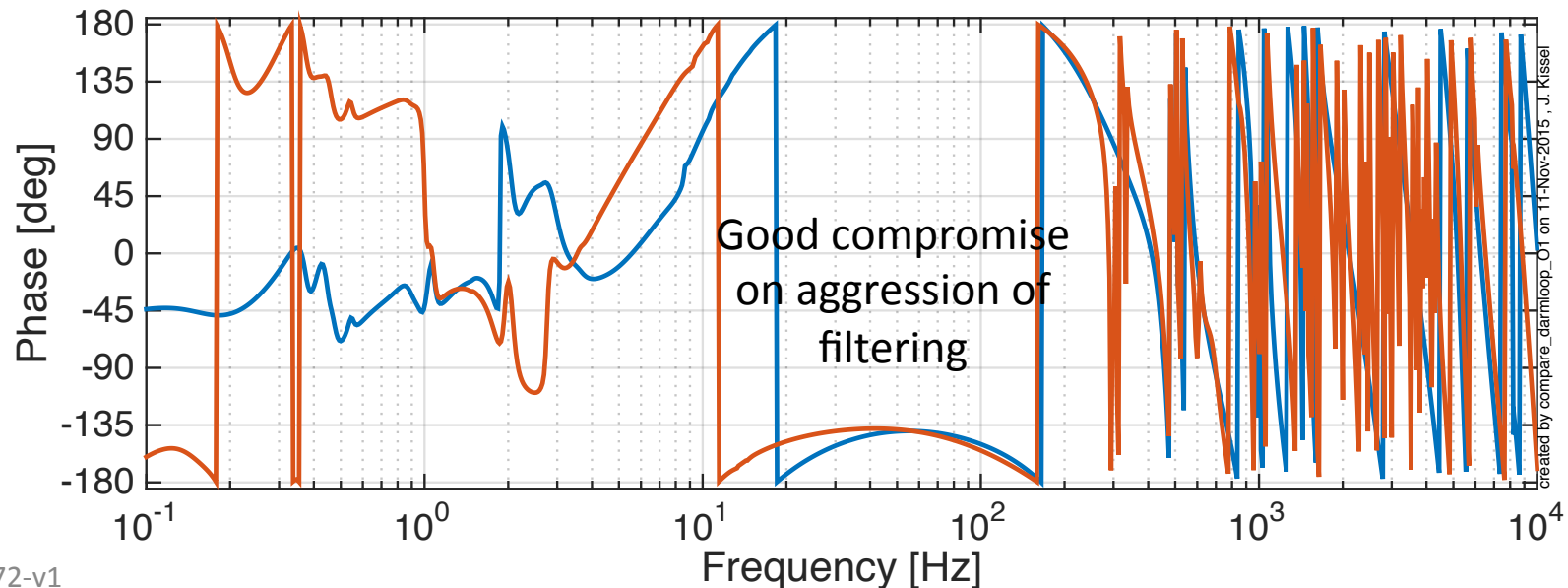
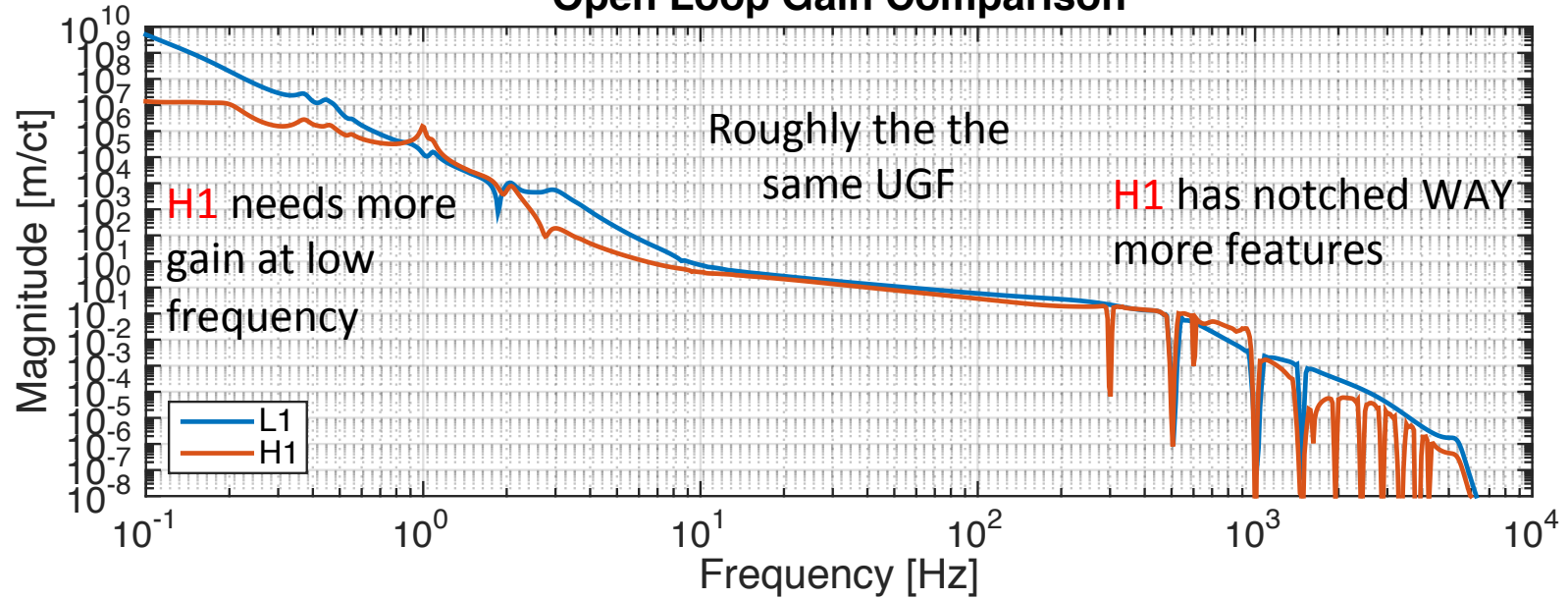


O1 DARM Loop Design Comparisons and Critiques

J. Kissel, for the ISC and Calibration Teams

DARM Open Loop Gain TF (Big Picture)

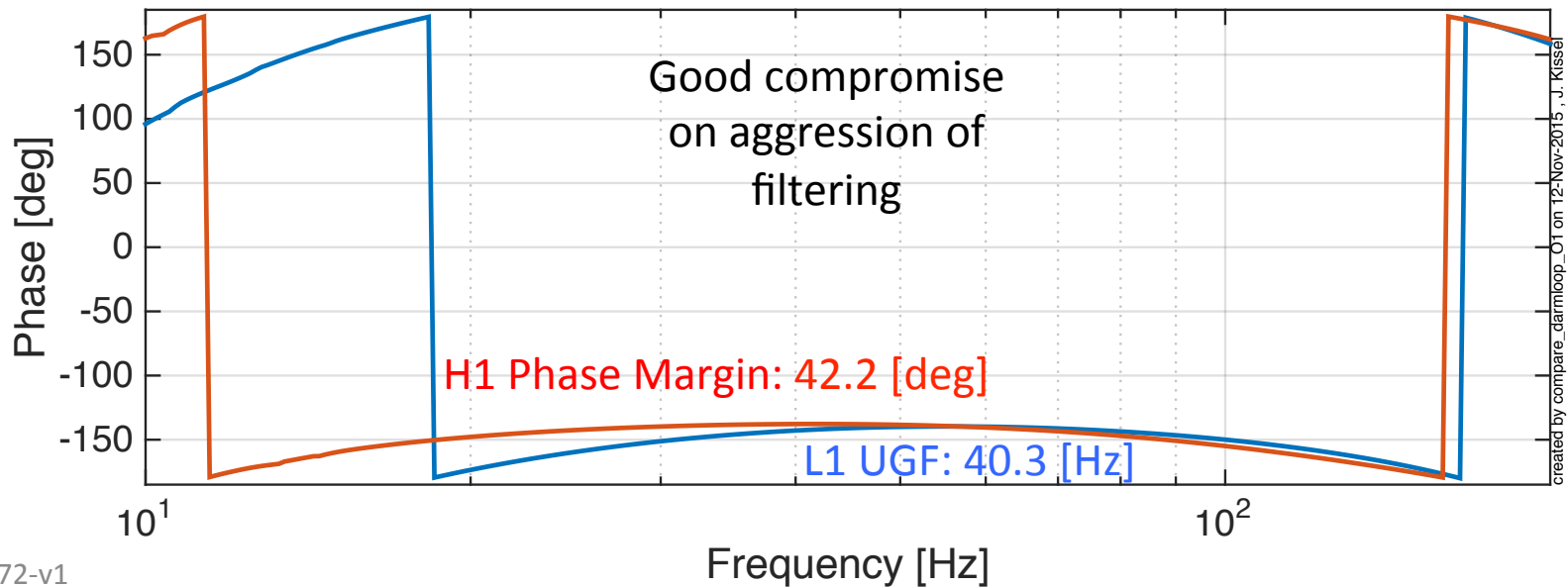
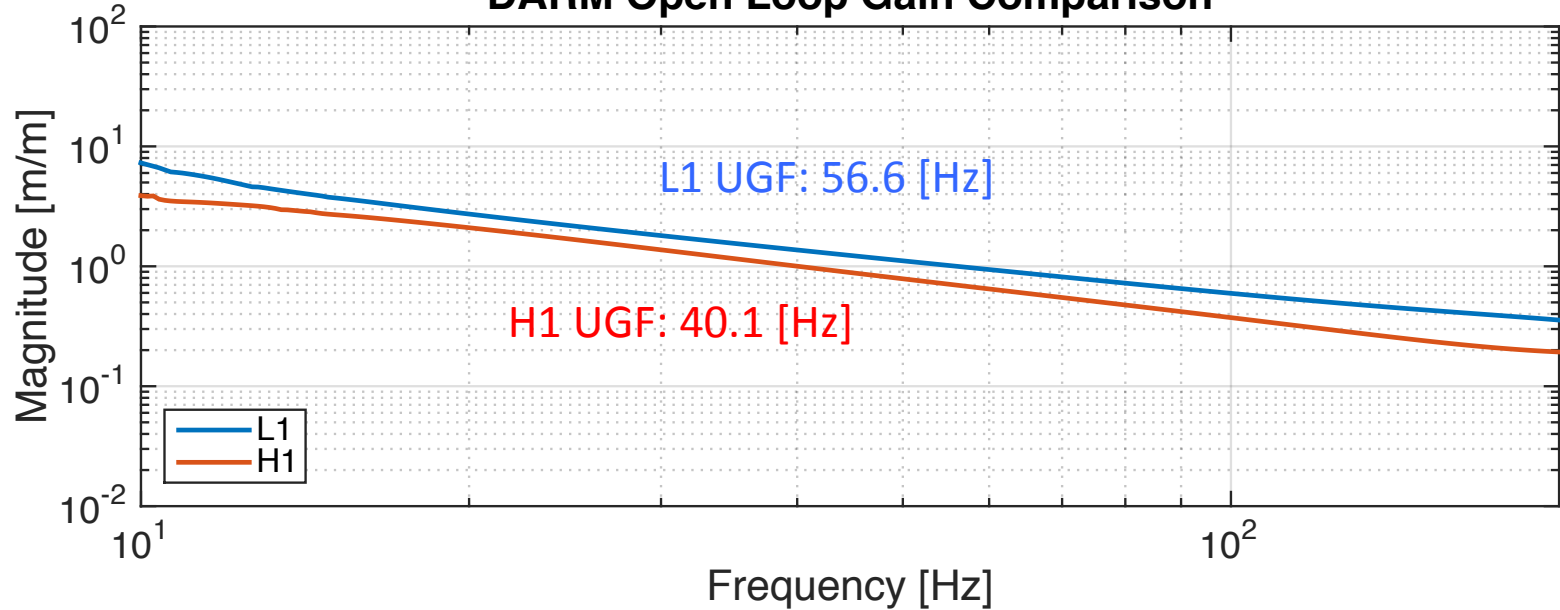
Open Loop Gain Comparison



