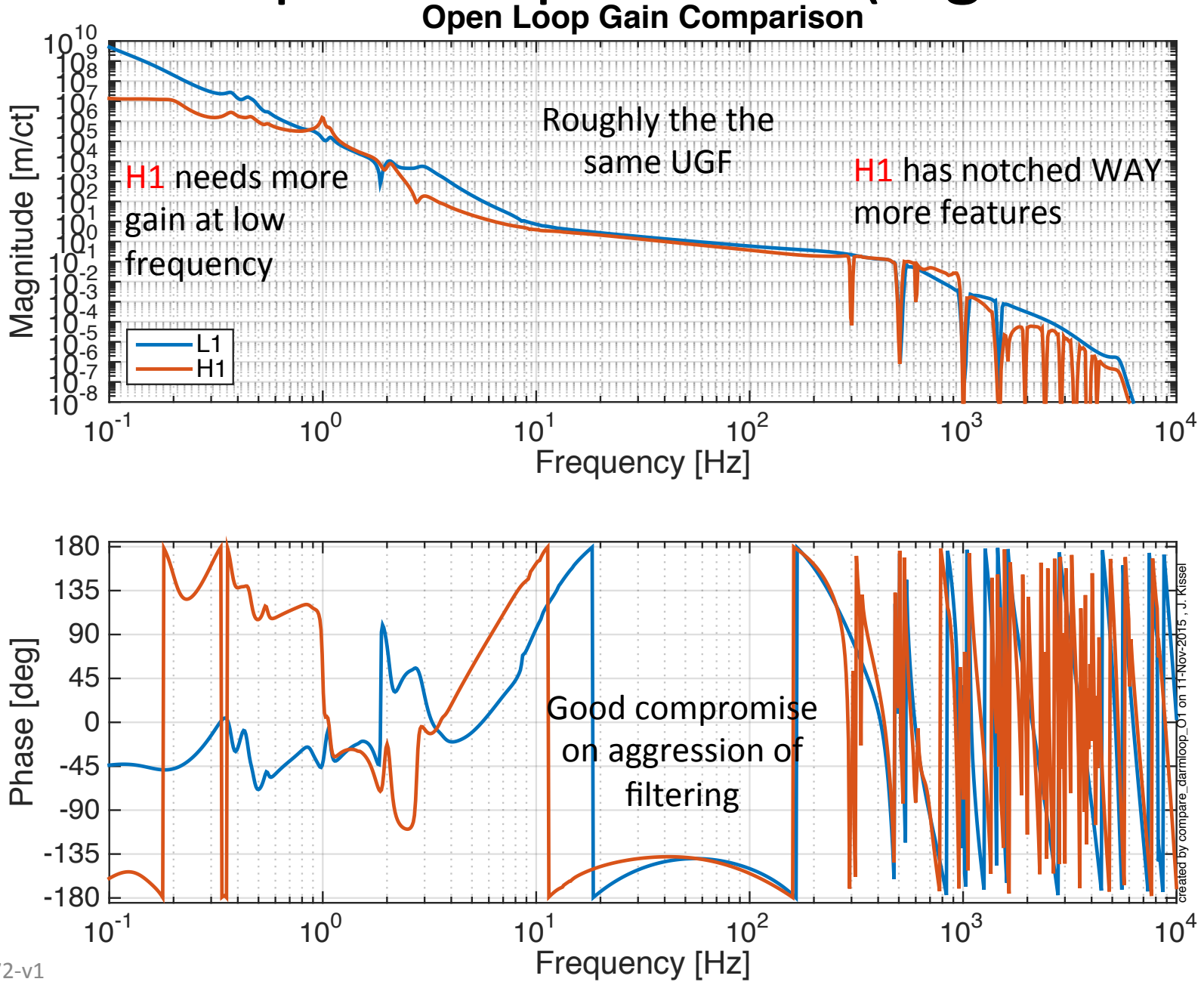
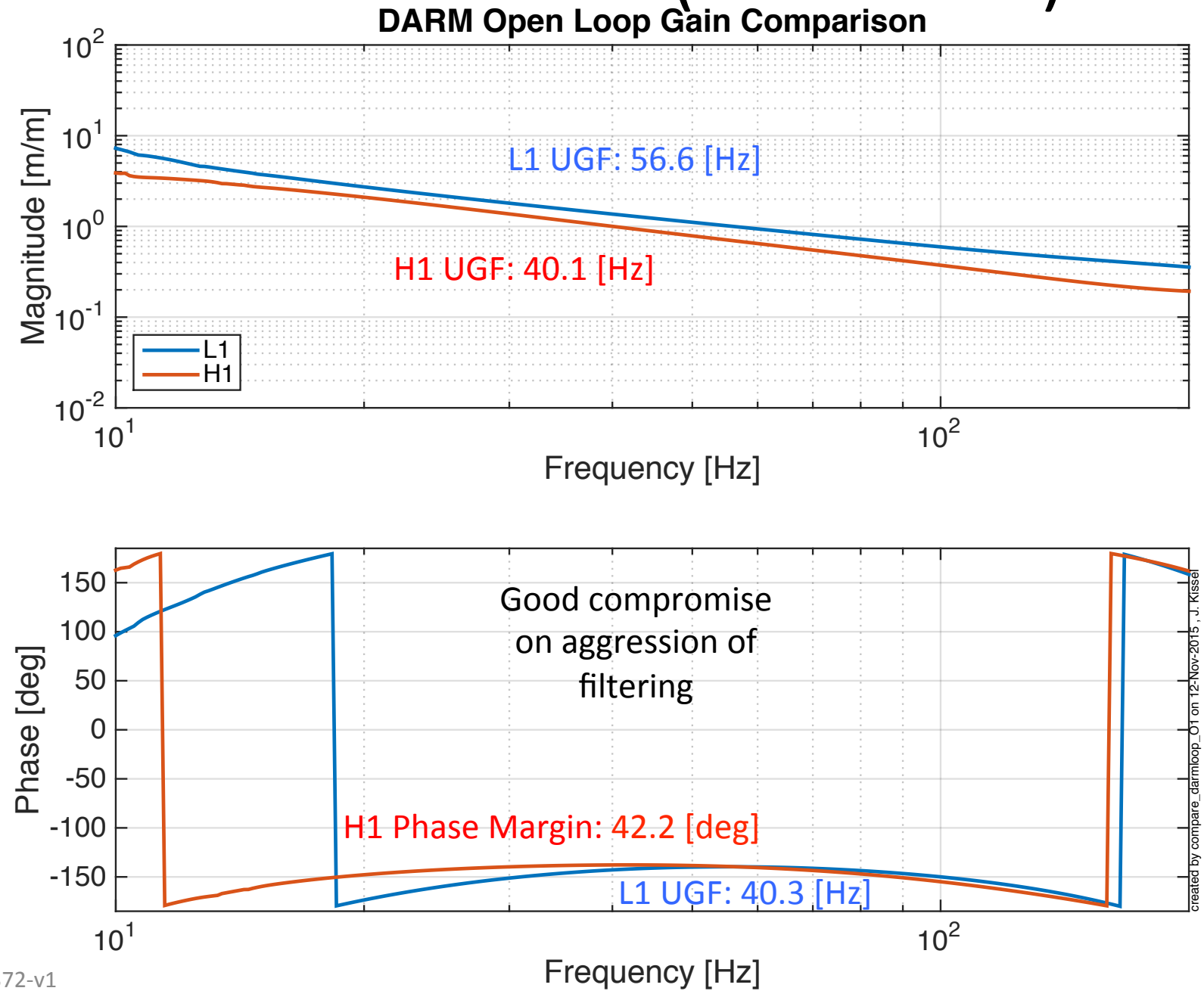
O1 DARM Loop Design Comparisons and Critiques

