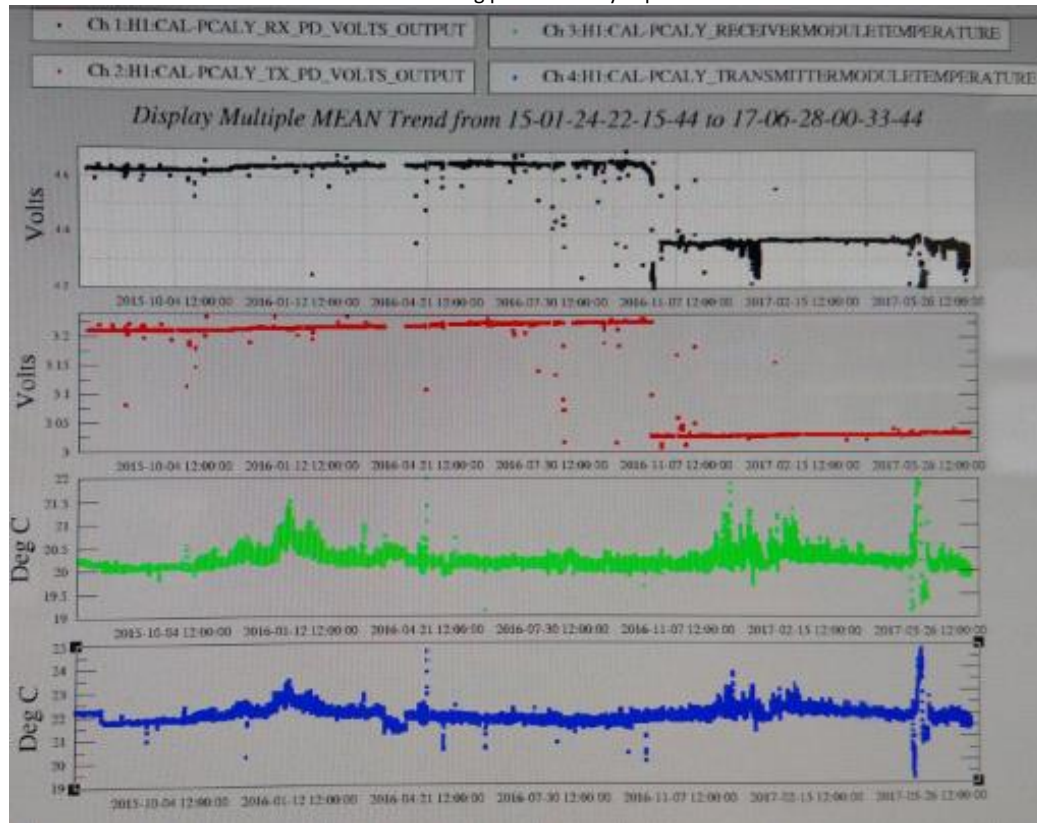


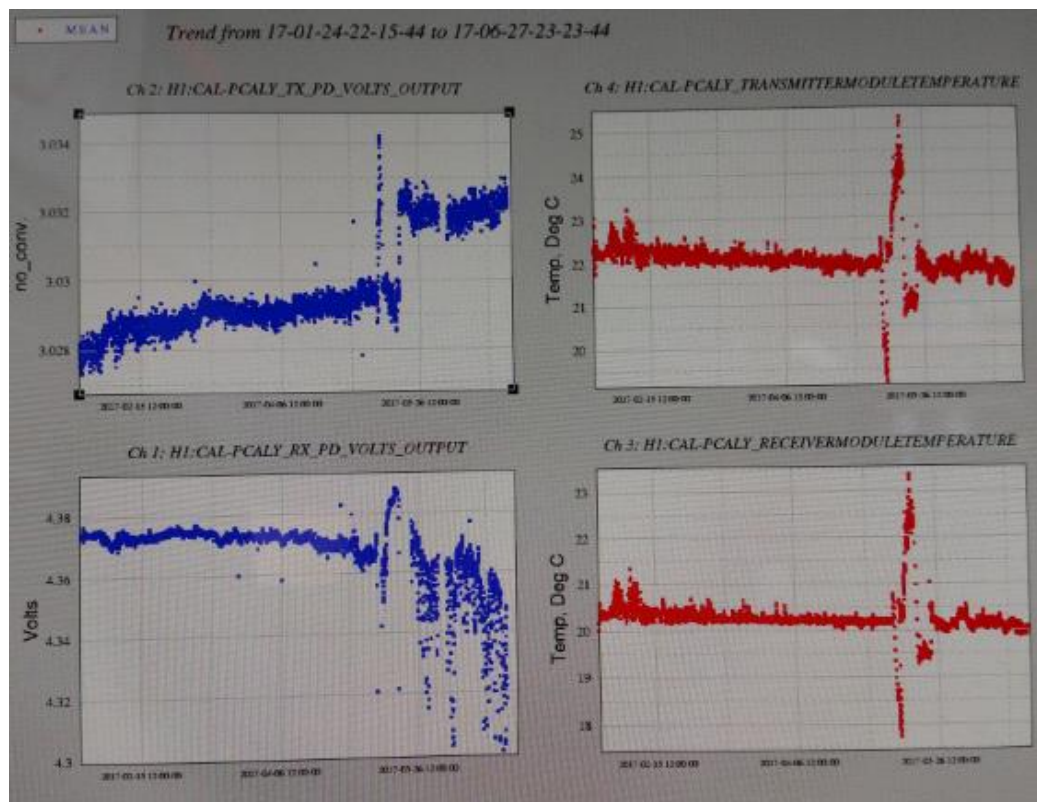
Issue History

Tuesday, June 27, 2017 17:07

Rick showed me dataviewer. Have some interesting plots from my experimentation with that:



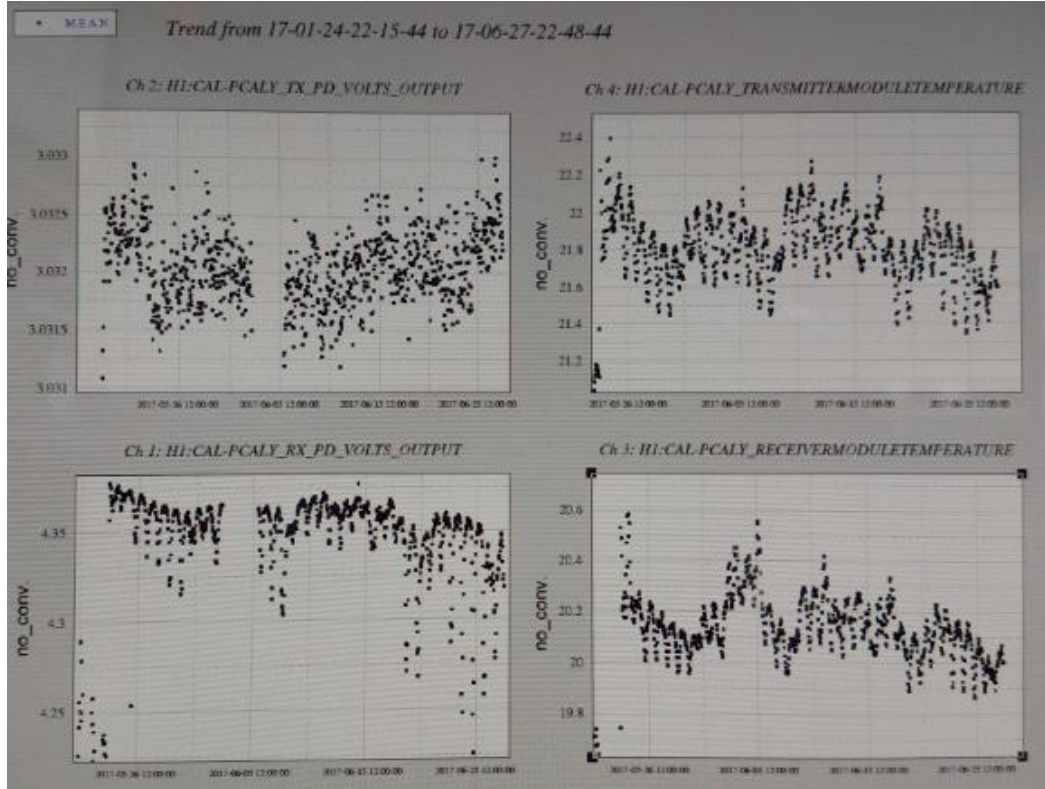
So some step change in PD levels around October of 2016; perhaps recalibration?



Looks like both Tx and Rx also received some adjustment during