Selected Commissioning Topics

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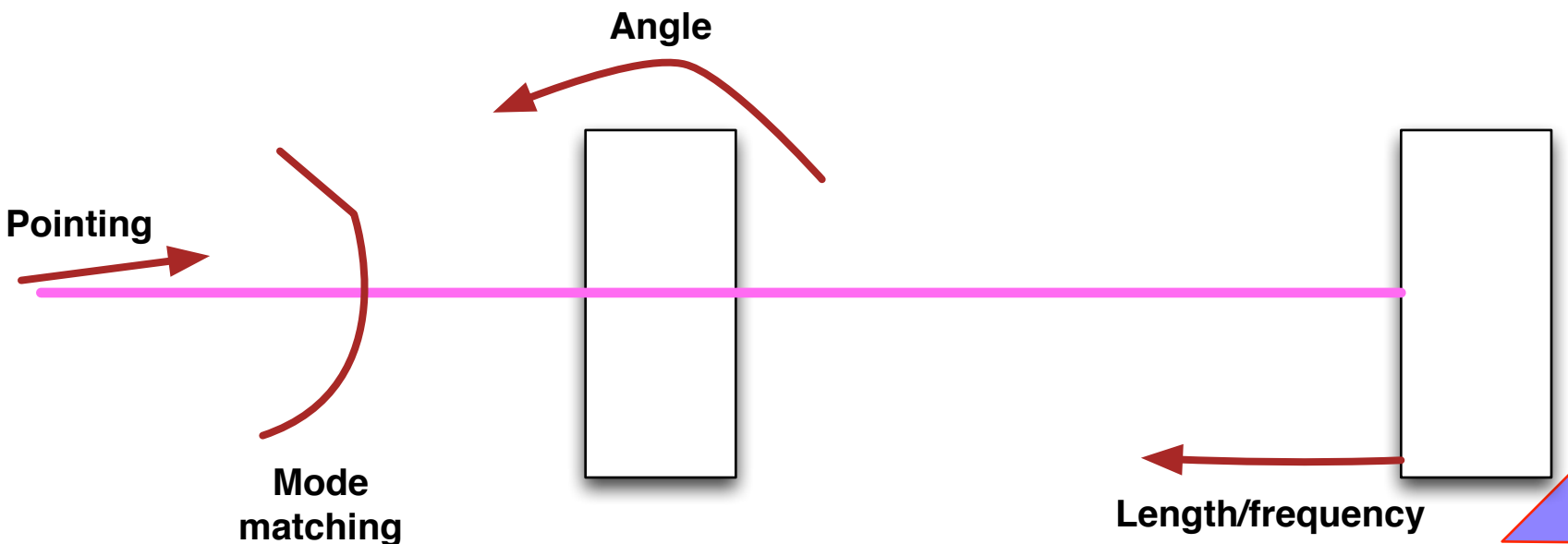
JGW-G1707104-v2

This talk

- Attempts to introduce several selected issues that aLIGO experienced.
- Aims to give idea of what might be happening during the commissioning times.



Commissioning issues

- **ALIGO experienced several unexpected (or not-well-thoughtrhough) issues.**

Incomplete list of such issues

- ⊗ **Mode hopping in signal recycling cav.**
- ⊗ **RF noise coupling**
- ⊗ **Beam pointing/size jitter coupling**
- ⊗ **Dependence of noise on beam spot positions**
- ⊗ **Vulnerability of ASC f1-f2 (36) signal**
- ⊗ **New rad. press. instability**
- ⊗ **Unintentional SRC detuning**