created by compare_darmloop_O1 on 11-Nov-2015, J. Kissel

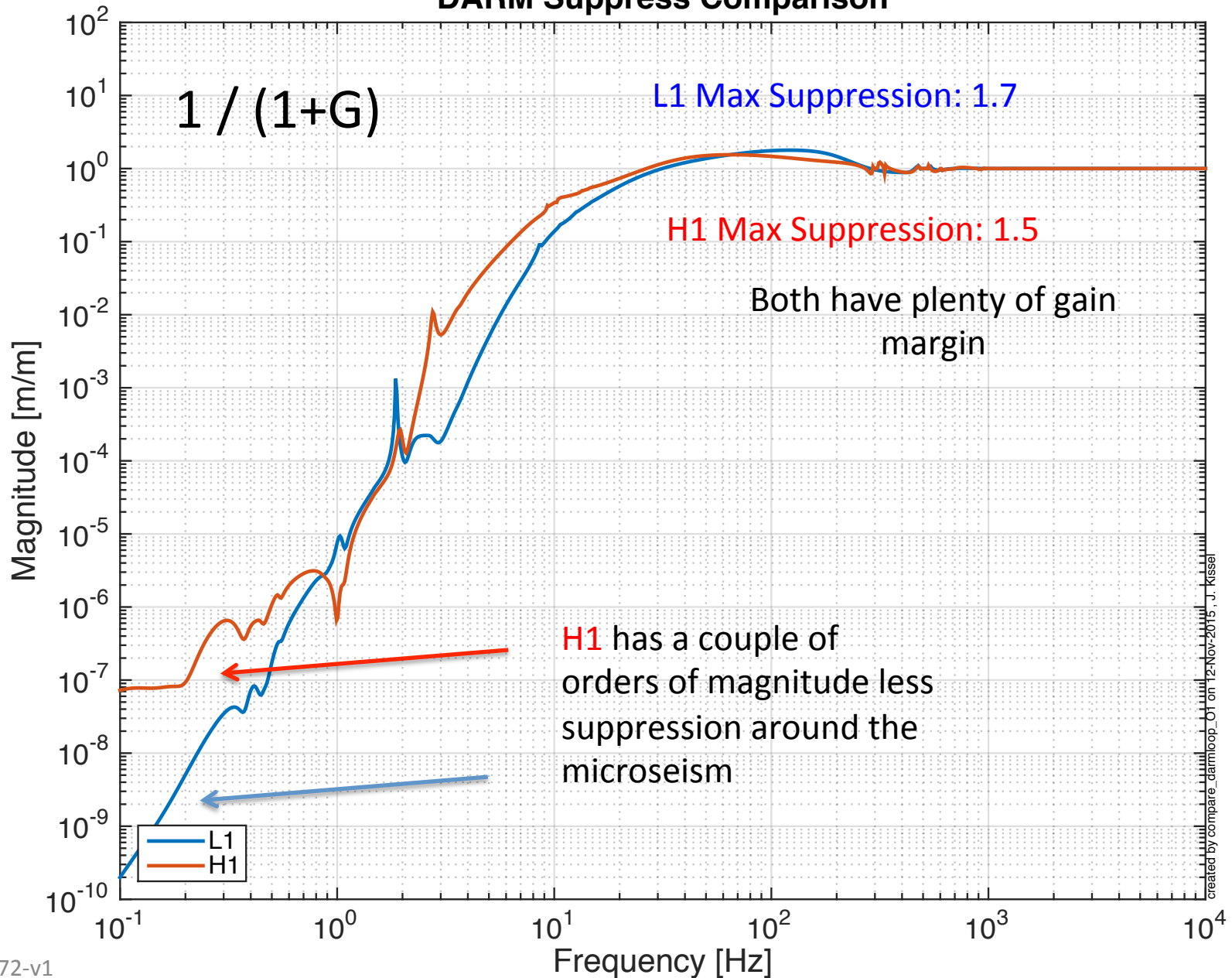
DARM OLGTF (UGF Zoom)

DARM Open Loop Gain Comparison



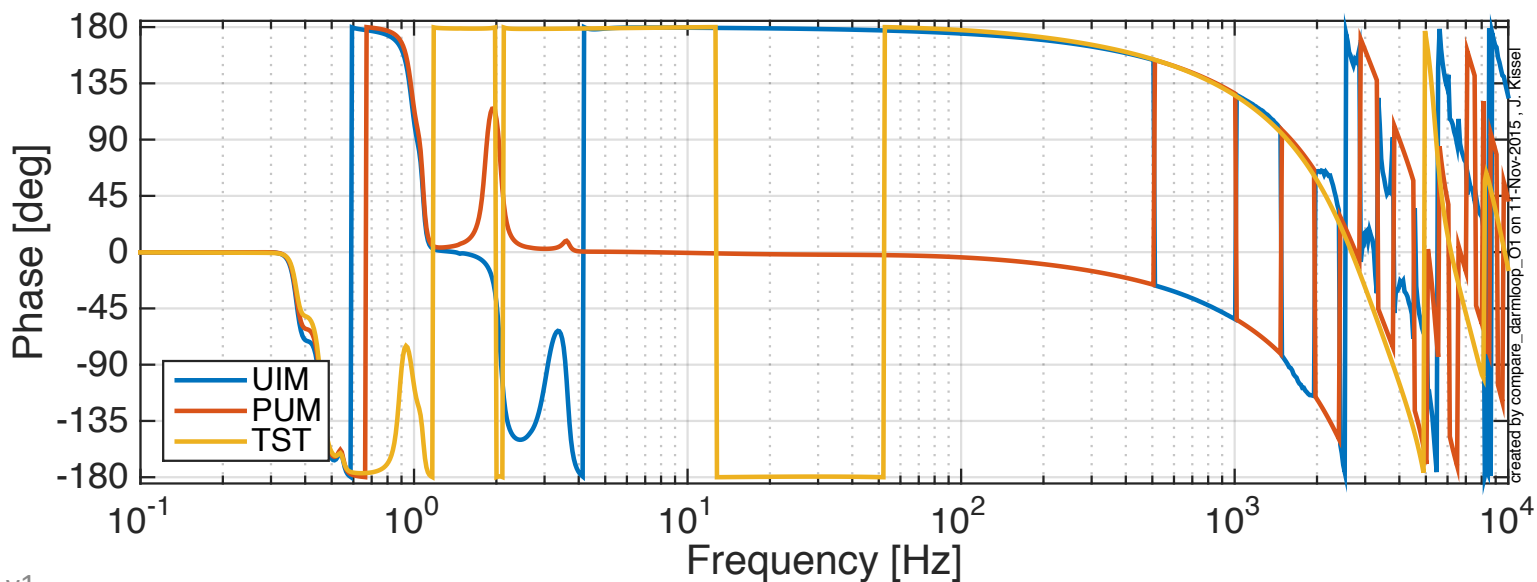
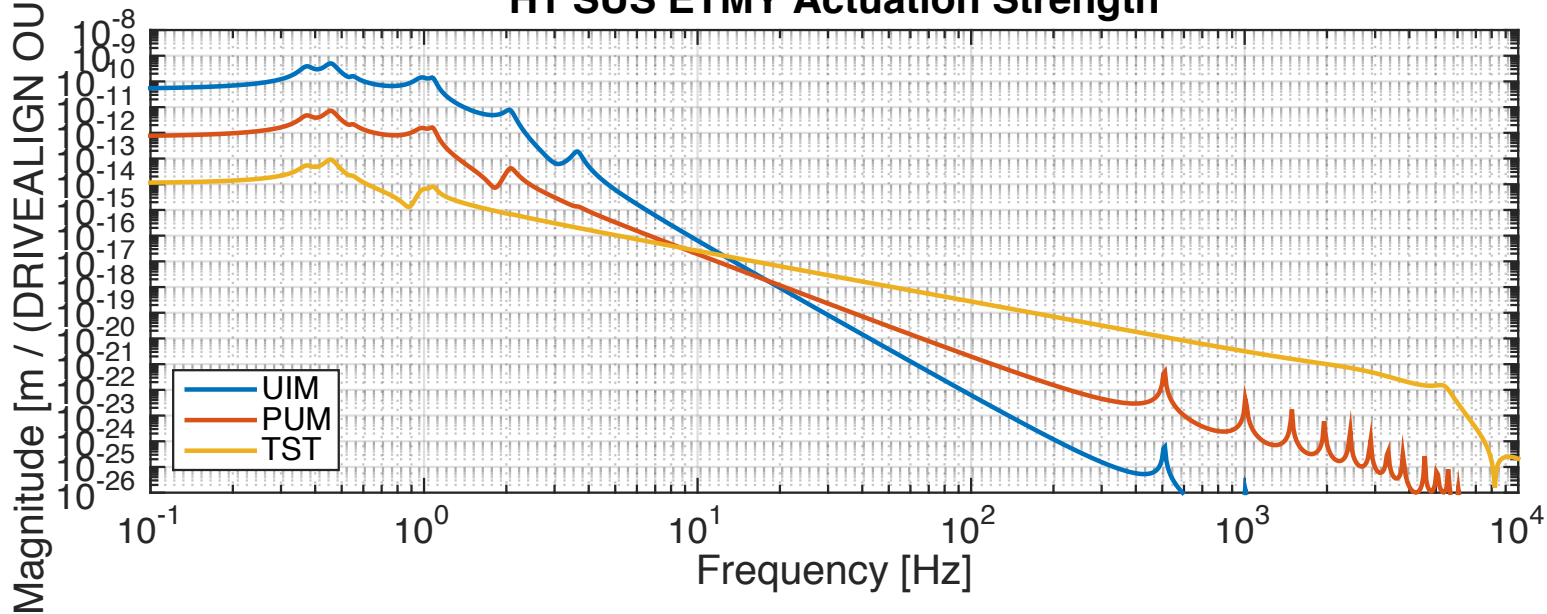
DARM Open Loop Gain TF