maintenance tasks following vent in May (will have to check aLOGs) but Rx sees that ugly variation afterward (will have to produce an X-Y

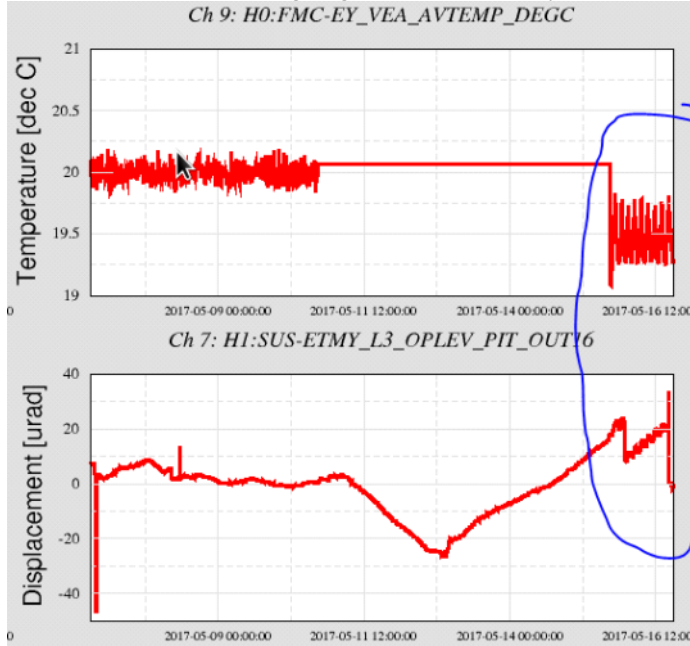
plot of Temp v PD volts after that). Just eyeballing it, that variation is roughly ~ 0.07 volts, or $0.07 / 4.38 = 0.016 = \sim 1.2\%$ variation. Tx varied about $0.002 / 3.032 = 0.0007 = \sim 0.07\%$ percent in the same period.