Issues

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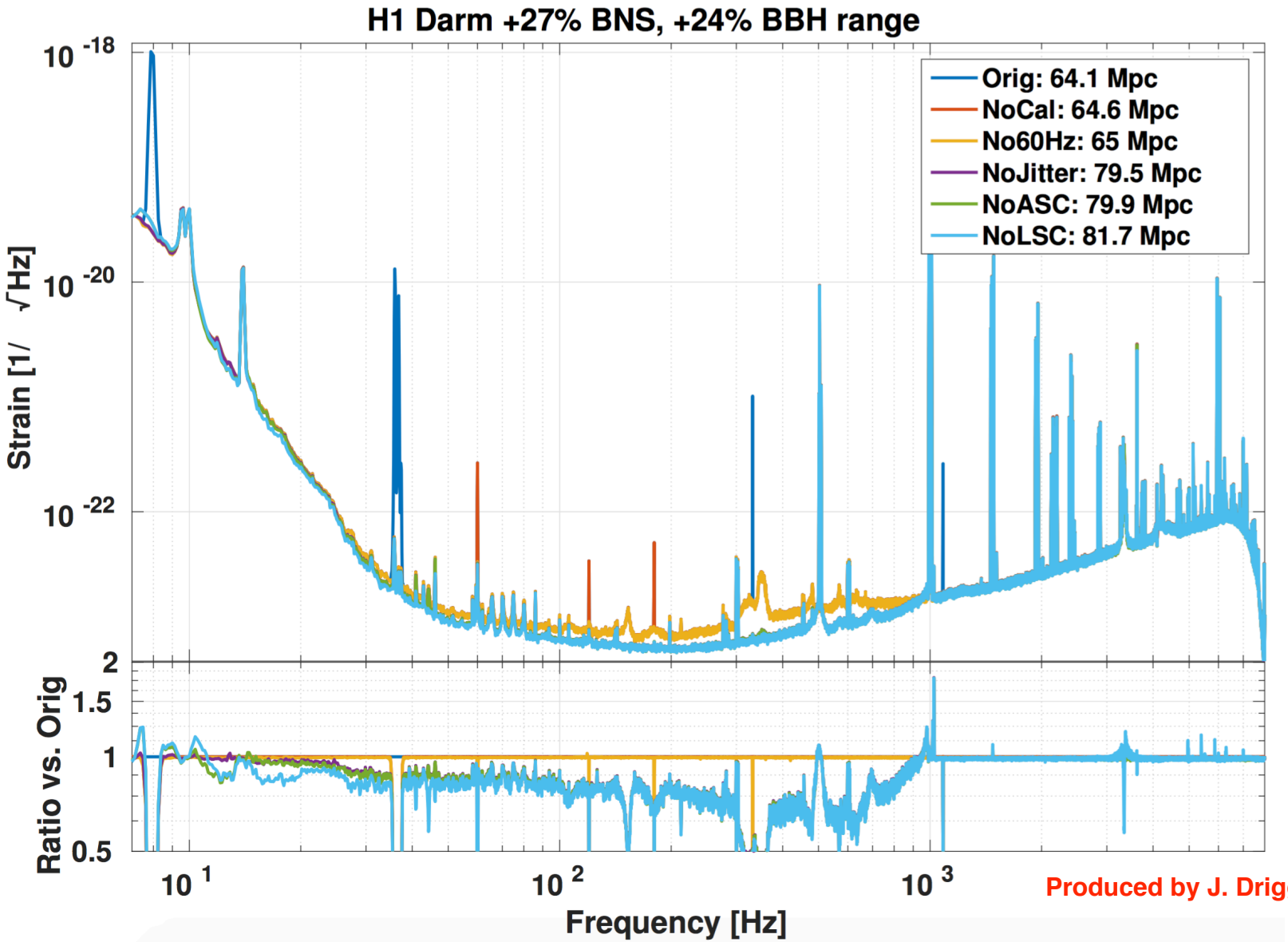
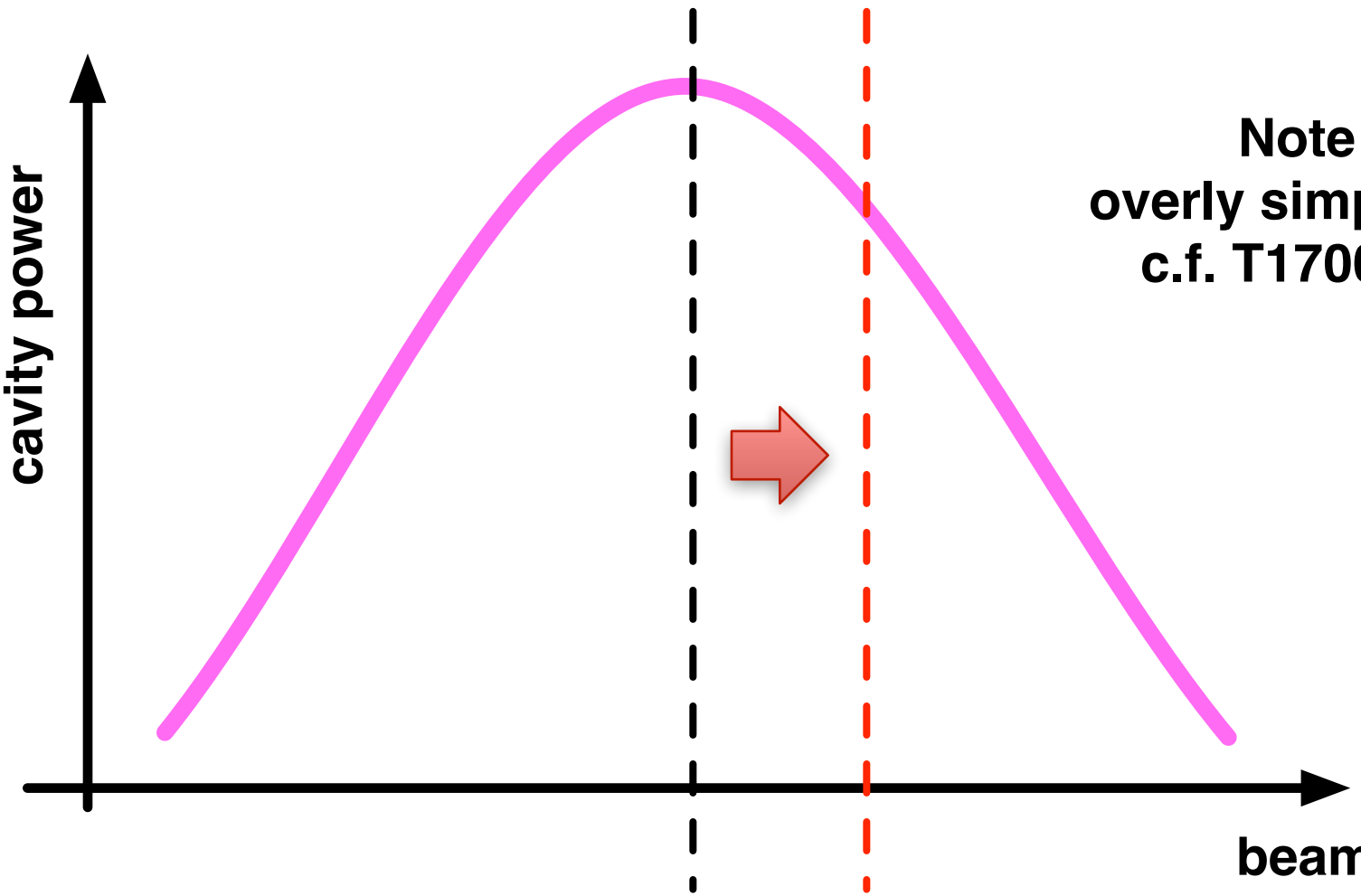
Topics of the day