J. Kissel, for the ISC and Calibration Teams

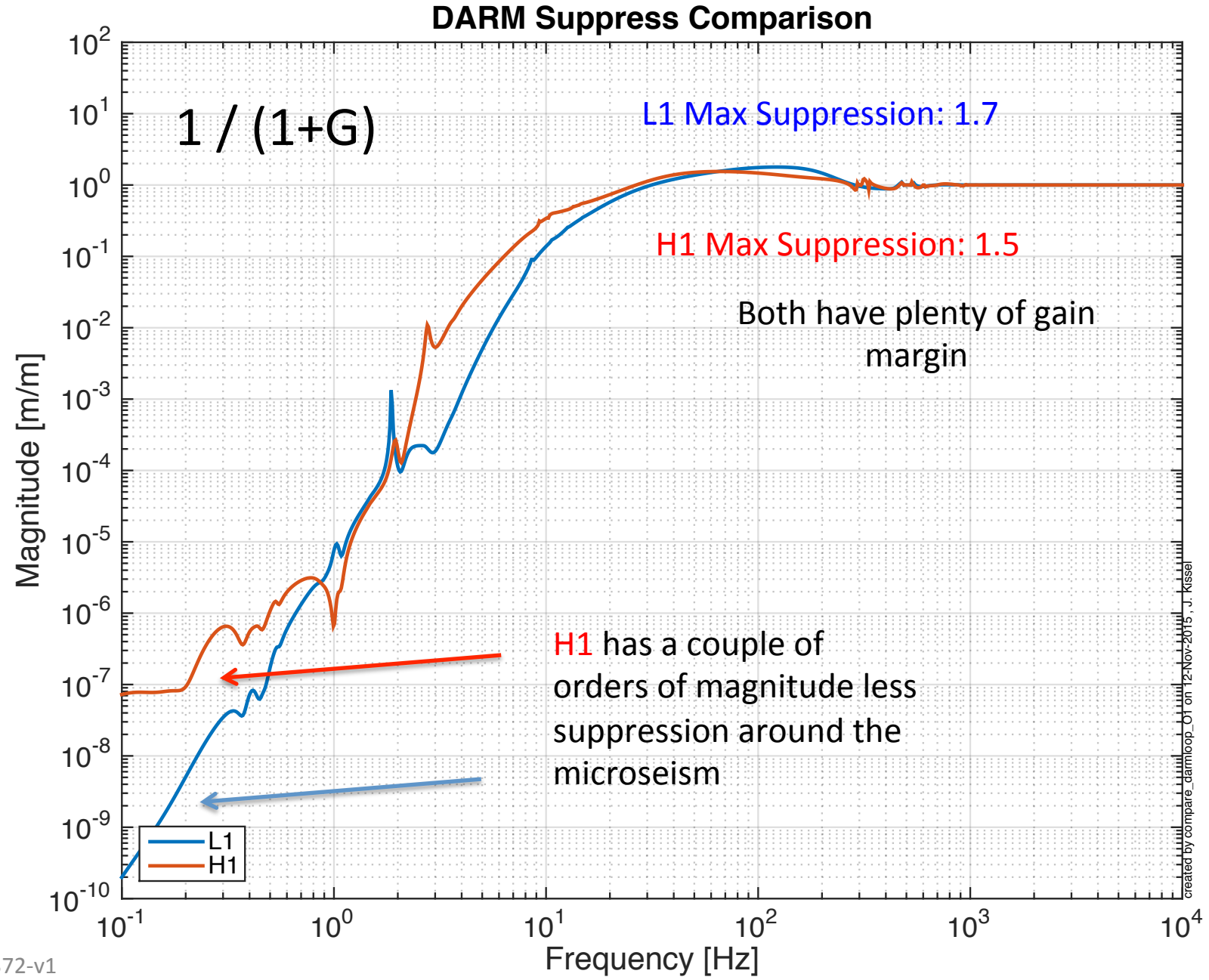
DARM Open Loop Gain TF (Big Picture)



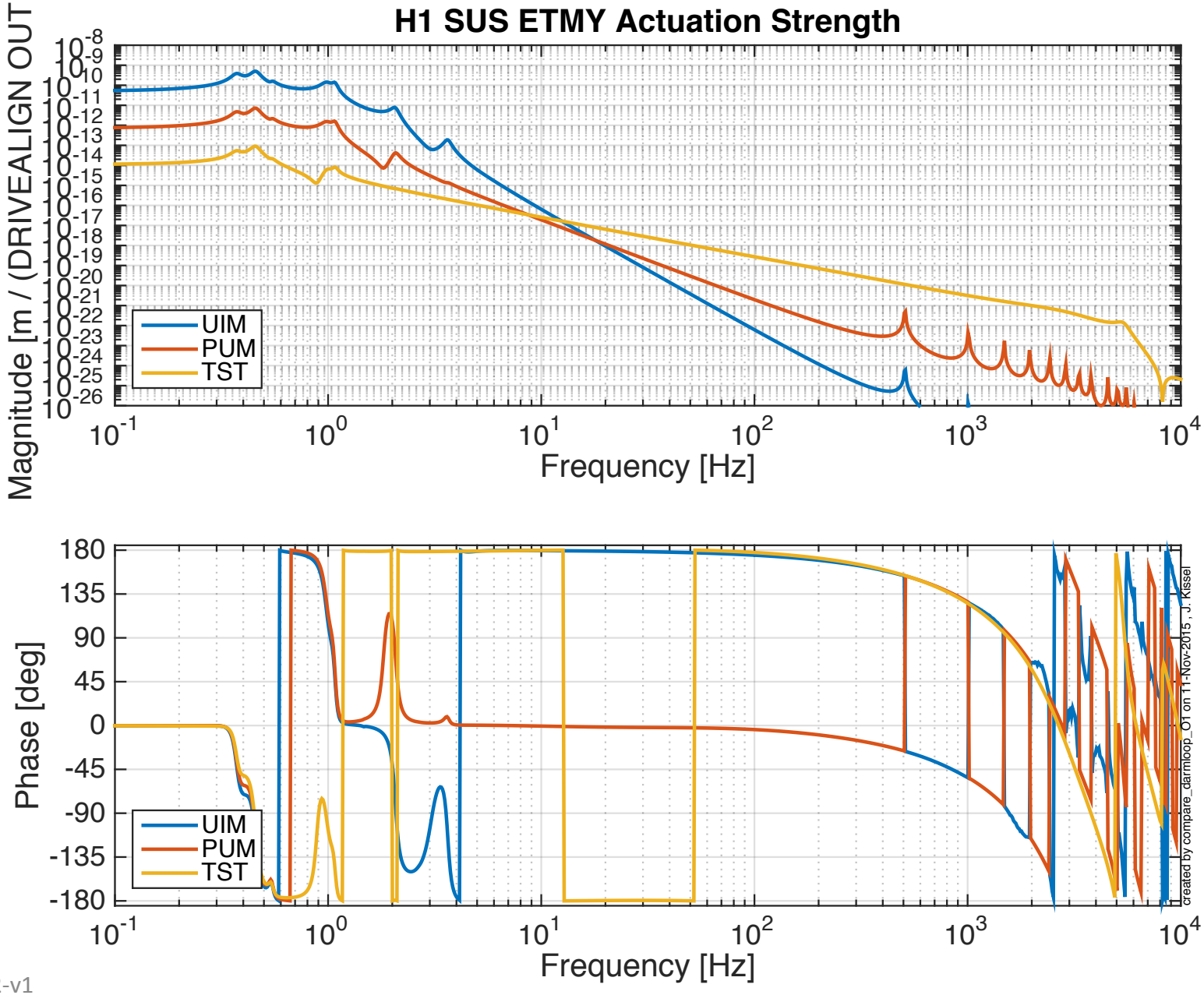
DARM OLGTF (UGF Zoom)