DARM Suppress Comparison



Actuator Strength Comparison

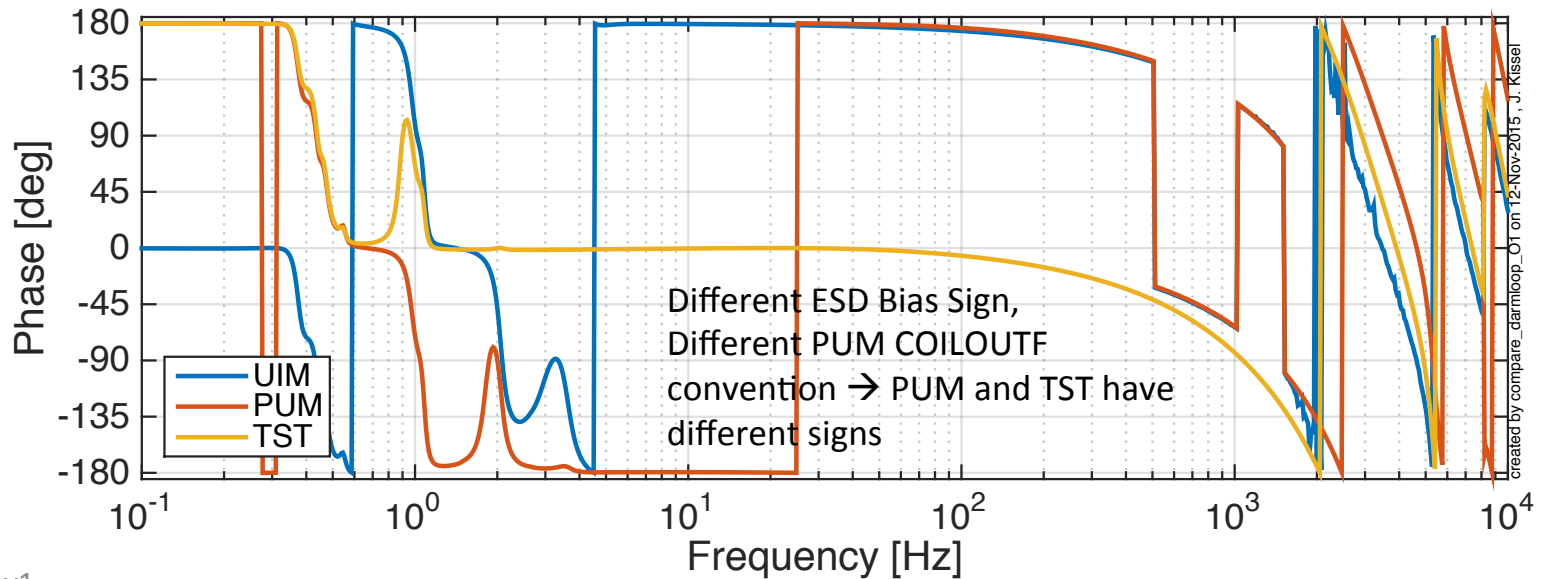
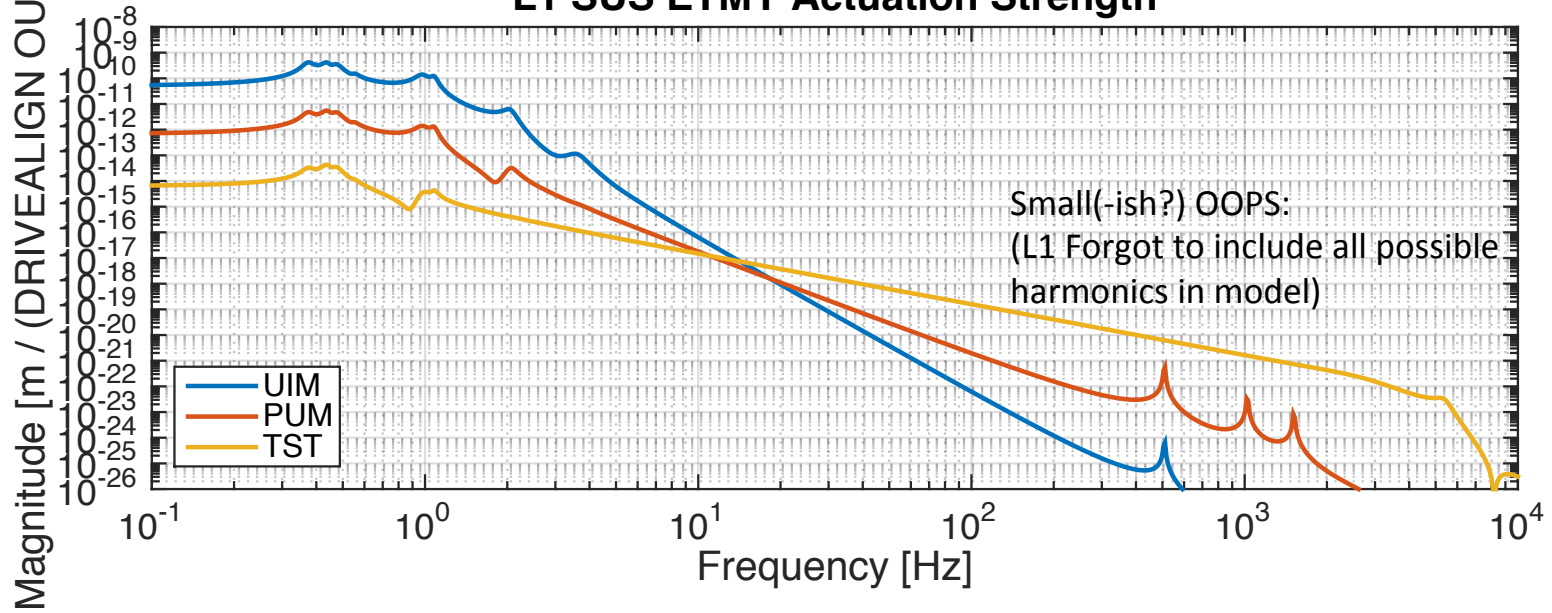
H1 SUS ETMY Actuation Strength