Pointing jitter coupling



Produced by J. Driggers

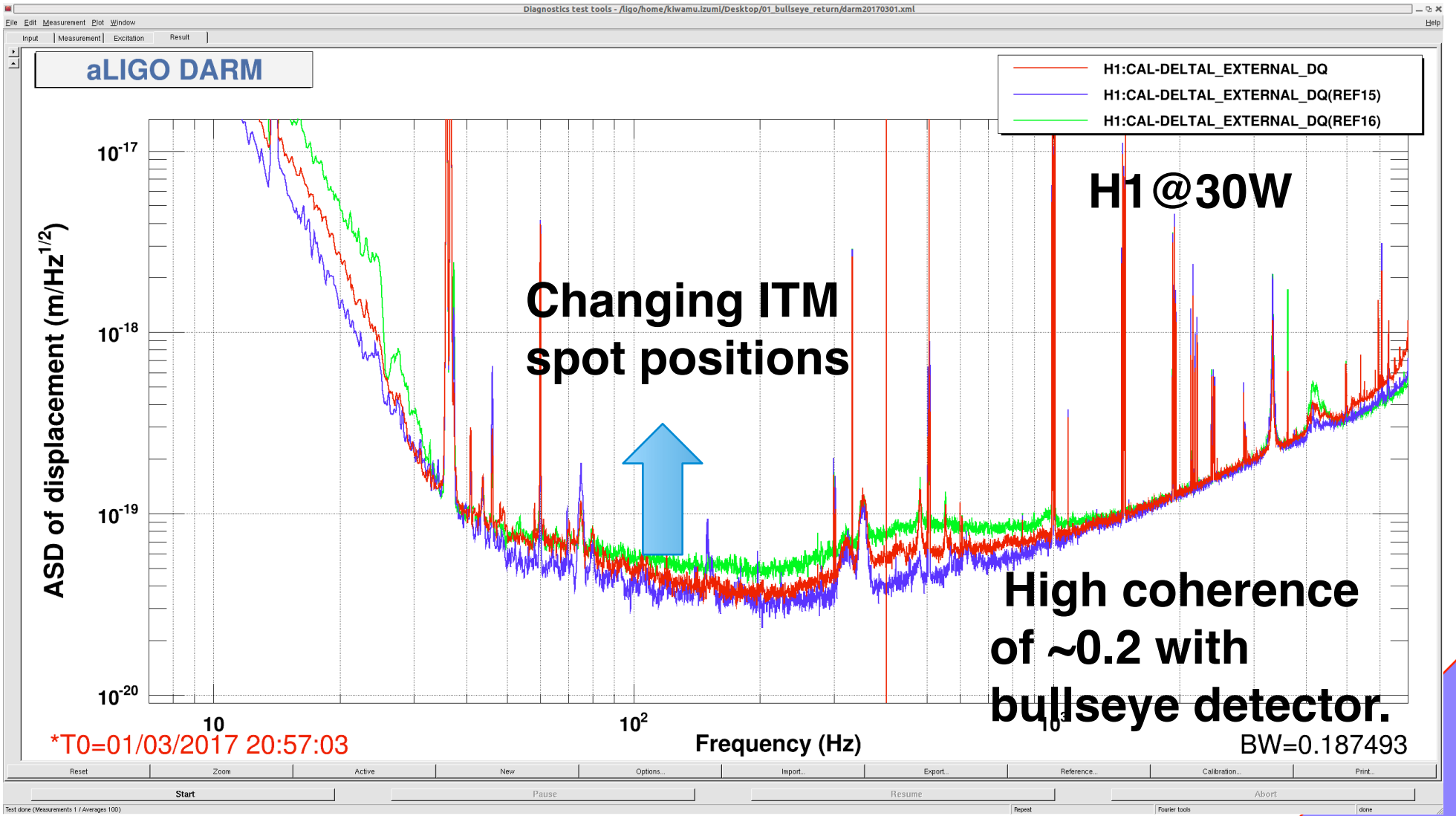
Why does it couple?