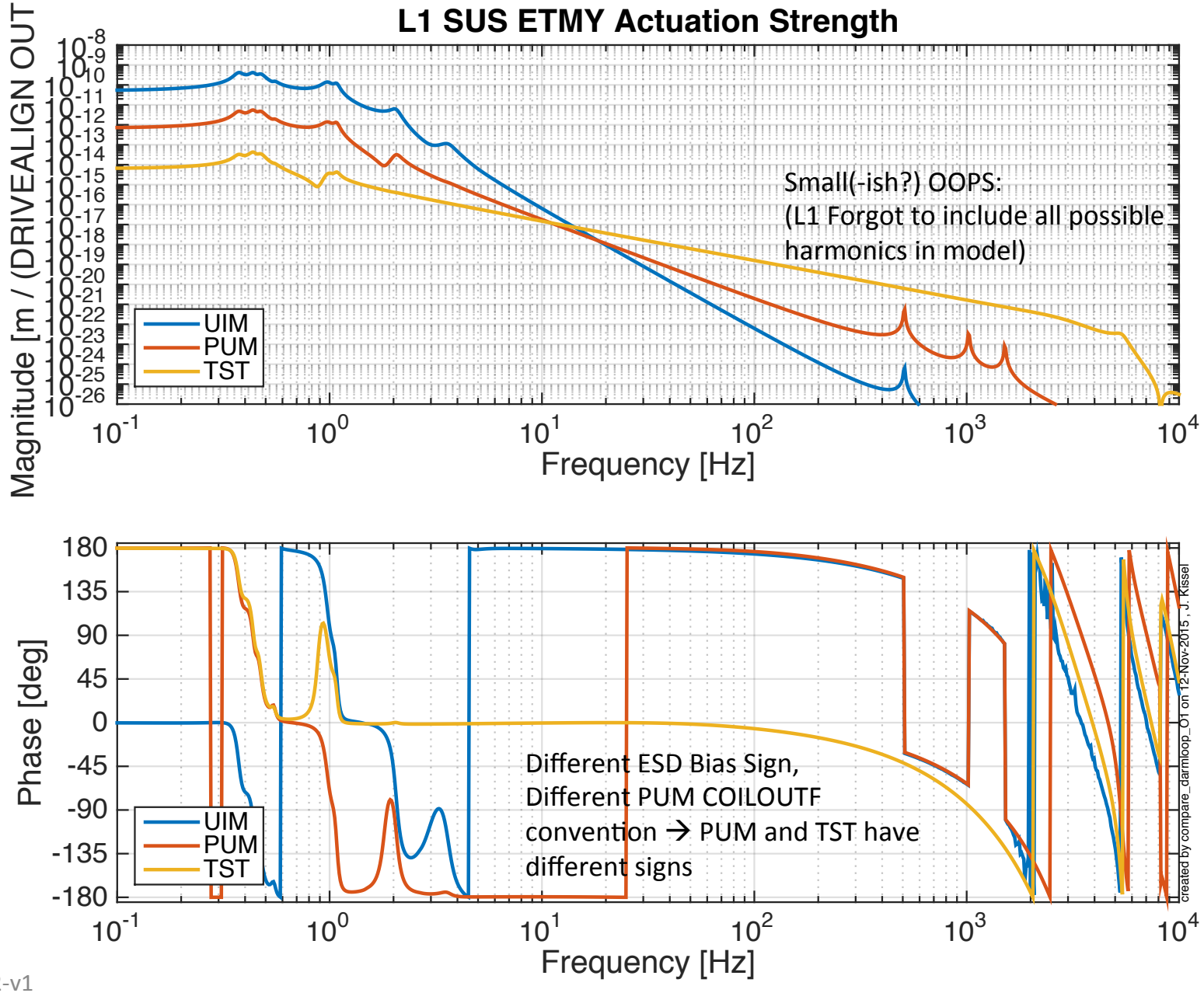
DARM Open Loop Gain TF



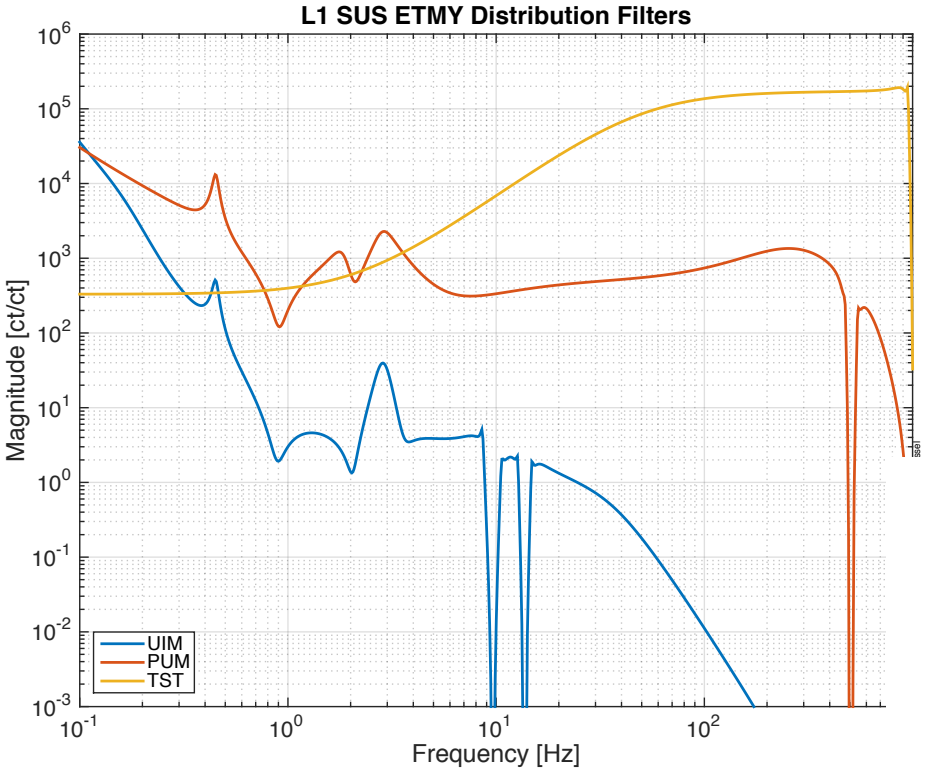
Actuator Strength Comparison



Actuator Strength Comparison

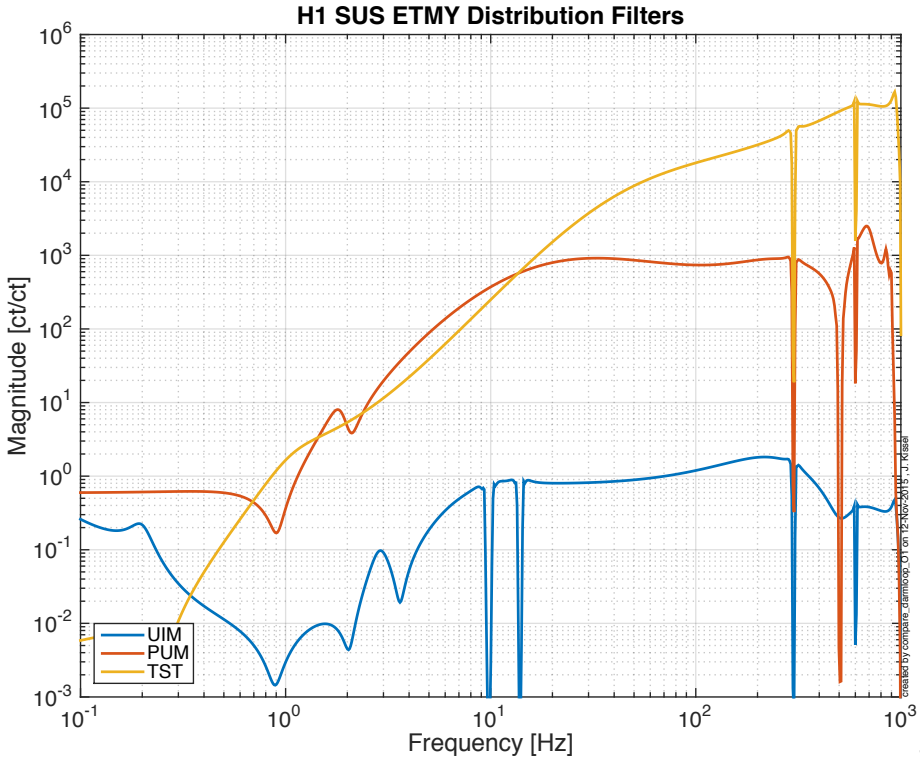


Actuator Comparison (Hierarchy Filters)



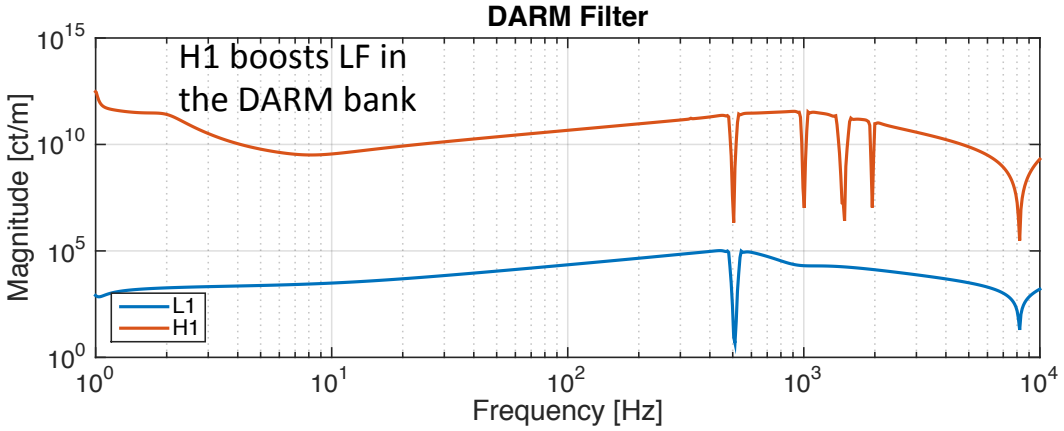
Both sites have a mish-mash of "offloaded" vs. "distributed" hierarchy filters due to staggered design