created by compare_darloop_OT on 11-Nov-2015, J. Kissel

Actuator Strength Comparison

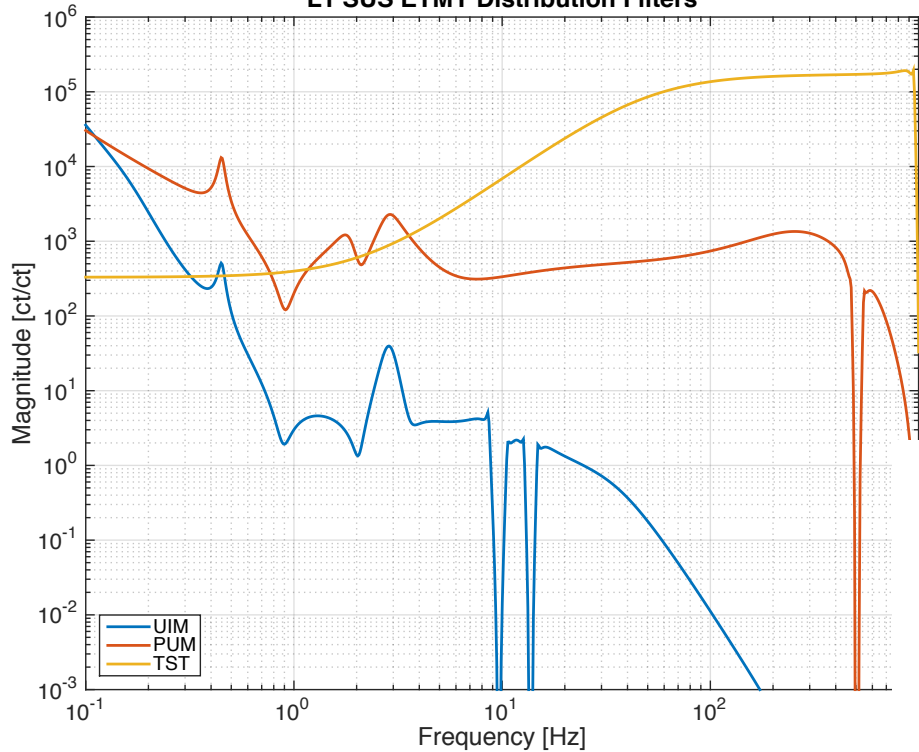
L1 SUS ETMY Actuation Strength



created by compare_darmloop_01 on 12-Nov-2015, J. Kissel

Actuator Comparison (Hierarchy Filters)

L1 SUS ETMY Distribution Filters

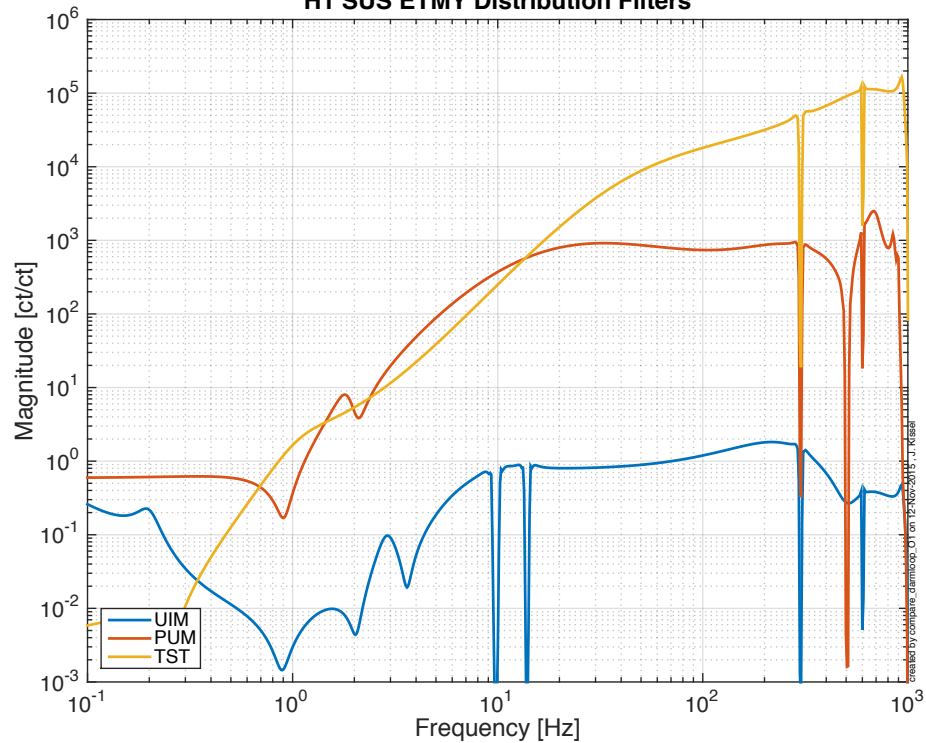


Note the difference in HF cut-off filter for all stages...

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

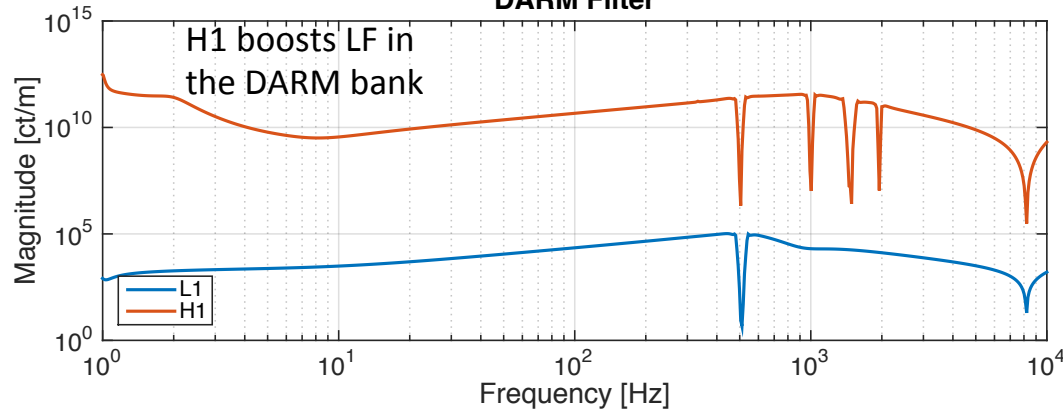
L1 does more loop shaping in the DARM bank (because of all the notching done at H1)

H1 SUS ETMY Distribution Filters

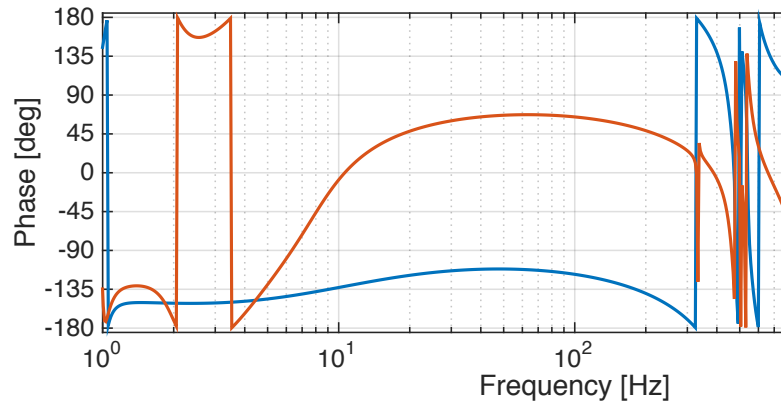


The DARM Filter and Sensing Function

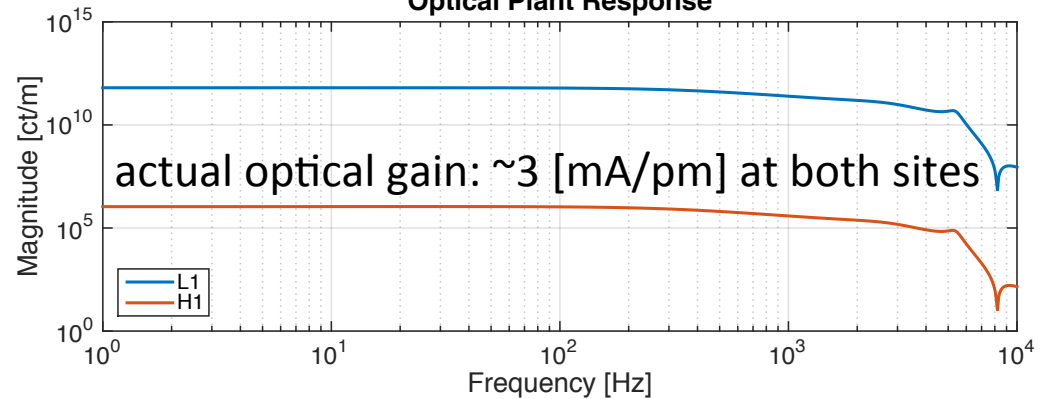
DARM Filter



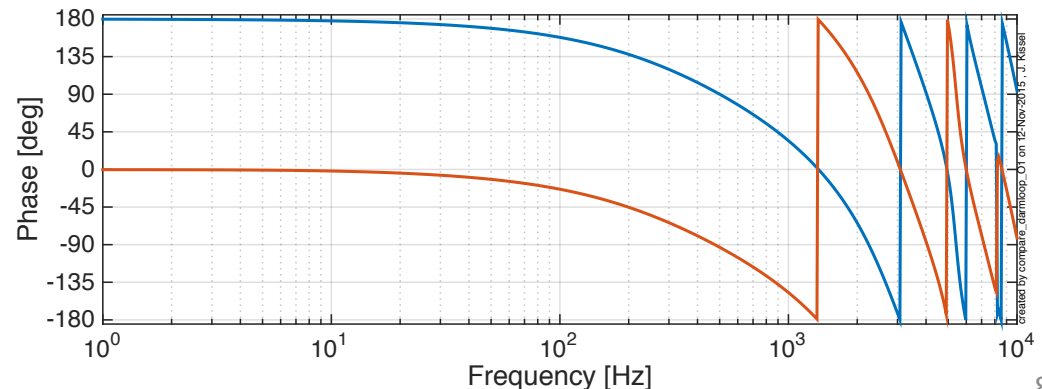
Digital gains (and a sign) are distributed differently on the sensing side, so DARM filter gain and sign compensate, otherwise pretty similar...