Note:
overly simplified.
c.f. T1700080

Beam size jitter

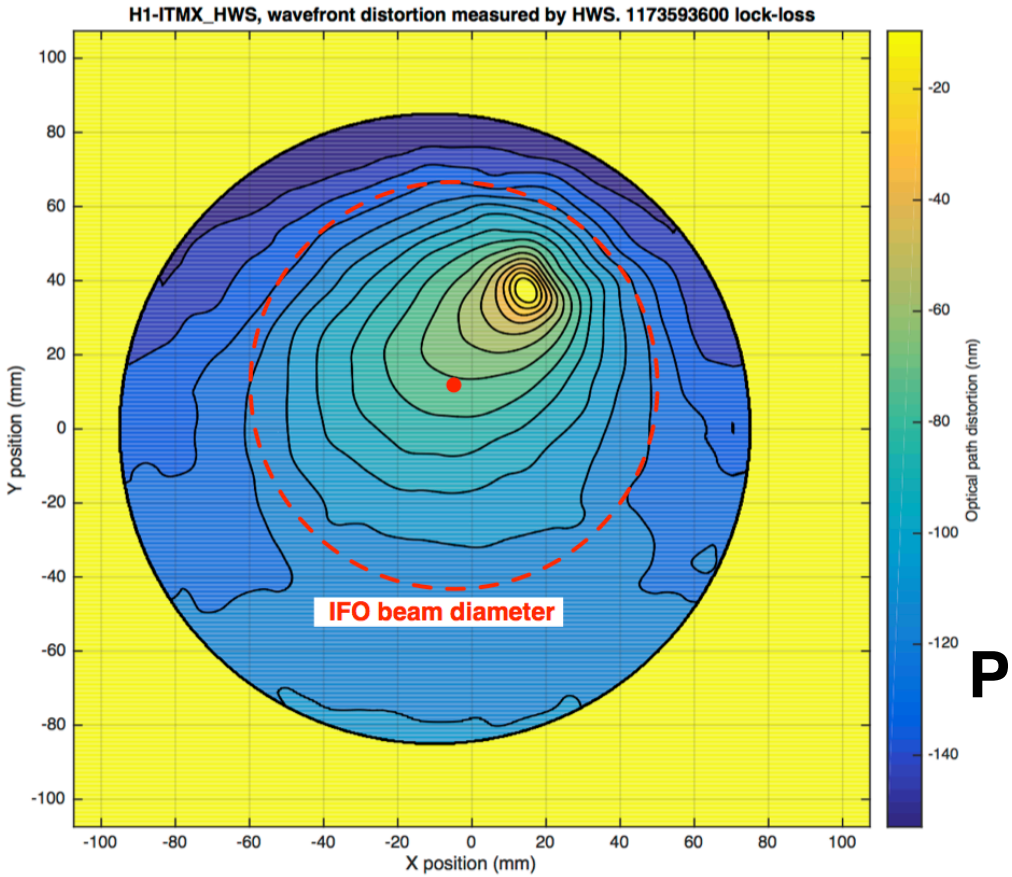
- **The same coupling exists.**



Plot from G1700364

LHO is worse, why?

- Most people think it has to be related to a point absorber on ITMX, despite no good explanation.