L1 does more loop shaping in the DARM bank (because of all the notching done at H1)

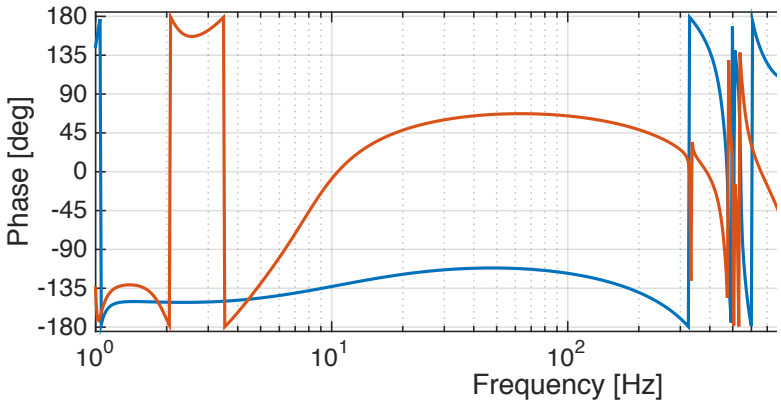


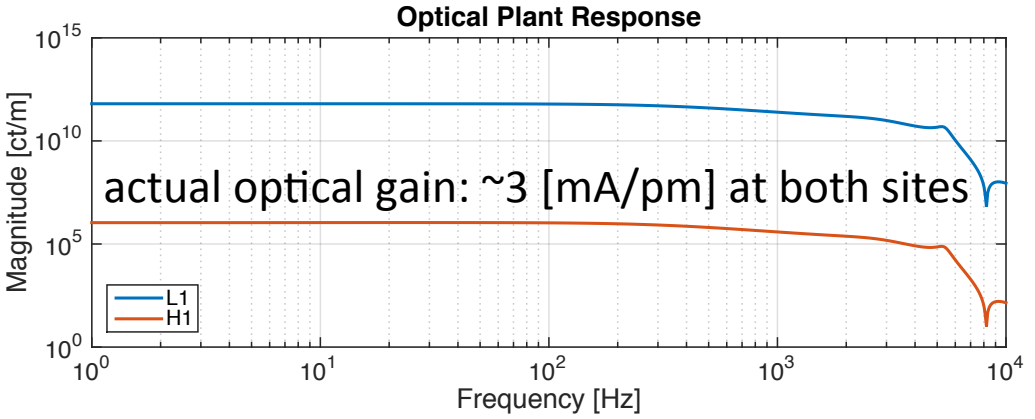
Note the difference in HF cut-off filter for all stages…

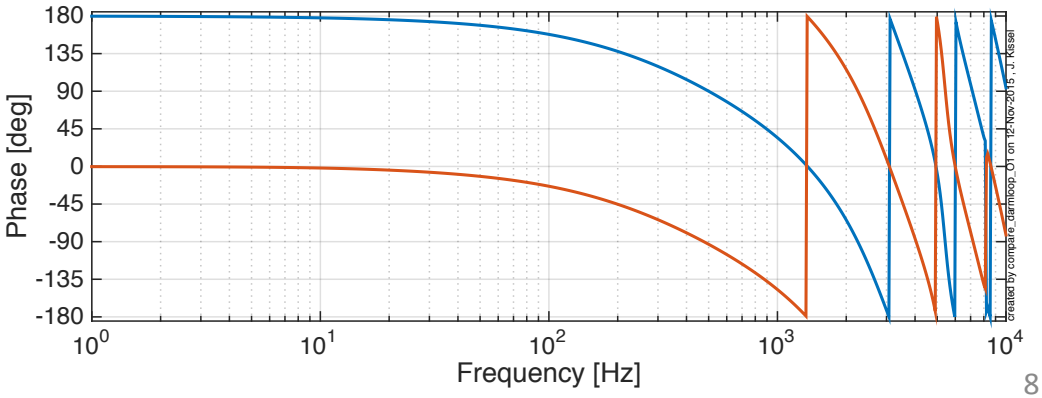
The DARM Filter and Sensing Function



Digital gains (and a sign) are distributed differently on the sensing side, so DARM filter gain and sign compensate, otherwise pretty similar…