Optical Plant Response

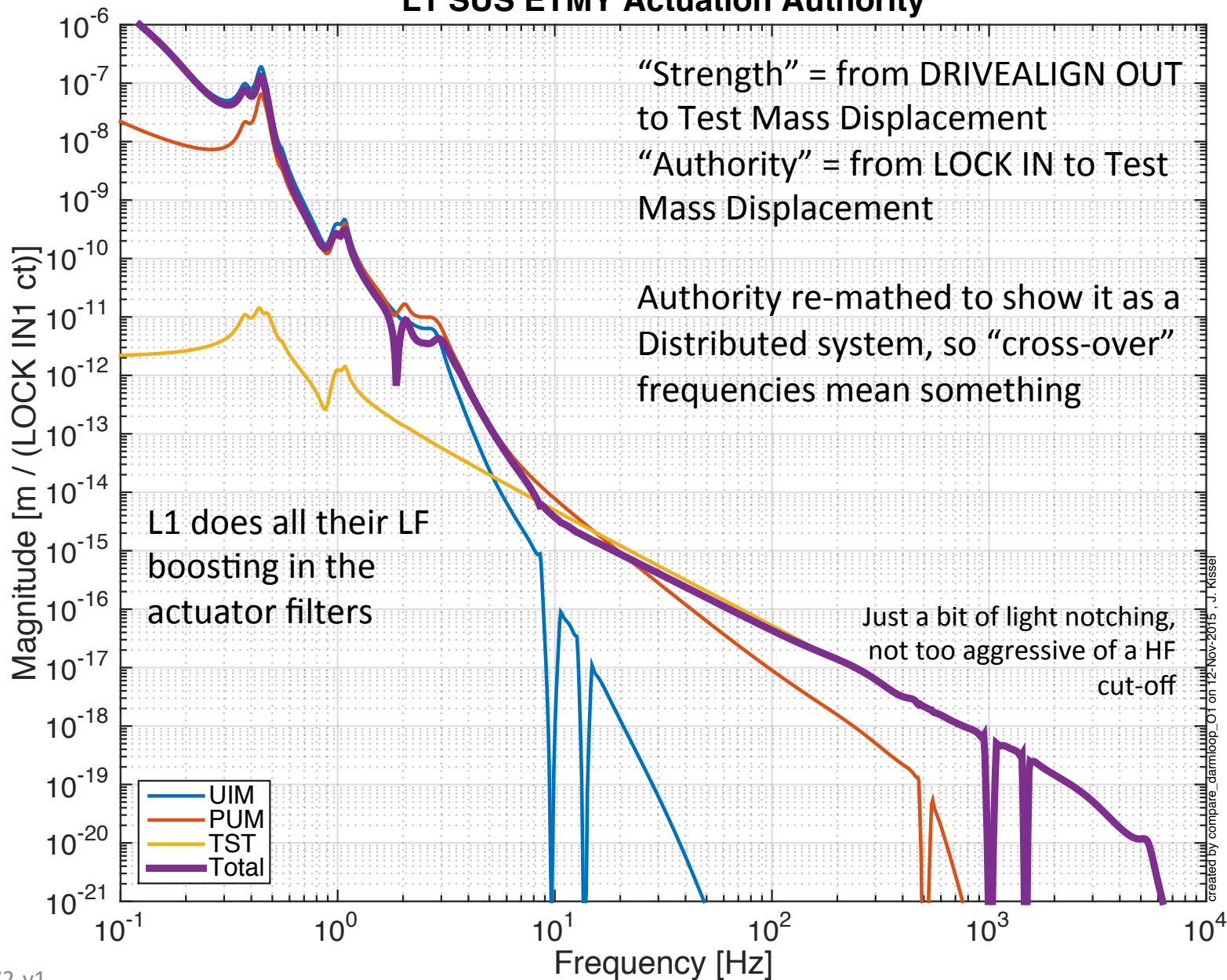


But because of the **different design choices**, with frequency response and gains all over the place, **tough to get a feel for the loop shaping from just one filter or plot**



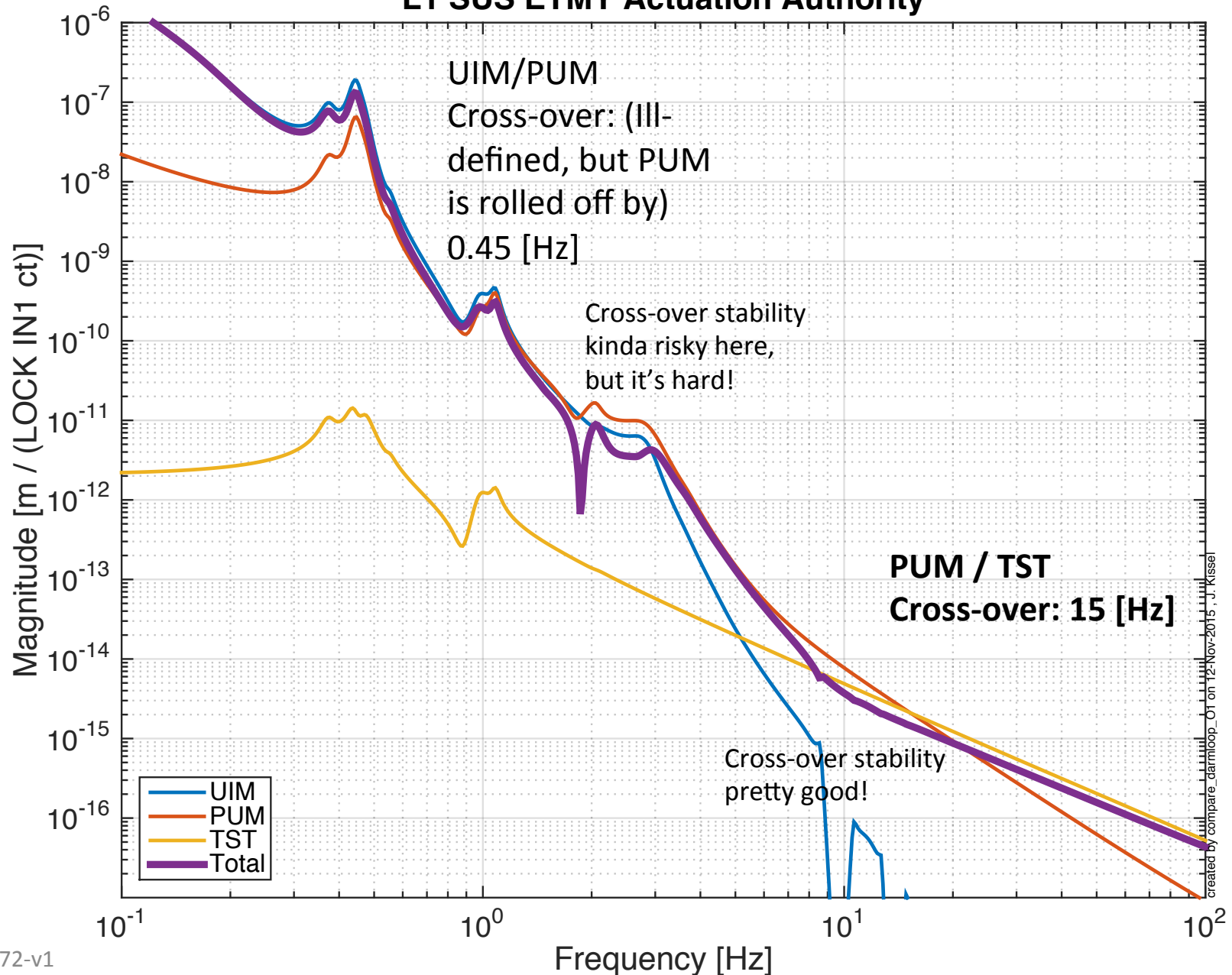
L1 Actuator Authority (Big Picture)

L1 SUS ETMY Actuation Authority



L1 Actuator Authority (X-over Zoom)