Plot by A.Brooks

ASC f1-f2 signal

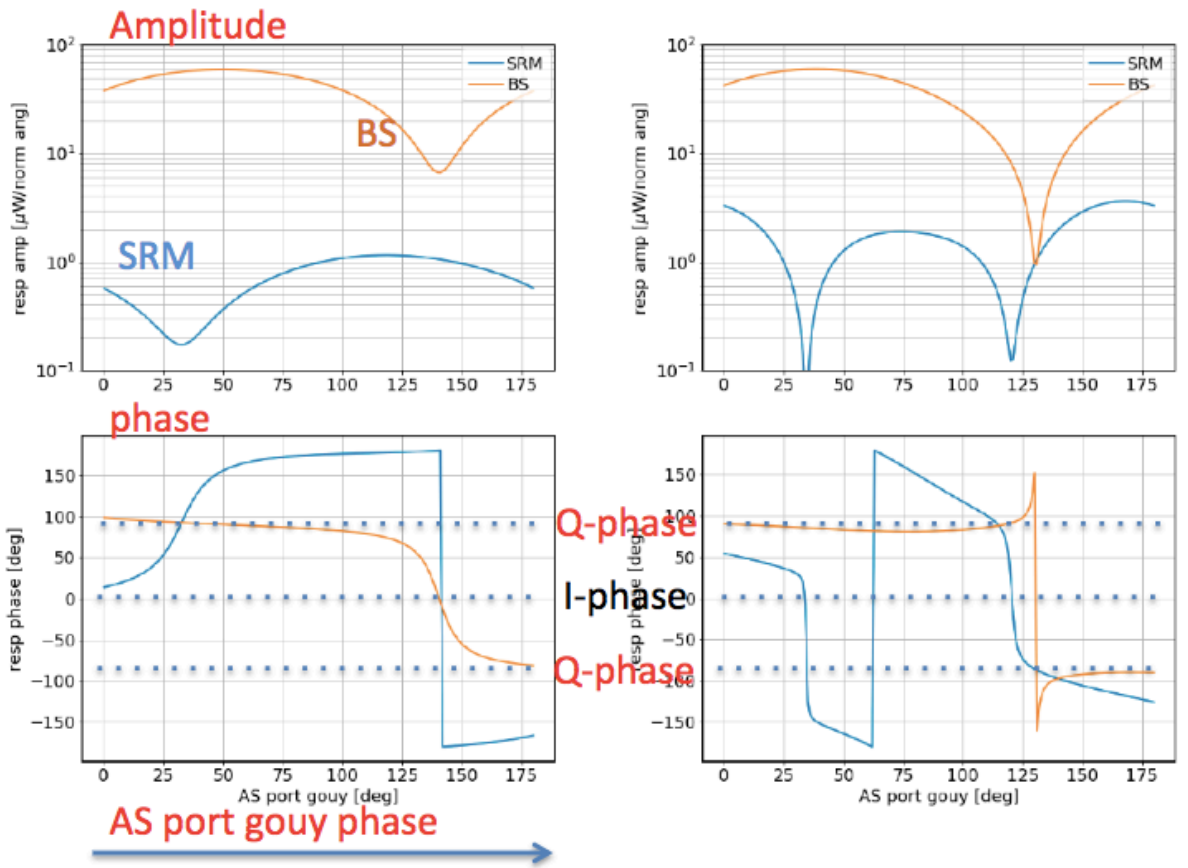
- **aLIGO uses AS36 to control SRM and BS angular d.o.f.**

- **Signal is made by beatnote of HG00(9MHz) and HG10/01(45MHz) for SRM sensing.**