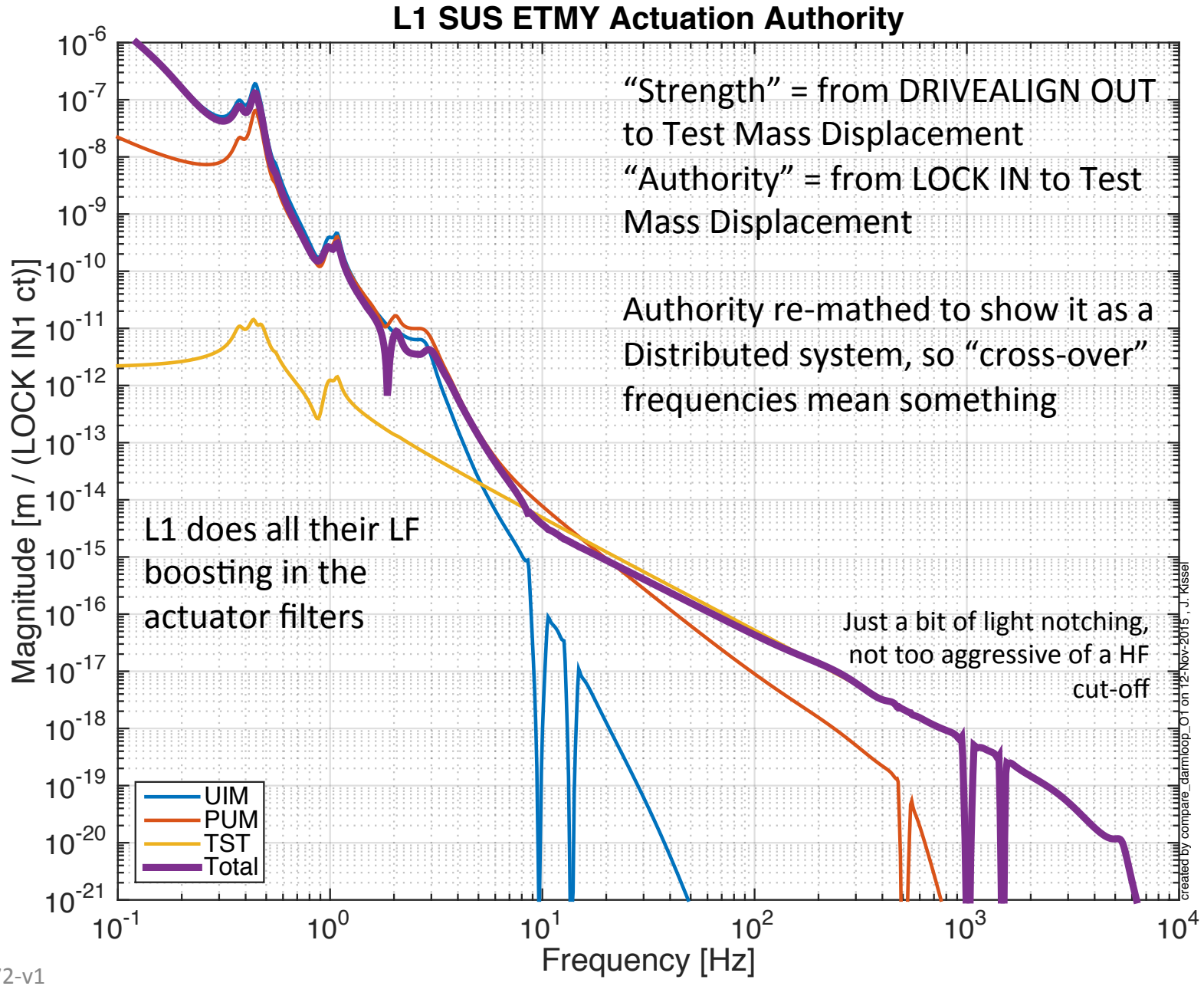




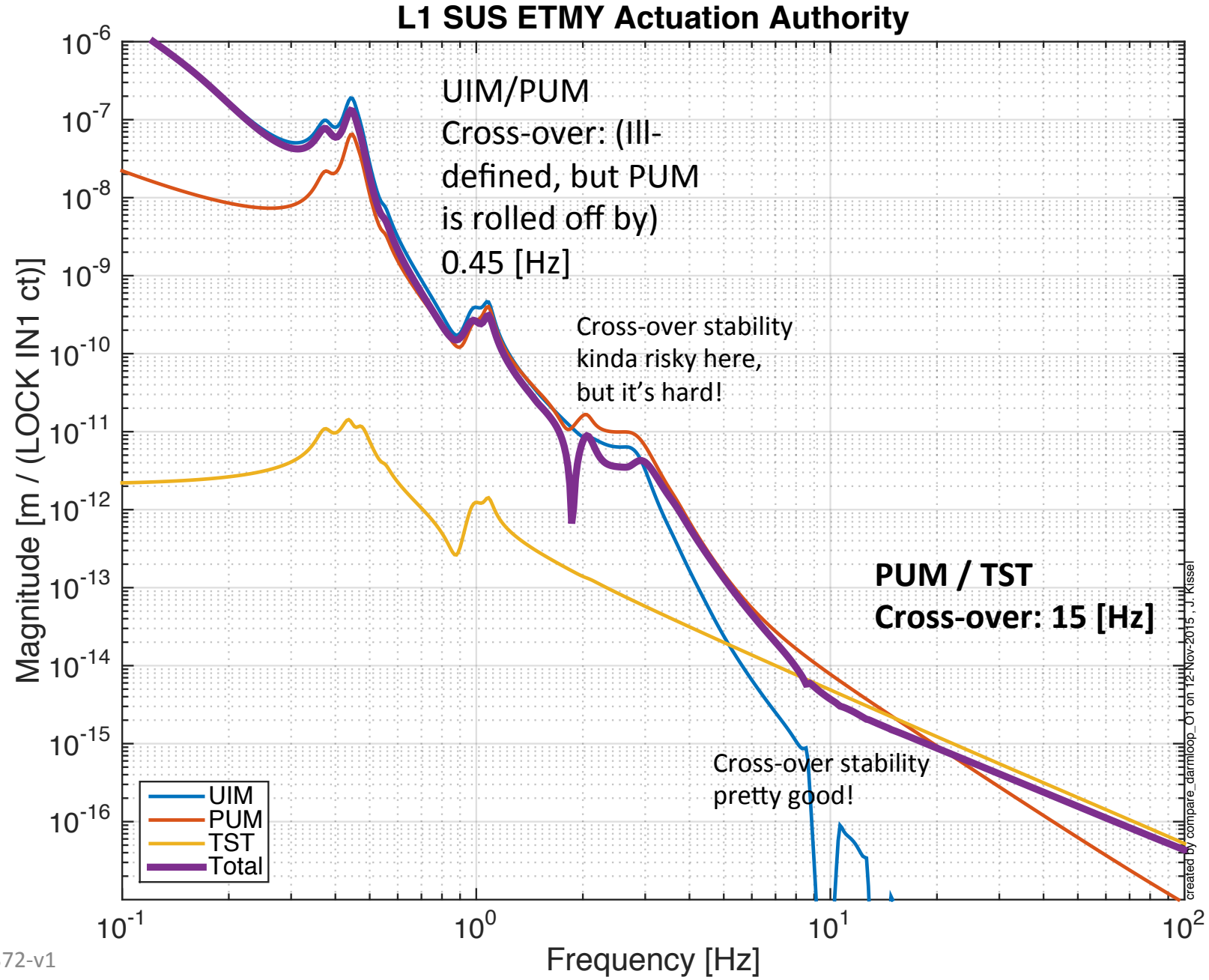


But because of the **different design choices**, with frequency response and gains all over the place, **tough to get a feel for the loop shaping from just one filter or plot**

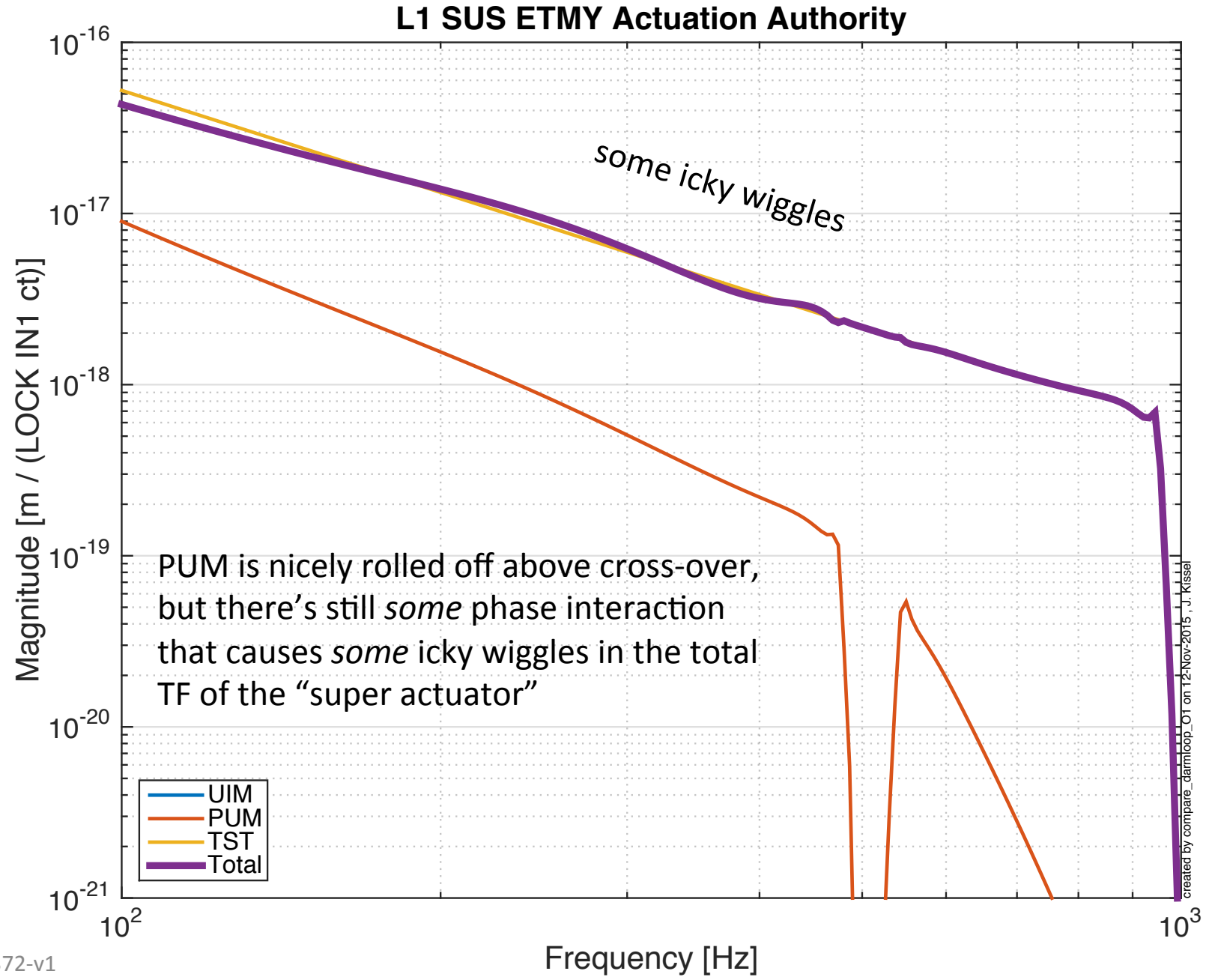
L1 Actuator Authority (Big Picture)