Another view of the "post-vent" period shown below:



At first glance, there is some correlation, but will need to dig deeper to confirm. If true, onto next investigation stage.

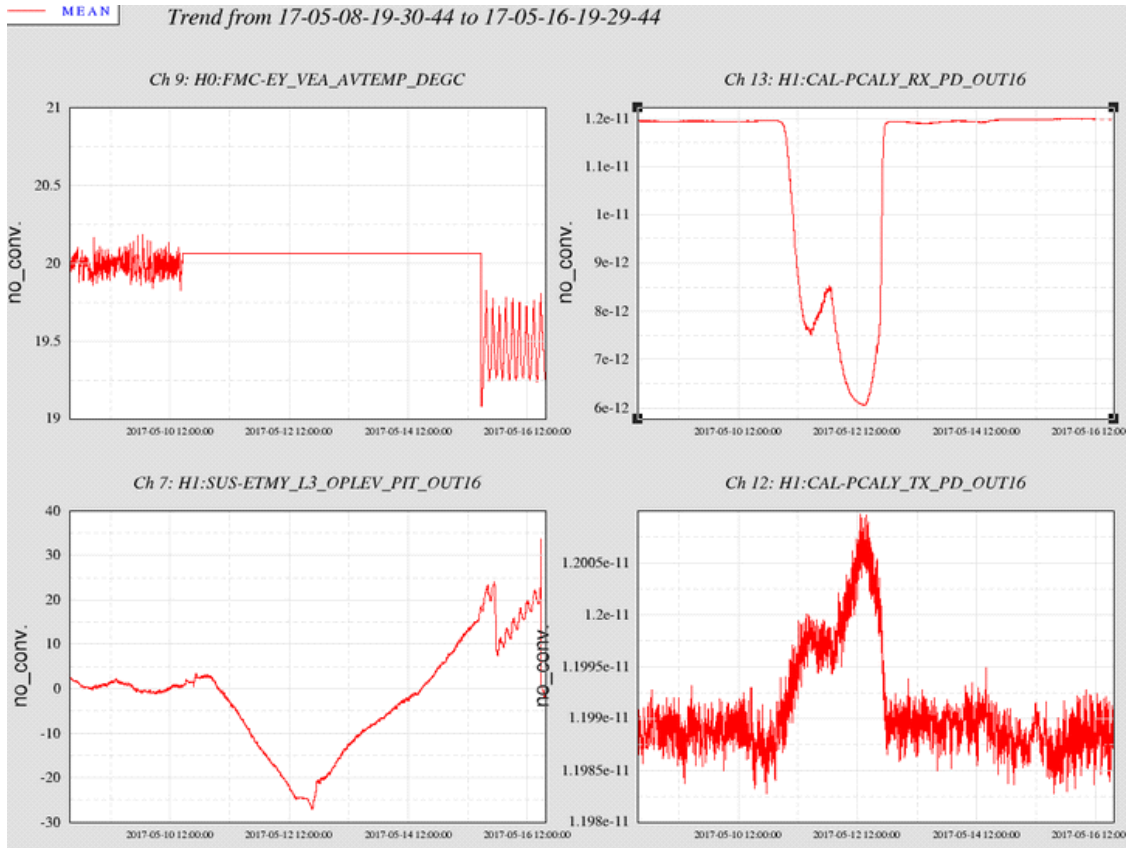
According to [aLOG 36208](#), the ETMY HVAC upgrades may have caused some sagging of the ETM and, therefore, a need to later change alignments once the temperature was stabilized



It also reports the first major change in Pcal PD outputs; per Jeff: "**Also note that PCAL Y sees a substantial effect of the large temperature excursions seen in the VEA during the upgrade as well, indicating that there is still some temperature sensitivity left in the system, like what was seen back in January (see, e.g. [LHO aLOG 34153](#)).**