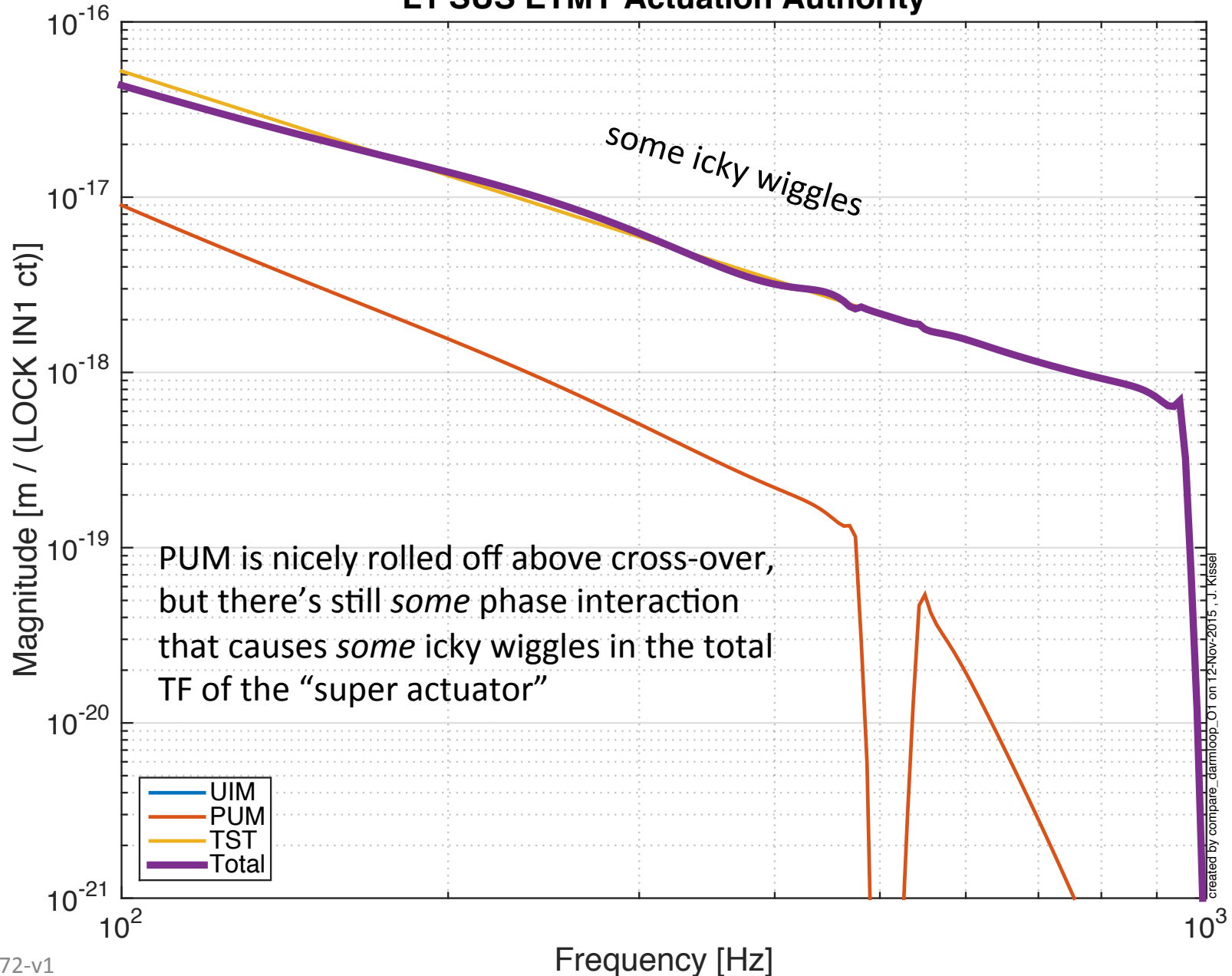
L1 SUS ETMY Actuation Authority



created by compare_darmloop_OI on 12-Nov-2015, J. Kissel

L1 Actuator Authority (HF Roll-off Zoom)

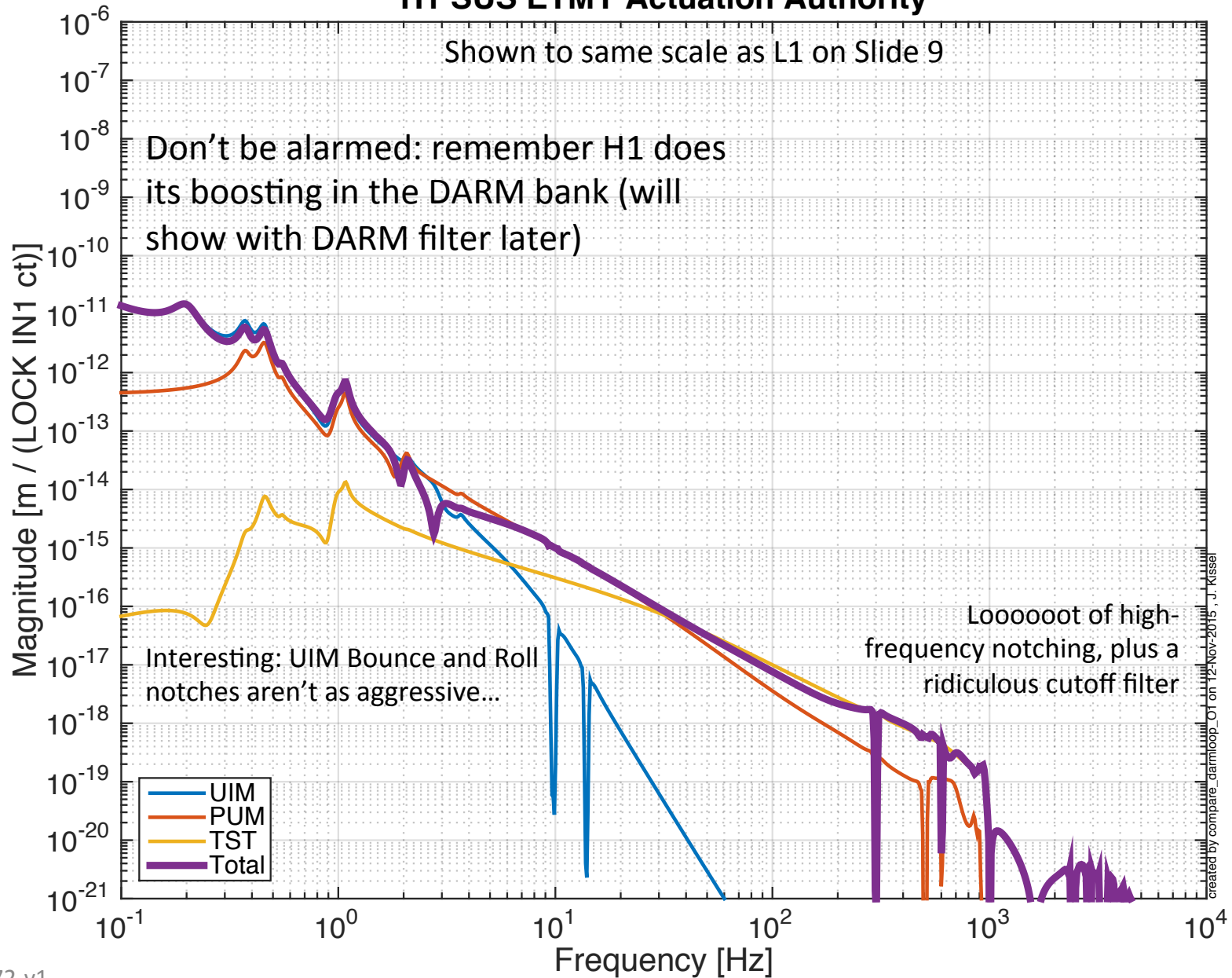
L1 SUS ETMY Actuation Authority



H1 Actuator Authority (Big Picture)