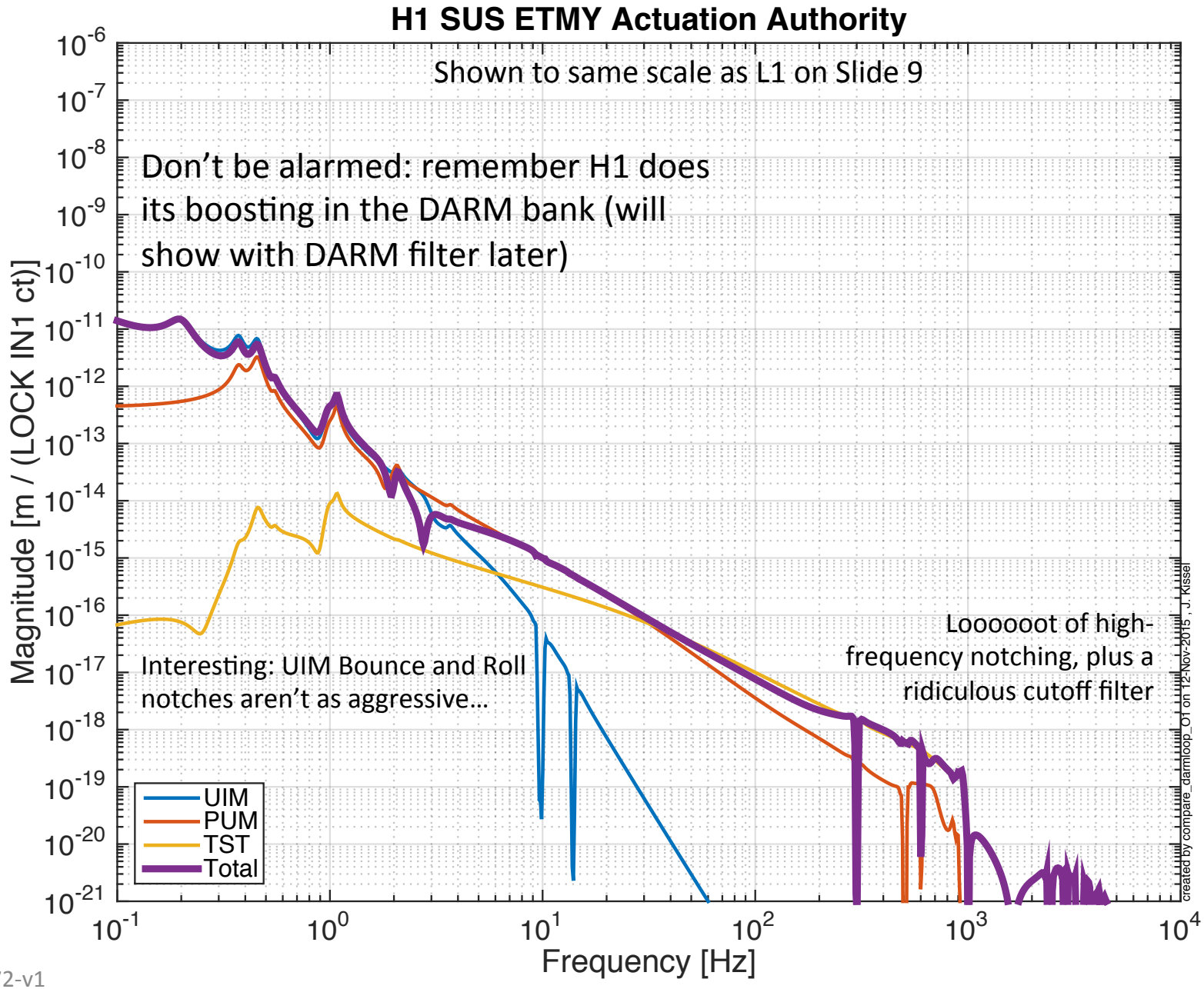
L1 Actuator Authority (X-over Zoom)



L1 Actuator Authority (HF Roll-off Zoom)



H1 Actuator Authority (Big Picture)



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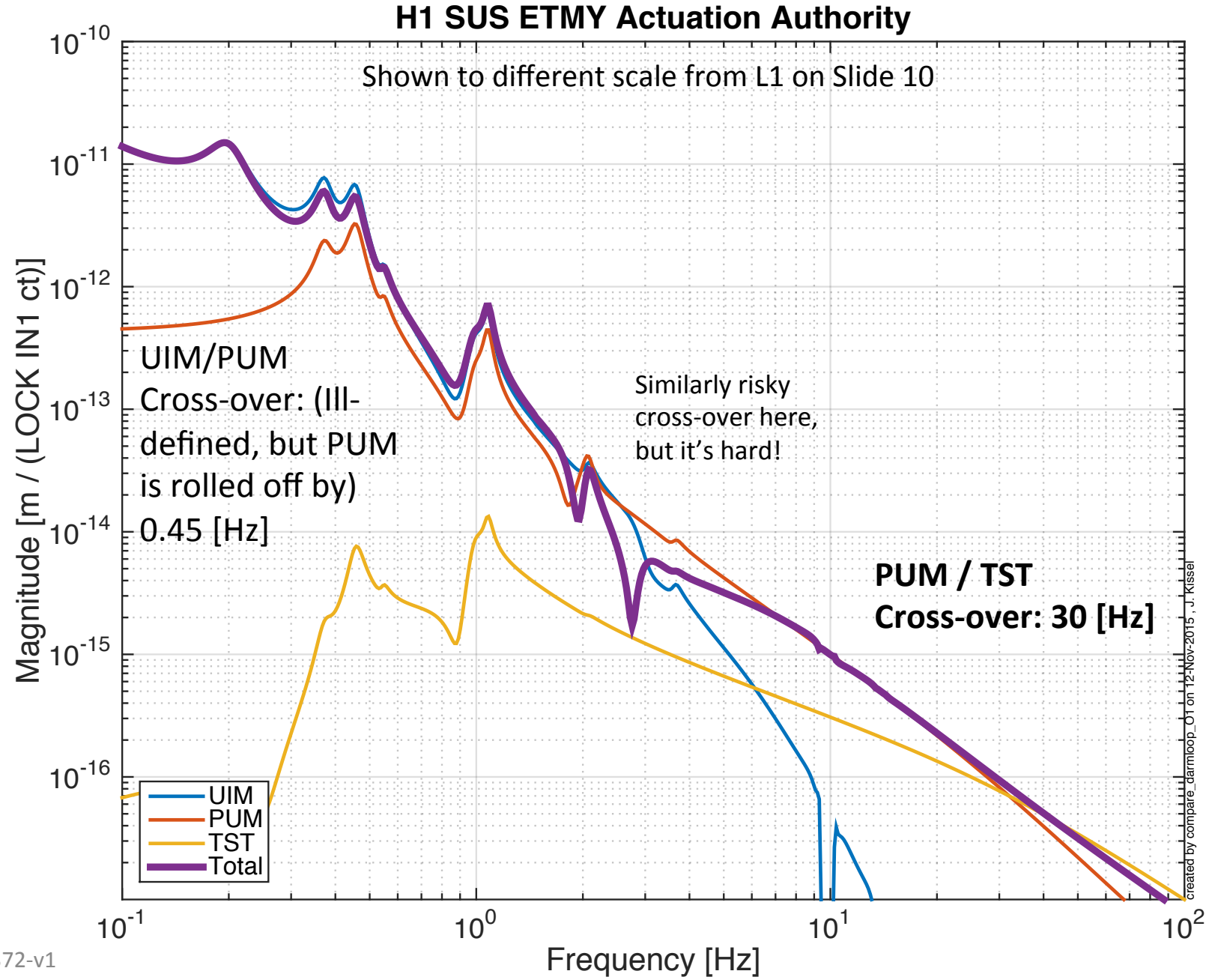
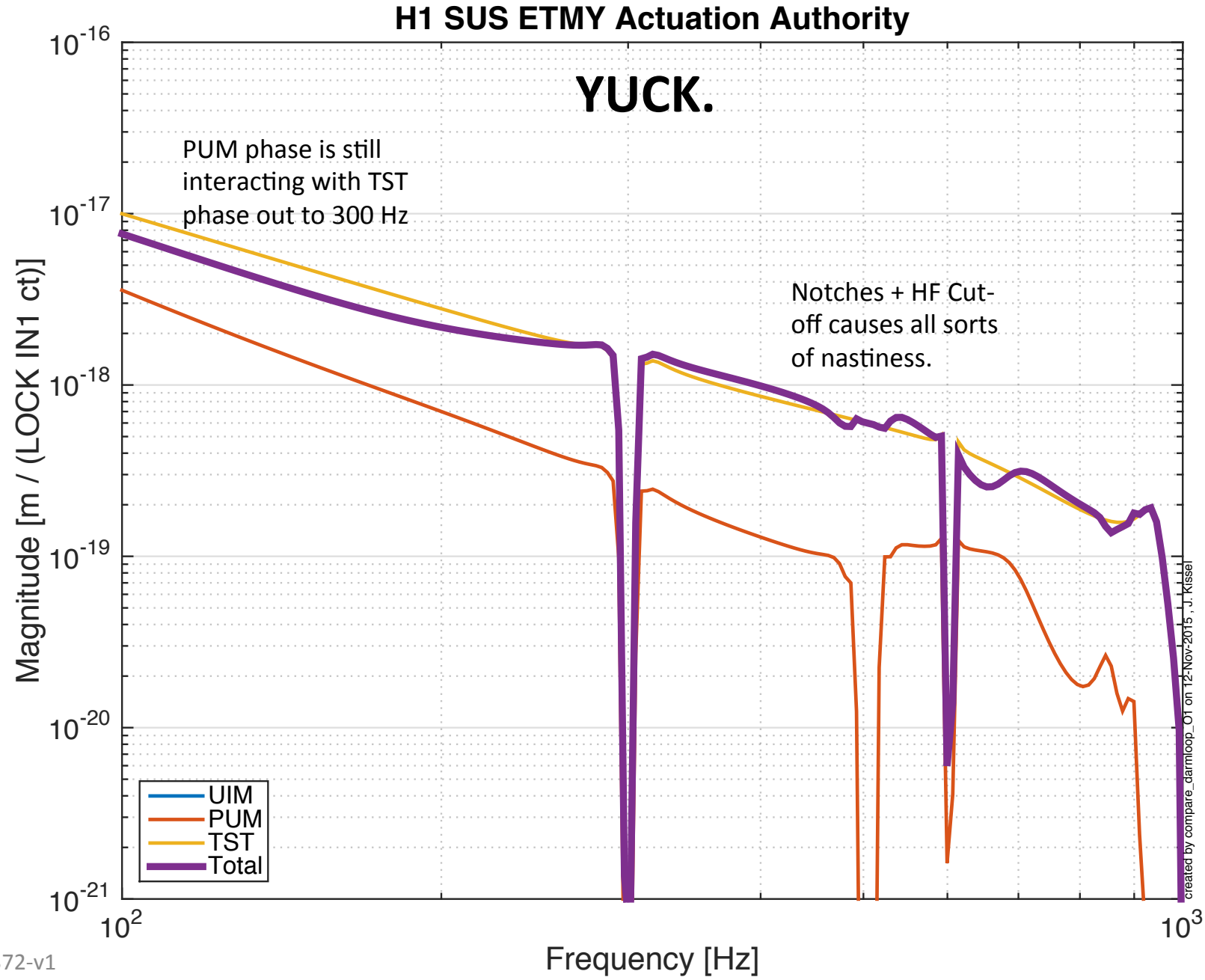
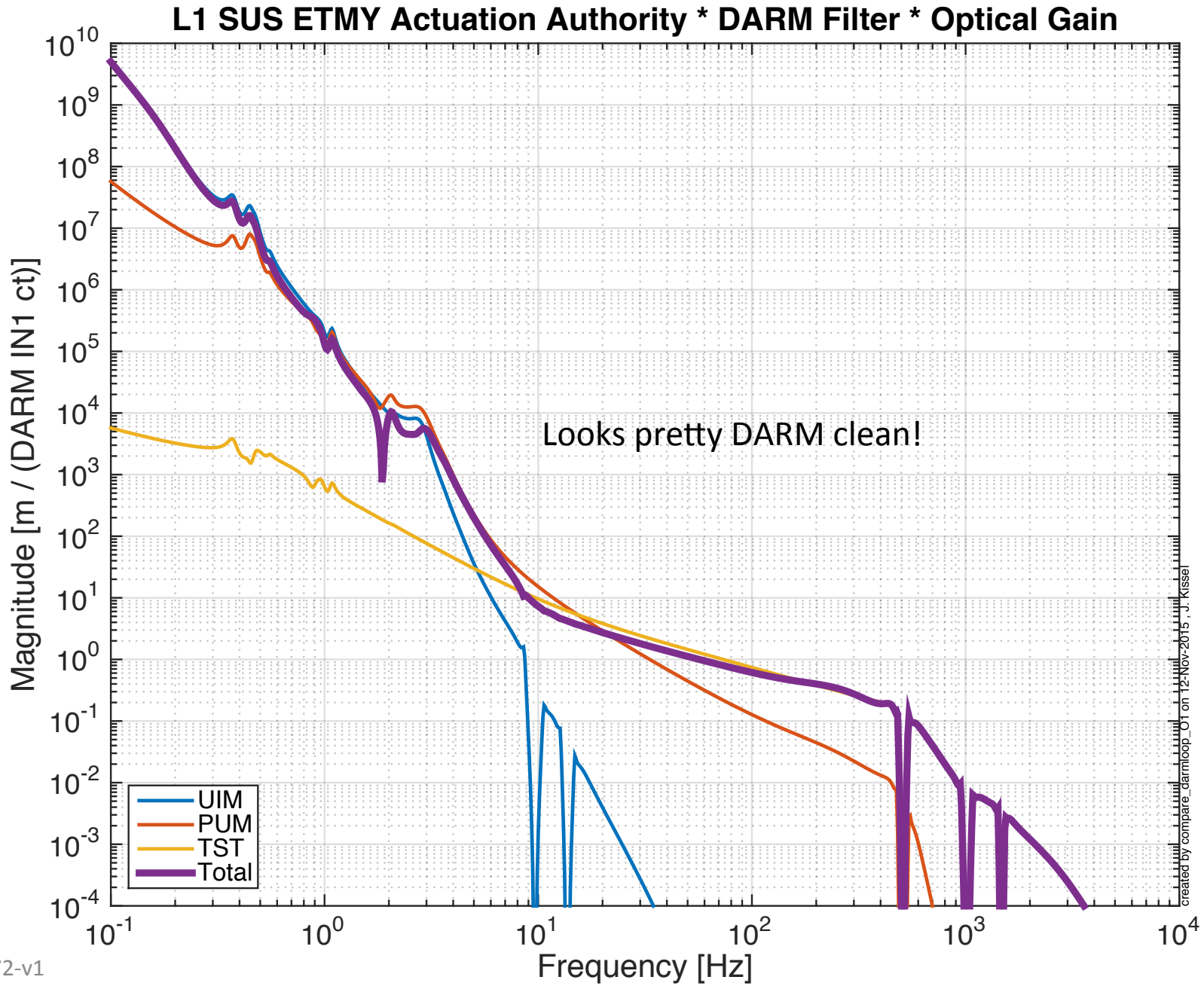