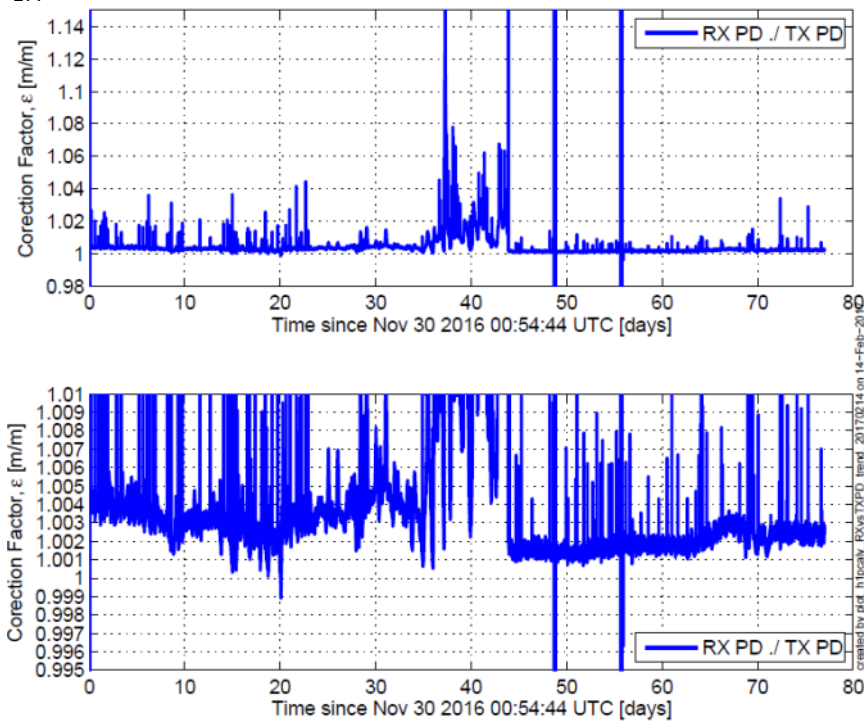
The gross clipping has gone away since the temperature has *mostly* recovered, but -- presumably because of the 0.5 deg C difference in static temperature, the RXPD is reporting 0.2% higher displacement than before the HVAC upgrade. Further, one can see the ~3 hour oscillation in the RX

and TX PDs."



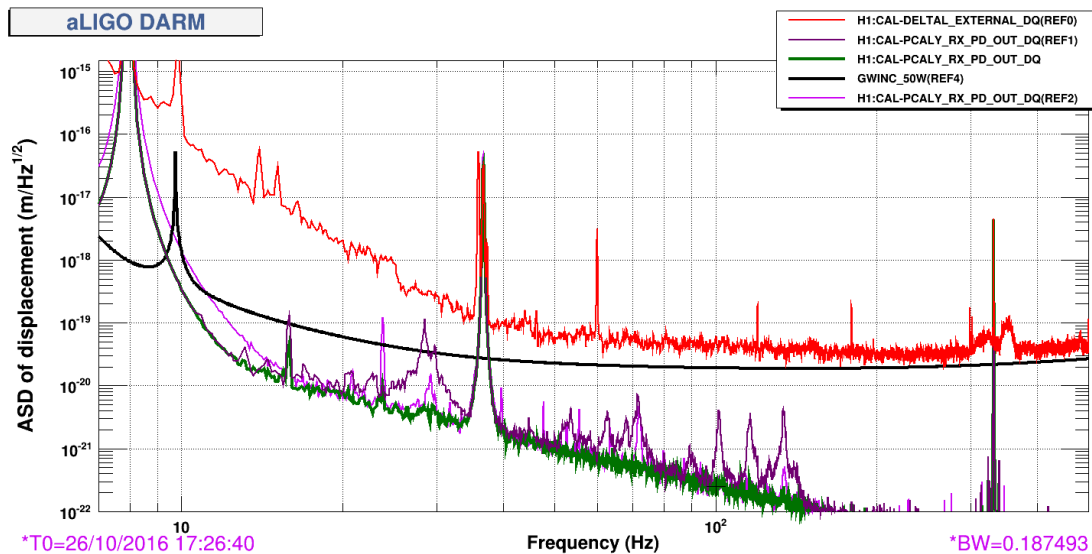
Clear interaction shown, though I'll want to look at ratio and sum of Rx and Tx PD's of the latter portion.

aLOG 34153 discusses the PCal clipping as an earlier problem, noticed around early January, and it links to further aLOG's [33108](#) and [33187](#). It also includes a plot of Rx/Tx PD ratios from Nov 30 '16 to Feb 15 '17:

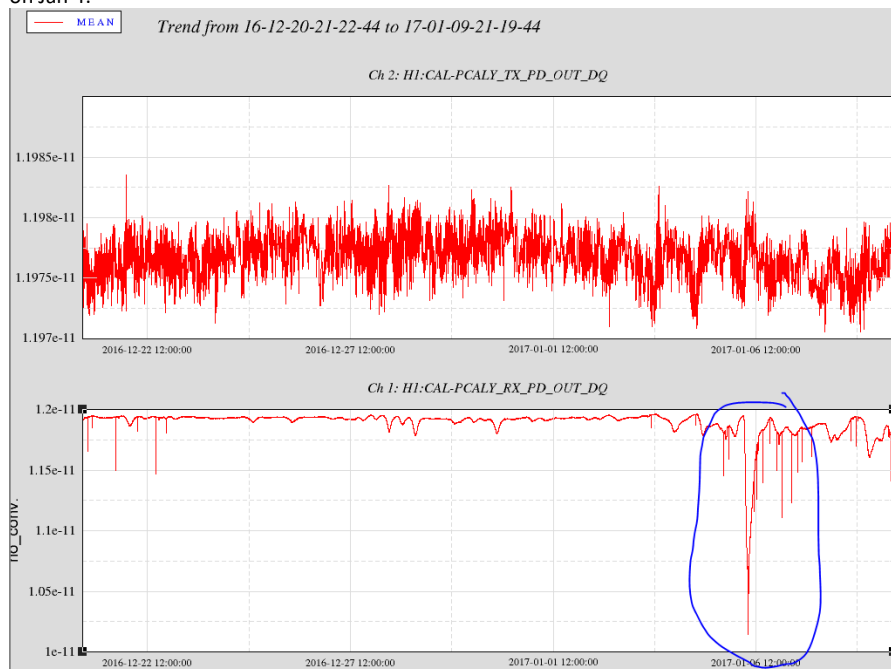


In this case, the ratio is positive because it describes the ratio of "reported displacement," which is inverse to PD voltage. Ratio variations are ~4% before ~Jan 9 and ~2% after.

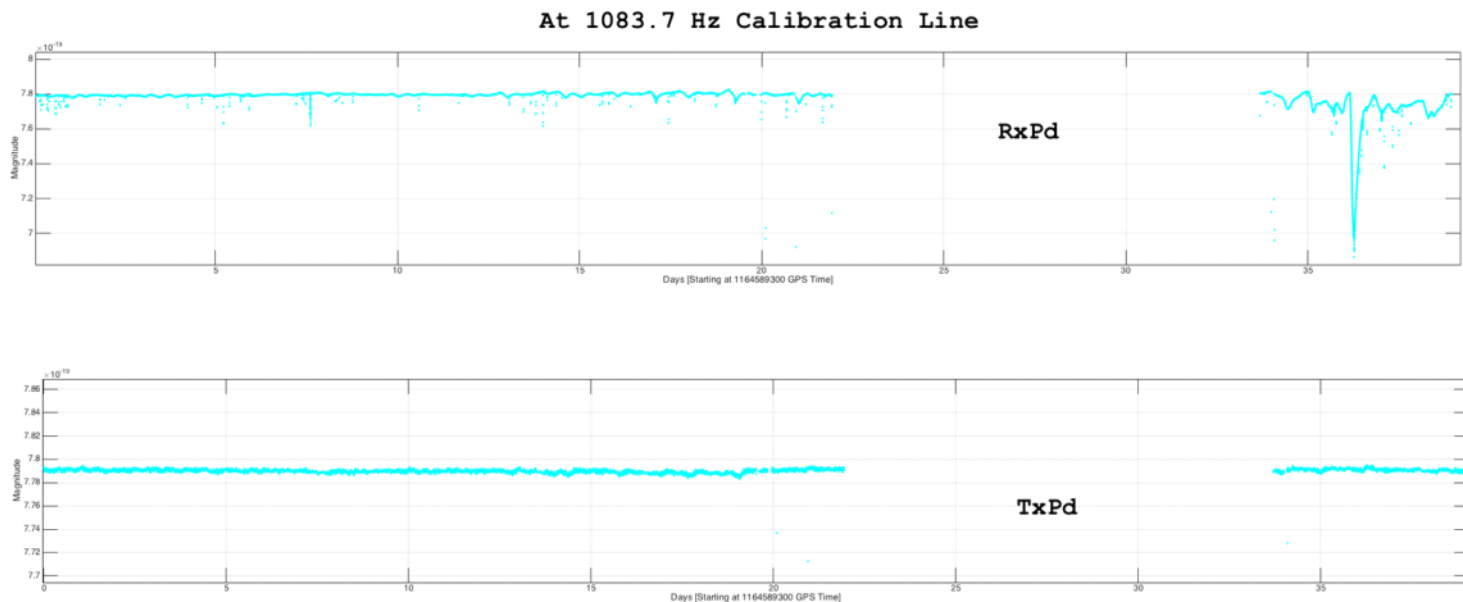
aLOG 33108 points to both the investigation aLOG 33187 and the initial identification back in October (per Jeff: **Identified in LHO aLOG 30827; Solved in LHO aLOG 30877**). 33108 from Jan 9 mentions repeat of previous indications in Rx PD's ASD and time series:



Purple is ASD of Rx RD Out from Jan 9, pink is from last October (post previous fix, to be explored in other aLOGs). Time series below indicates that assumed "clipping" returns after IFO resumed operations on Jan 4:

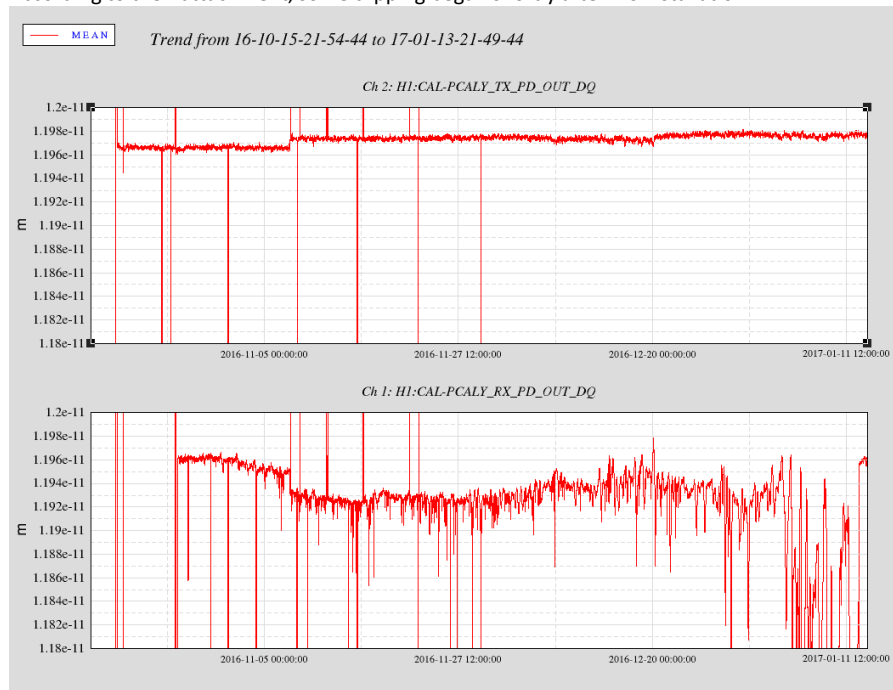


As part of that aLOG, Sudarshan reported a change of magnitude of the ~1.08 kHz calibration line on Rx after the most recent "break" before January (the below is Dec 1 to Jan 8):

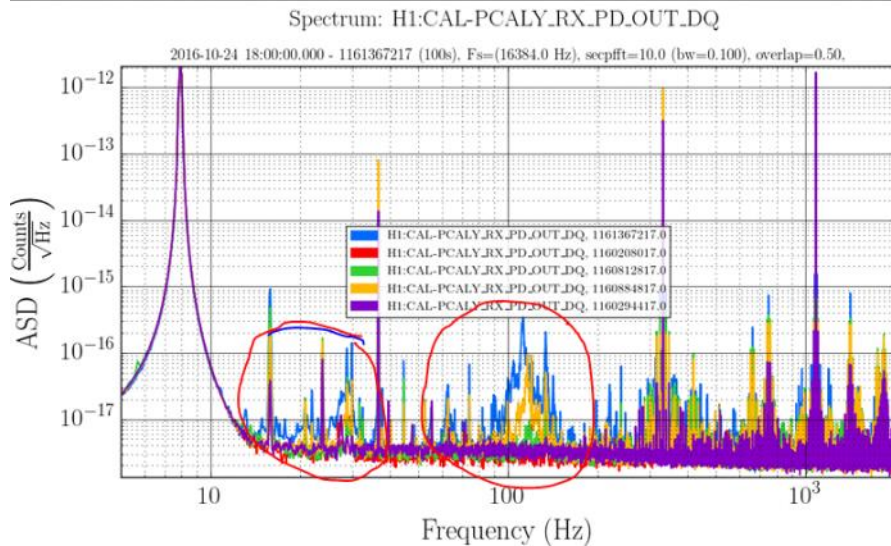


Will have to ask someone why this calibration line.

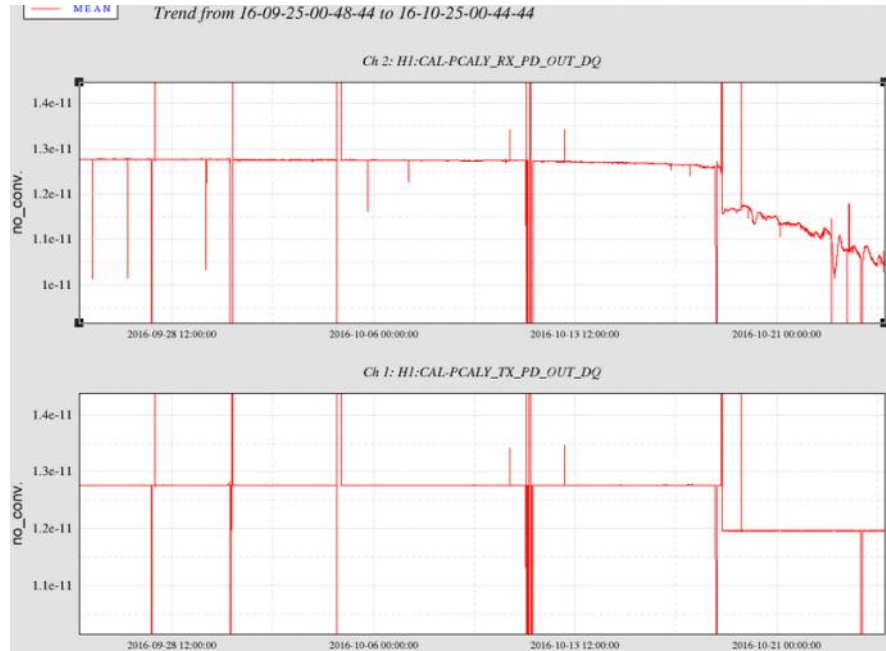
Since aLOG 33187 is supposed to be the "solution" to the above discovery, it reports that Travis/Evan felt that clipping was occurring at "newly installed alignment irises" installed during the final two aLOGs in this investigation (two oldest). They proposed to move said irises instead of moving the Tx steering mirrors but I'll need to search the logs to see if this was done. They hypothesized that either Tx module steering mirrors or in-vac periscope mirrors may be drifting but they don't know why. According to their attachment, some clipping began shortly after iris installation:



The *original* aLOG reporting clipping goes all the way back to 24-Oct in log 30827. Evan noticed ASD peak growth for the 15-30 Hz and 90-140 Hz regions of the Rx when the Tx was unchanging:



Their best clue at the time was that these peaks seemed to start changing after Pcal beam realignment in mid-October, though they didn't reference an aLOG for this (they quote Oct 18). They show a time series to demonstrate:

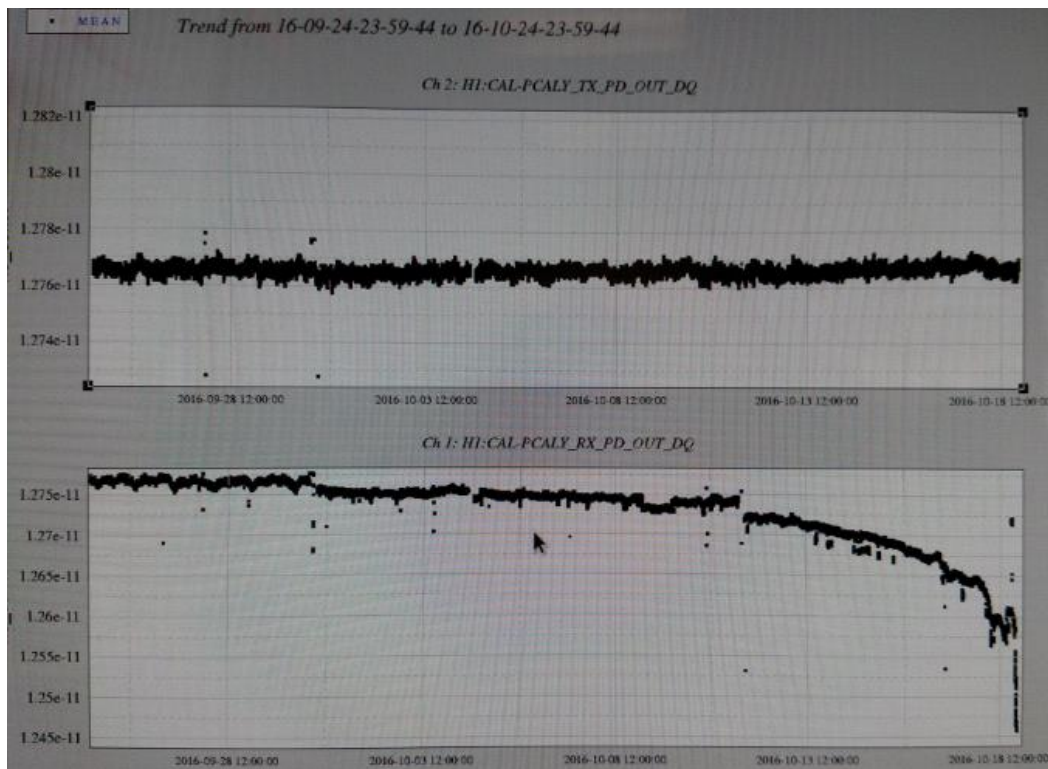


After the large step, they saw a **monotonic decrease of $(1.15 - 1.05) / 1.15 = 0.087 = 0.087 = \sim 9\%$** .

To my eyes, some curvature of the output begins before the large step. I'm not entirely convinced that this was the origin of the power loss but realignment may have contributed further to power loss, or there is some physical clipping combined with another issue.