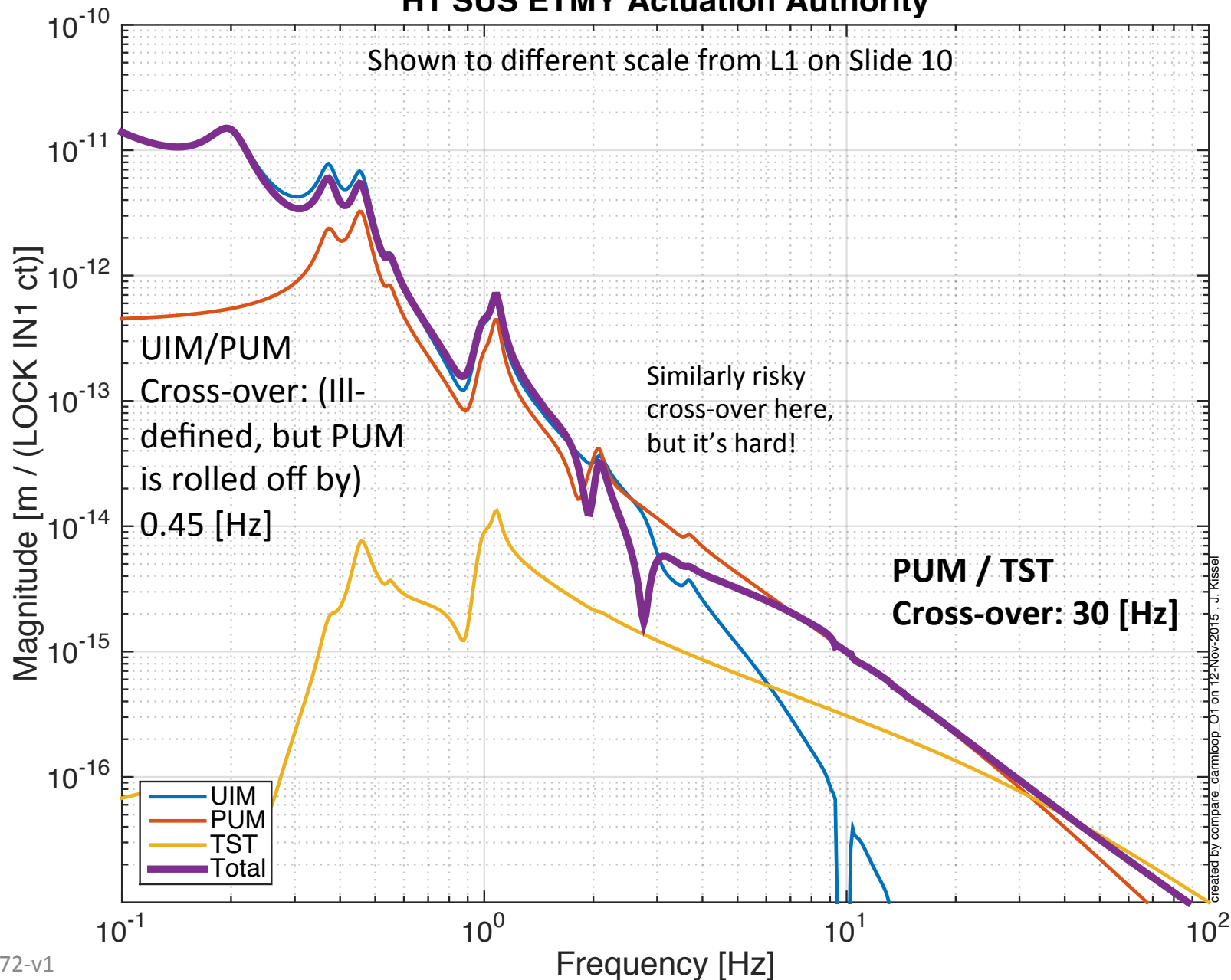
H1 SUS ETMY Actuation Authority

Shown to same scale as L1 on Slide 9



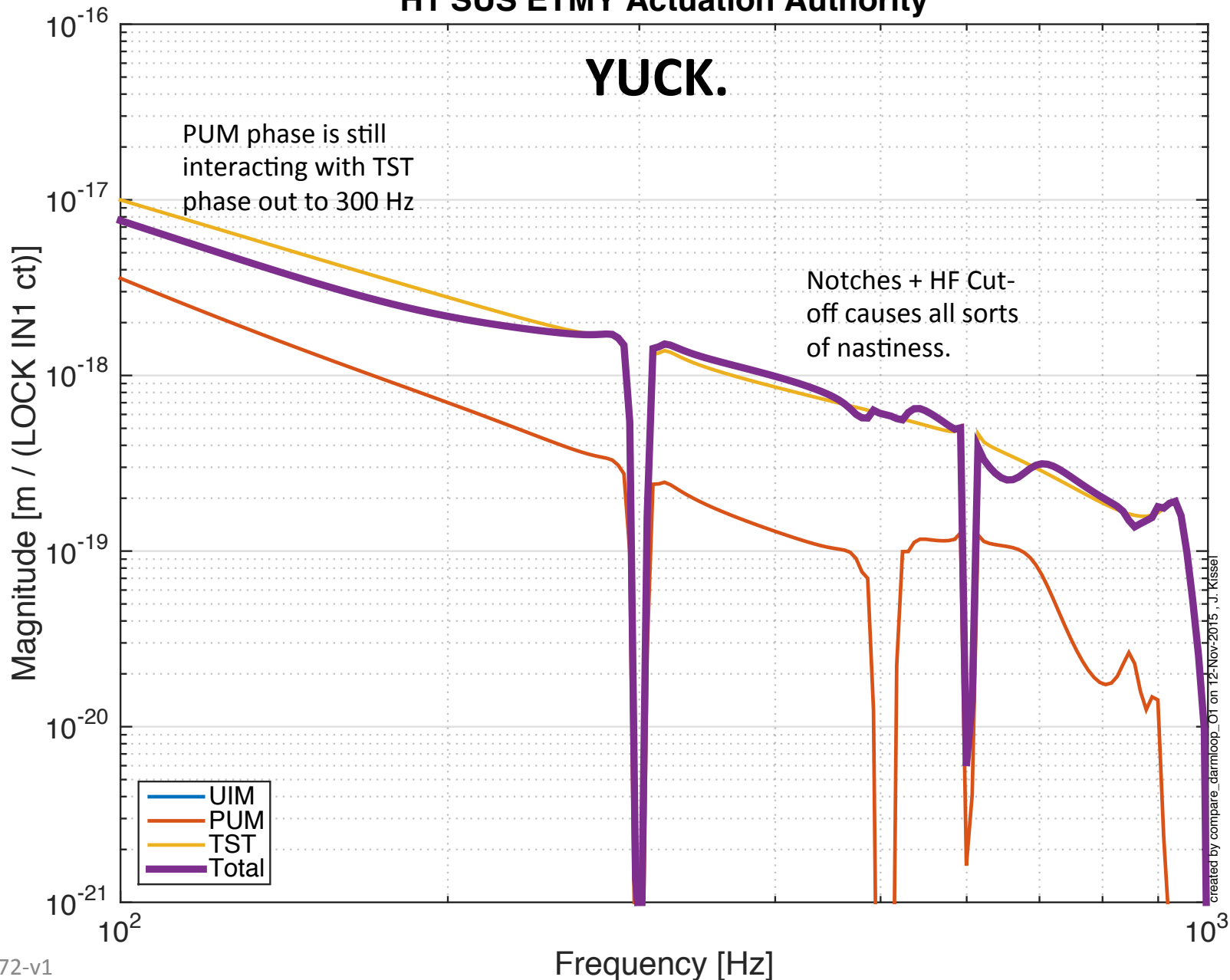
H1 Actuator Authority (X-over Zoom)

H1 SUS ETMY Actuation Authority



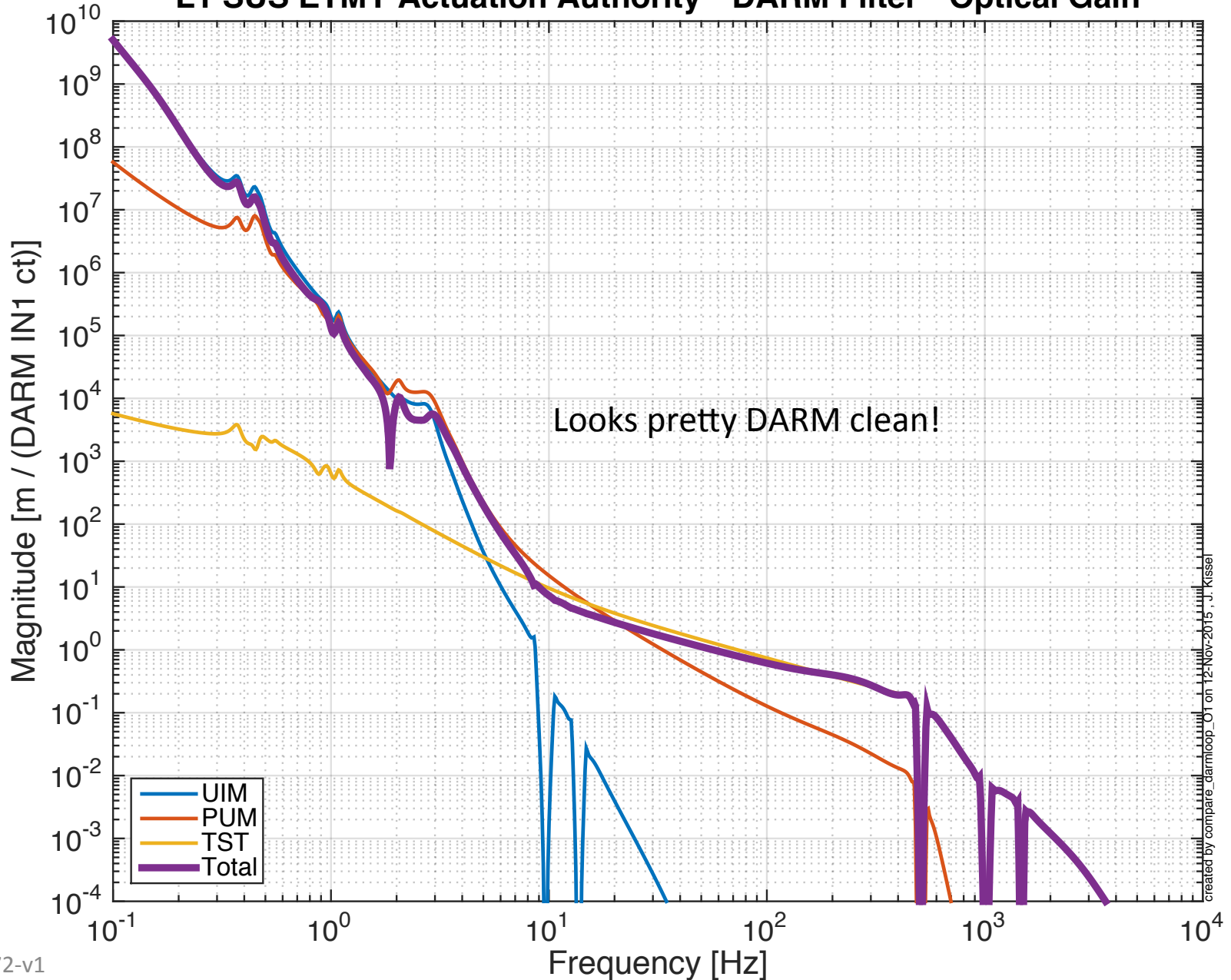
H1 Actuator Authority (HF Roll-off Zoom)

H1 SUS ETMY Actuation Authority



Authority Including DARM Filter (scaled by optical gain)