H1 Actuator Authority (HF Roll-off Zoom)



Authority Including DARM Filter (scaled by optical gain)



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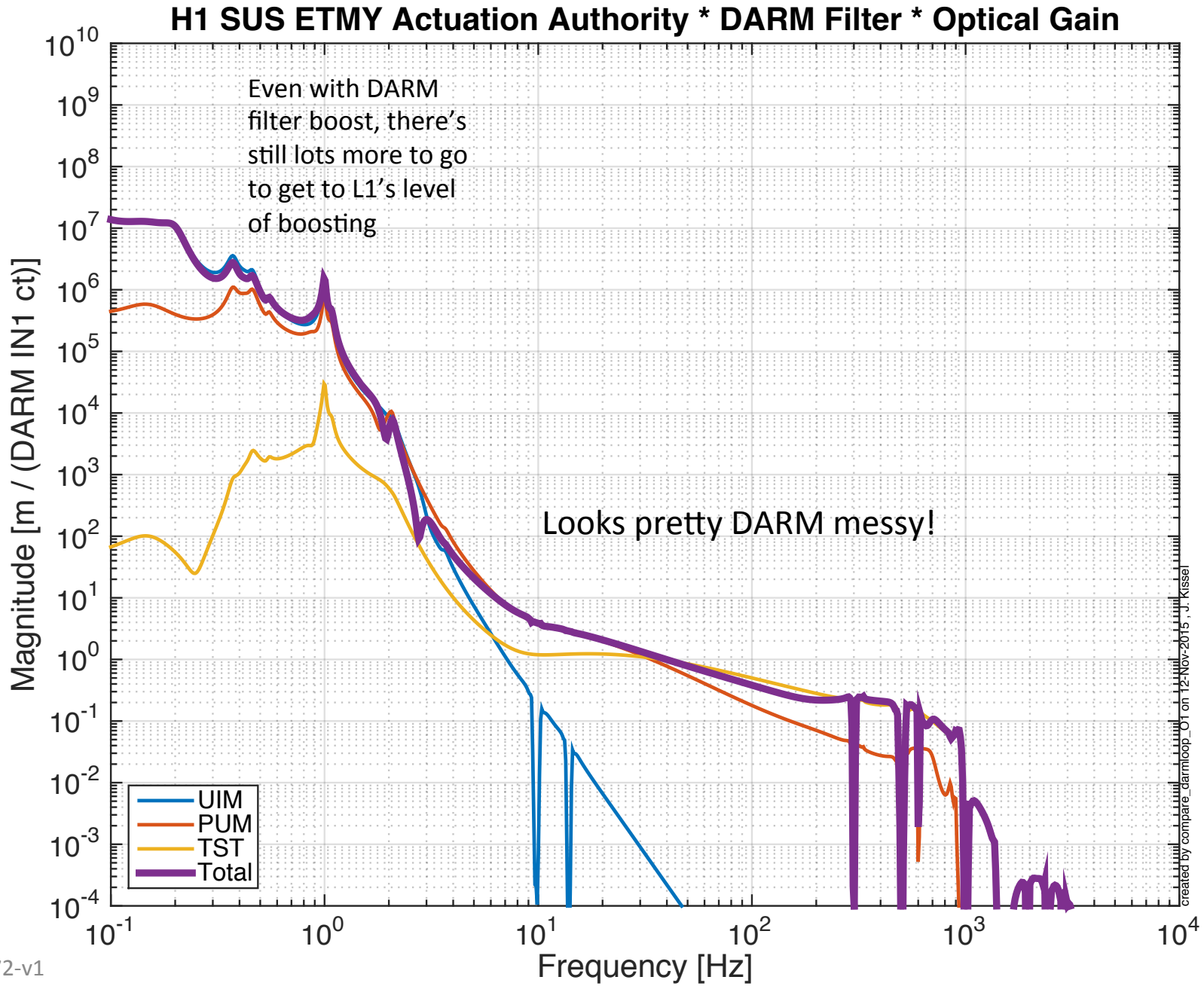