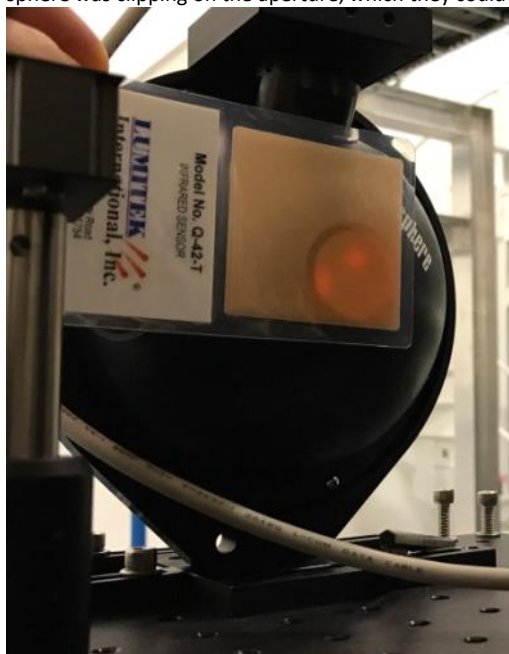
- Side tangent- Perhaps a buildup somewhere? What could build up inside vacuum with temperature control? How long ago was the concrete poured which the breadboard stand for the Rx side sits on? How would we even check for defects in the concrete at this point?

Confirmed, there is definitely earlier curvature:

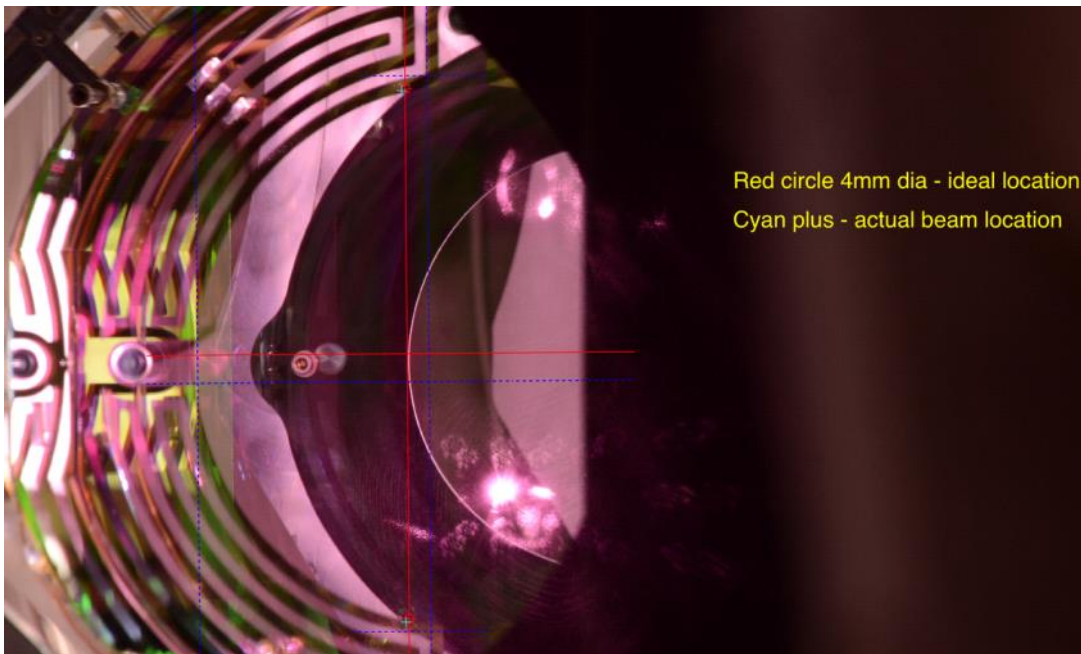


Looks to be about a week before this date of October 18. The above shows $(1.27 - 1.255) / 1.27 = 0.0118$ = a ~1.2% drop in one week, monotonically (not counting the last vertical drop). How does this compare to the range of the last few months?

So aLOG [30877](#) describes the beam realignment. They state that the outer beam at the Rx integrating sphere was clipping on the aperture, which they could see with infrared cards.



They also took images showing beam movement on the ETM, thus confirming that the beam had moved but not the ETM.



The following measurements were made: the upper dot was left 1.5mm and up 1.8mm, and the lower beam was left 6.9mm and down 2.5mm; post alignment, they changed this to the upper beam being left 1.4mm and down 0.9mm and the lower beam being left 1.3mm and down 1.4mm (above image). They then installed "apertures" (more irises?) at Tx output and Rx input.

After realignment:



Info from aLOGs in Oct 11-19 date range:

- PCalY cal line frequency changed on 11th (30434)
- PCalY cal line amplitudes increased on 12th (30476)
 - 36.7 Hz x5, 331.9 Hz x3, switched off 1kHz line
- PcalY OFS glitches reported to be ticking up on 13th (30548)
 - Supposedly due to manual changes and maintenance but LLO said they'd seen this with power supplies issues
- PCalY cal line frequency changed on 13th (30499)
- PCalY cal line frequency changed on 17th (30597)
- Pcal OFS optimization performed from control room on 18th (30642)
 - Interesting details in Evan's response
- Vague statement: "Pcal crew to EY at 16:00 UTC" on 19th (30676)
 - Doublecheck dates- was this Evan and Travis?
- PCalY realignment done on 25th (30877)