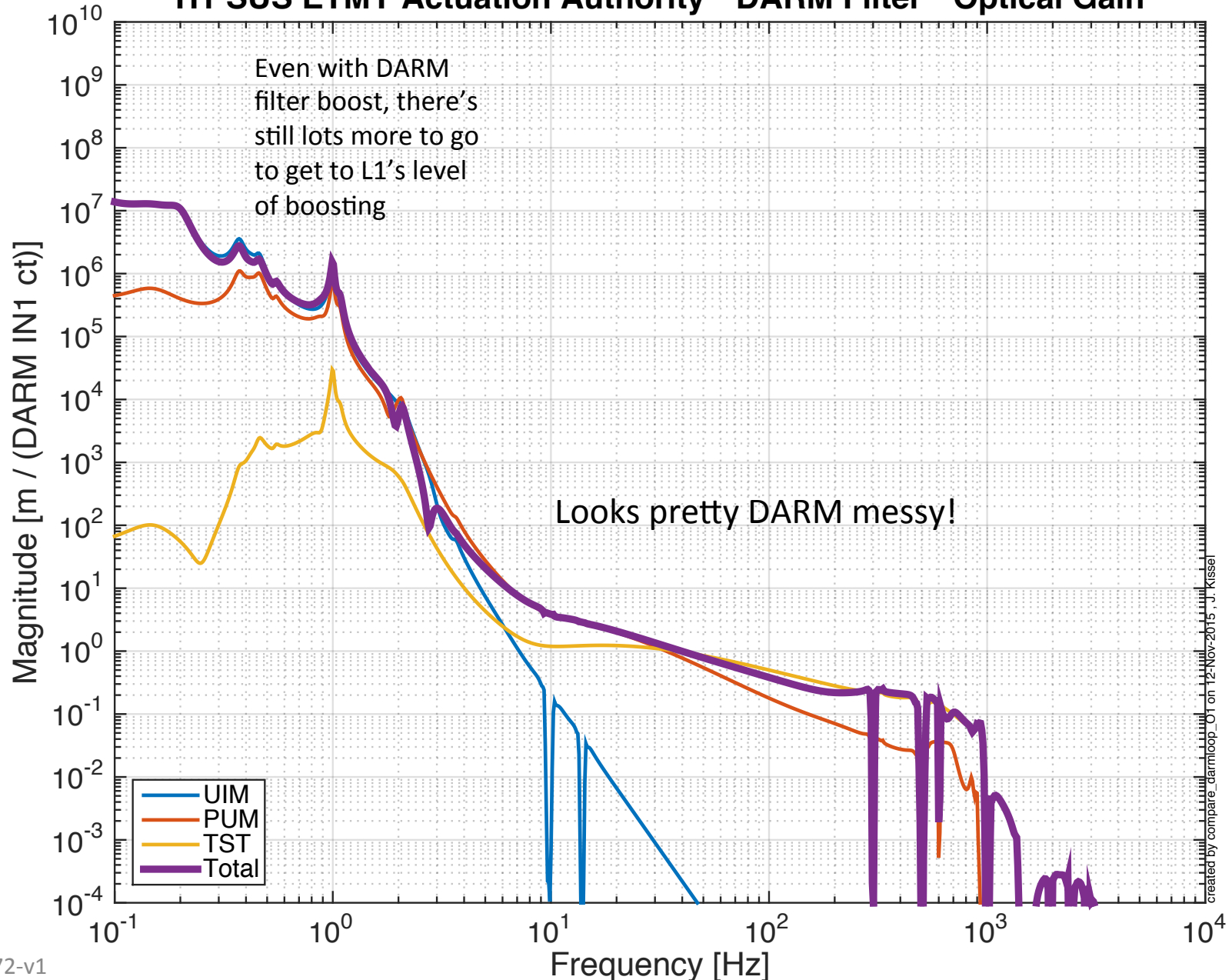
L1 SUS ETMY Actuation Authority * DARM Filter * Optical Gain



created by compare_darmloop_01 on 12-Nov-2015, J. Kissel

Authority Including DARM Filter (scaled by optical gain)

H1 SUS ETMY Actuation Authority * DARM Filter * Optical Gain



Conclusions

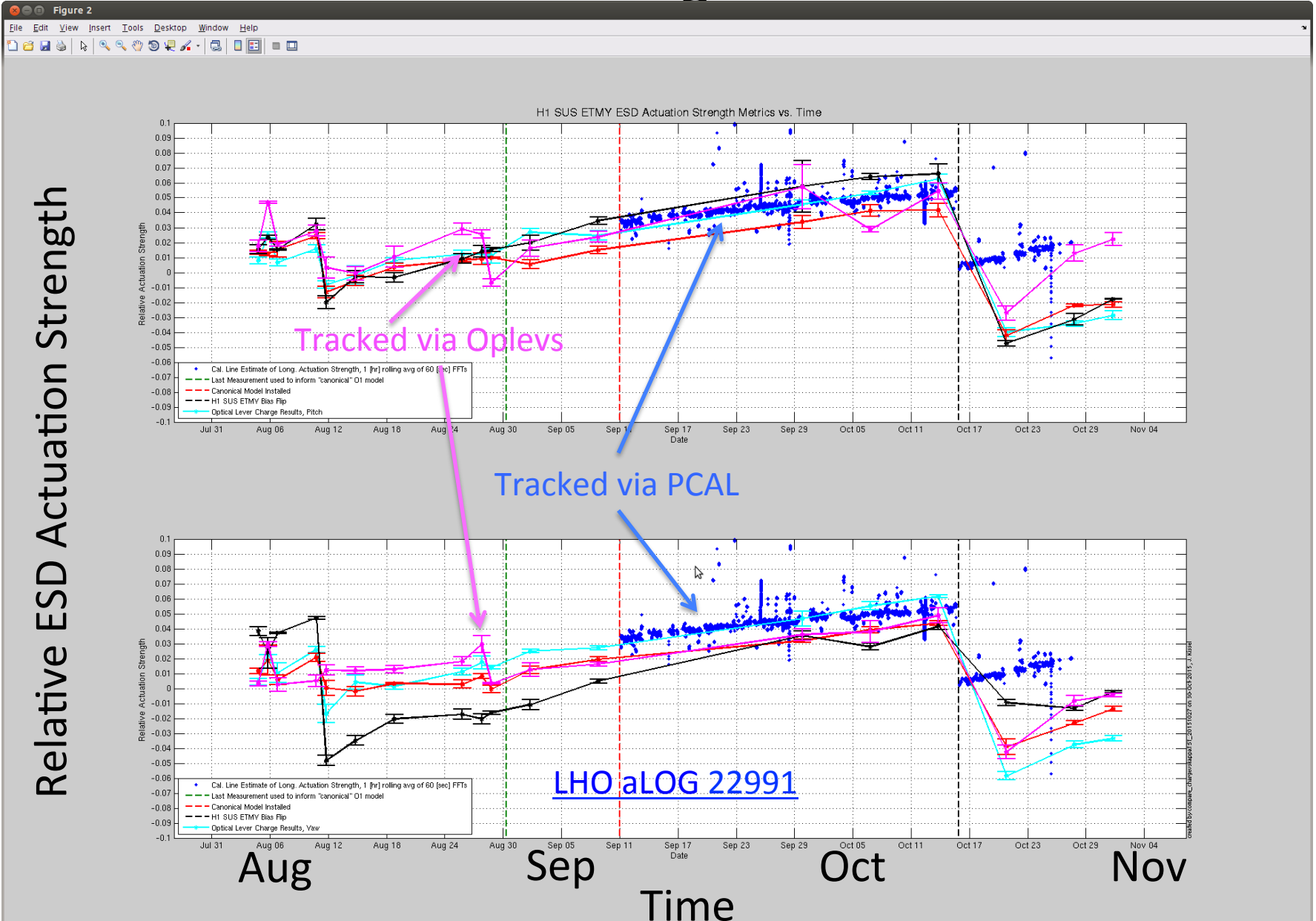
- H1 DARM Loop needs some tune-up and clean-up
 - More boosting at low-frequency
 - Better / simpler distribution filters
 - Less notching?
- Frequency response is splayed out everywhere at both sites, evident that “design” was staggered and piecemeal
 - Both sites should consider consolidating, for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

Bonus Material: Calibration Parameter Time Dependence

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

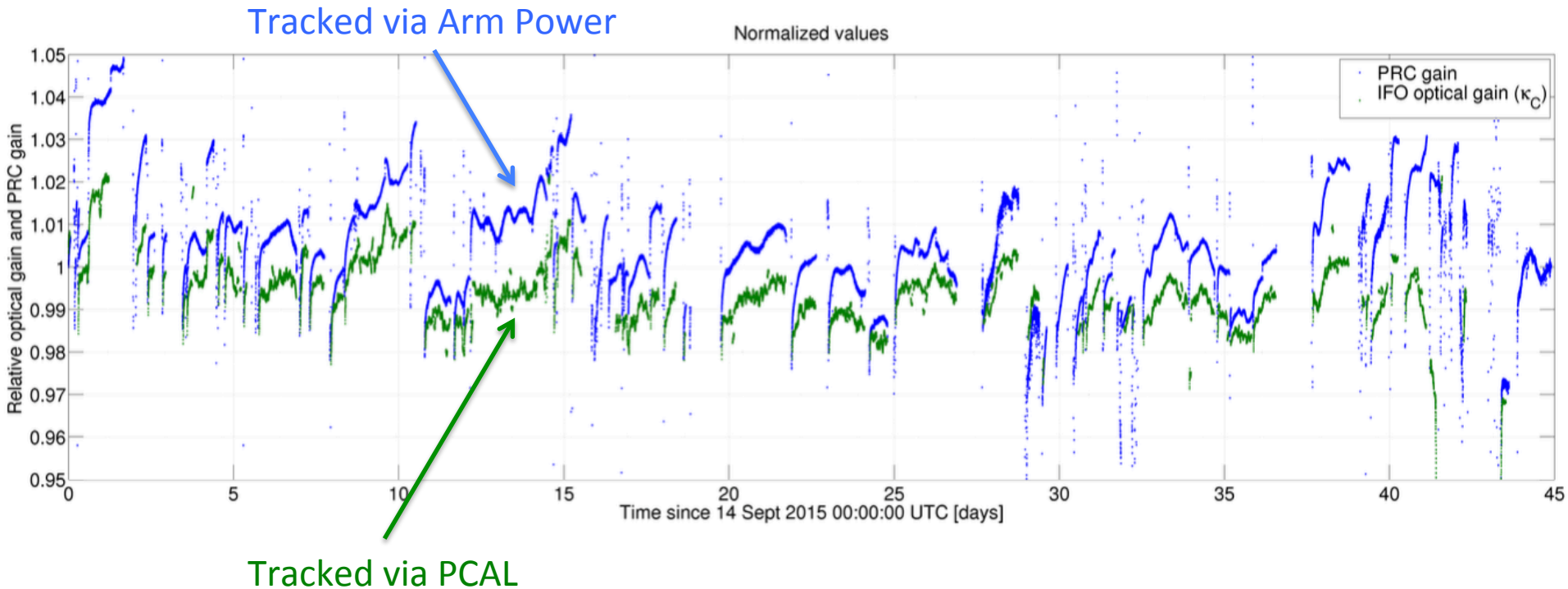
Comparison Between Relative ESD Actuation Strength

Relative ESD Actuation Strength



Comparison Between Relative Optical Gain Measurements

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



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

[LHO aLOG 23147](#)