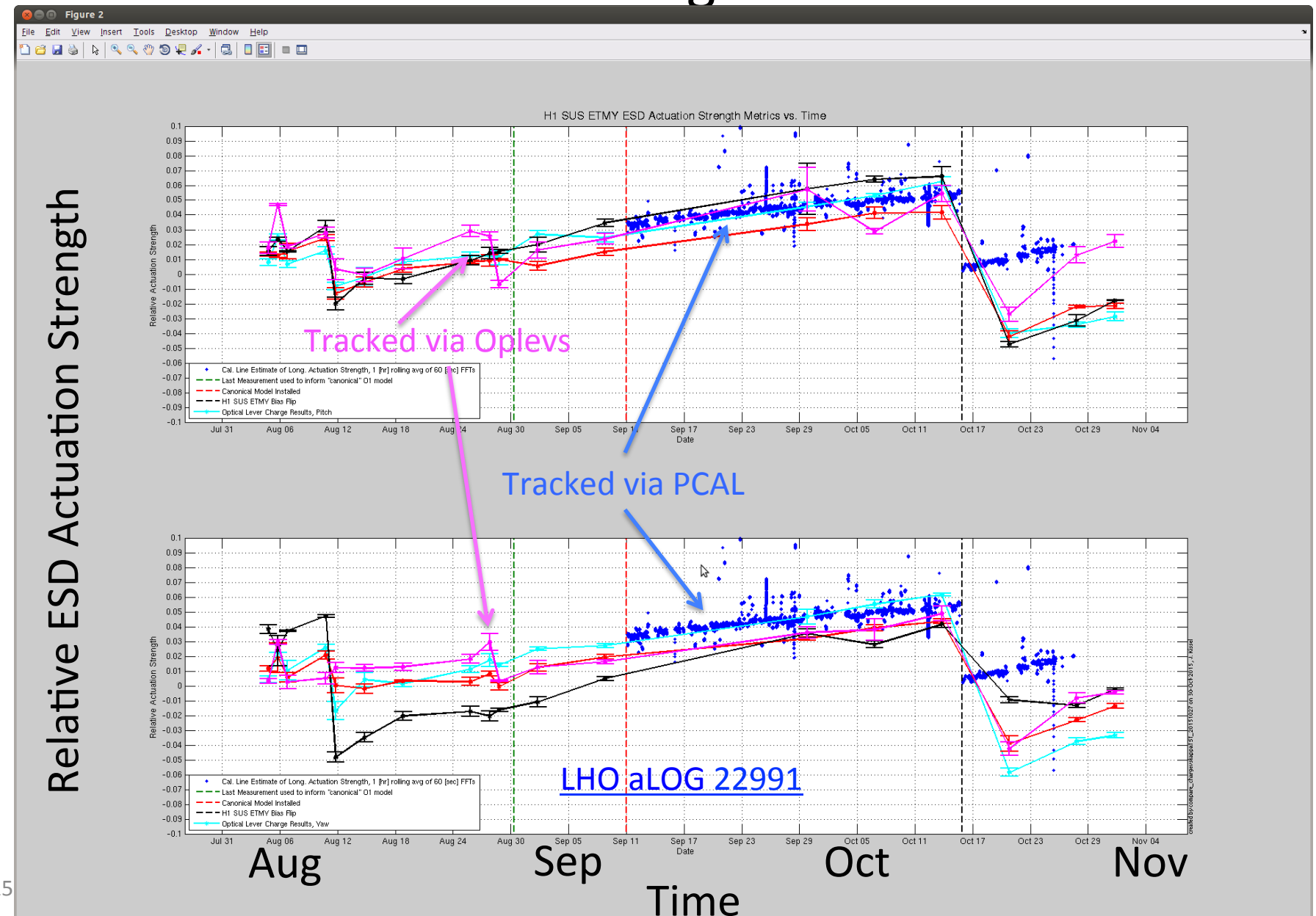
Conclusions

- H1 DARM Loop needs some tune-up and clean-up
  - More boosting at low-frequency
  - Better / simpler distribution filters
  - Less notching?
- Frequency response is splayed out everywhere at both sites, evident that "design" was staggered and piecemeal
  - Both sites should consider consolidating, for easier analysis of performance

Bonus Material: Calibration Parameter Time Dependence

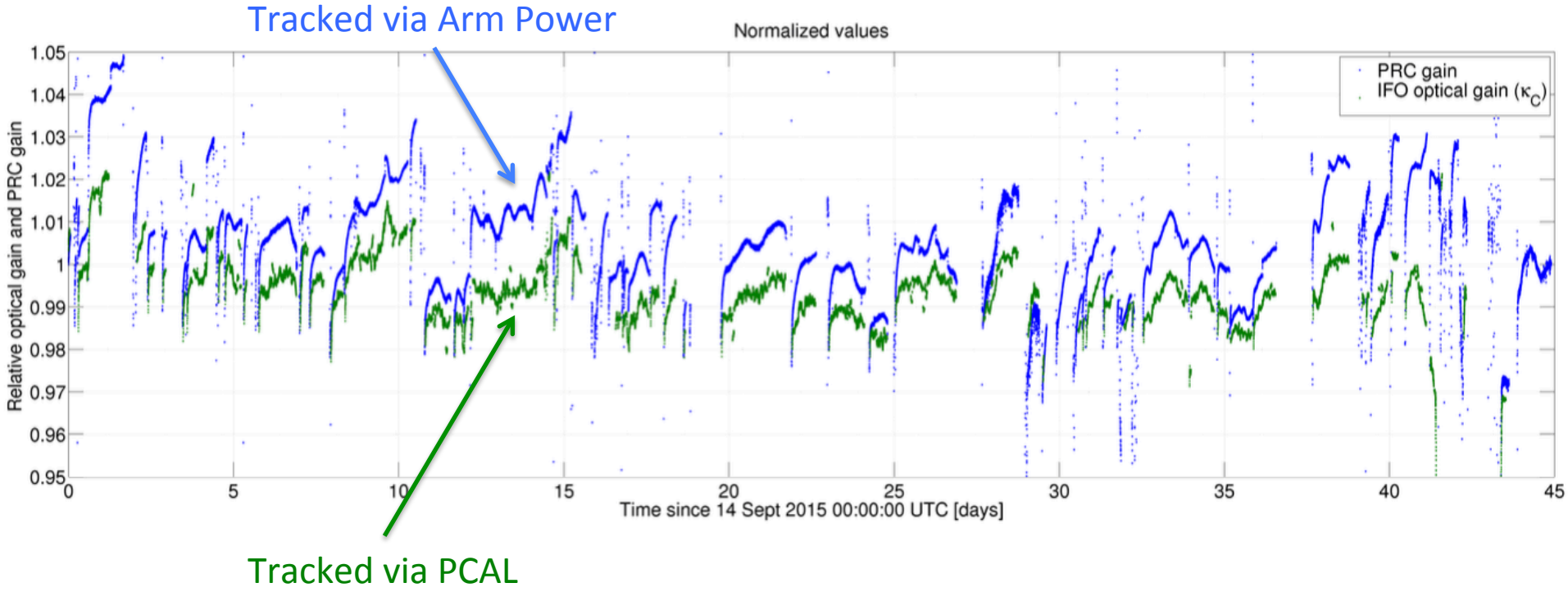
Clues of “real” IFO parameters changing -- confirmation from alternative measurements

Comparison Between Relative ESD Actuation Strength



Comparison Between Relative Optical Gain Measurements

Arm Power (divided by PRM transmittion), normalized by the start of the lock stretch



PCAL Estimation of the change in optical gain from 330 [Hz] PCAL lines

LHO aLOG 23147