- **SRM sensing matrix evolves as the IFO powers up.**

Contamination in 9MHz

- **The 9MHz SBs at the AS port is sensitive to ITM differential lens.**



(a) Nominal (b) Extra 100km ITMX thermal lens

See G1700603 and G1700973 for more details

Simulated by H. Yu

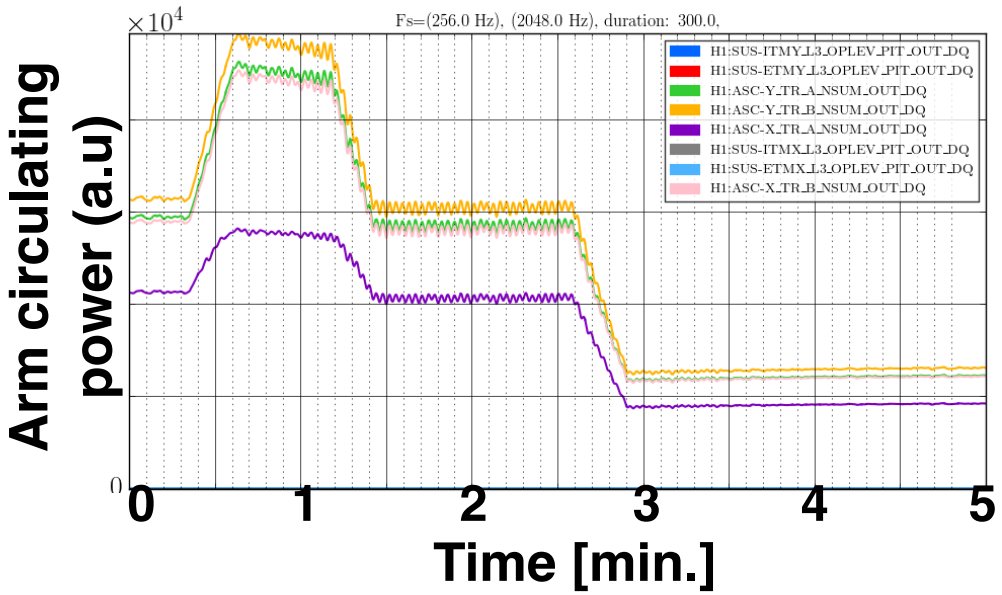
Mitigations

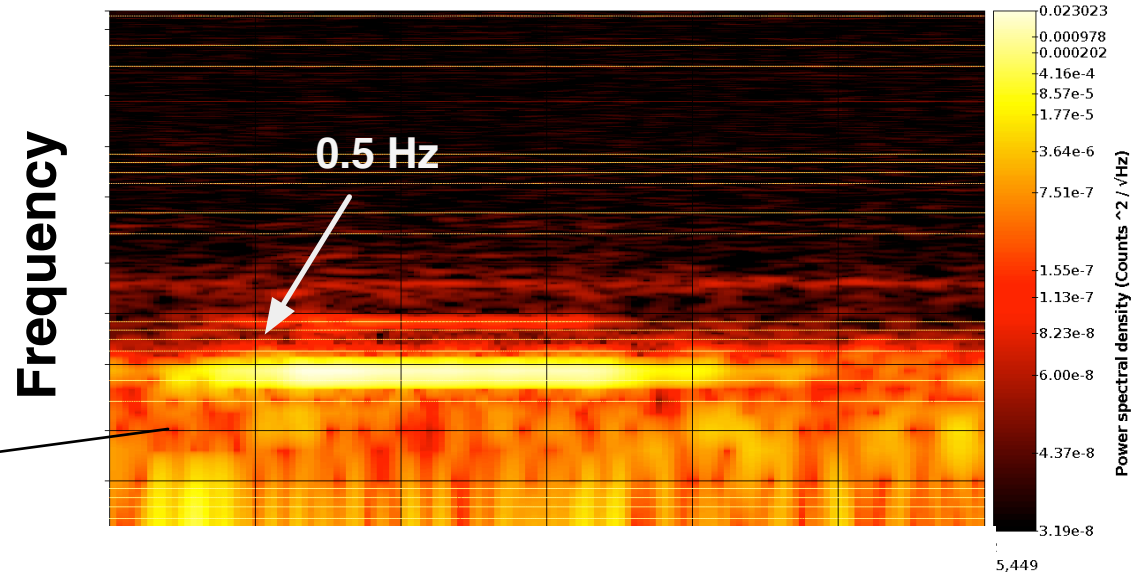
- Add another RF SB at 117 MHz.
- Demodulate signal at 72 MHz (45 - 117 MHz).
- Since the 117 MHz SBs experience lower finesse in DRMI, they are less sensitive to change in mode-matching.
- Test will be performed at some point.

See T1700215 and T1700324 for more details

New rad. press. instability

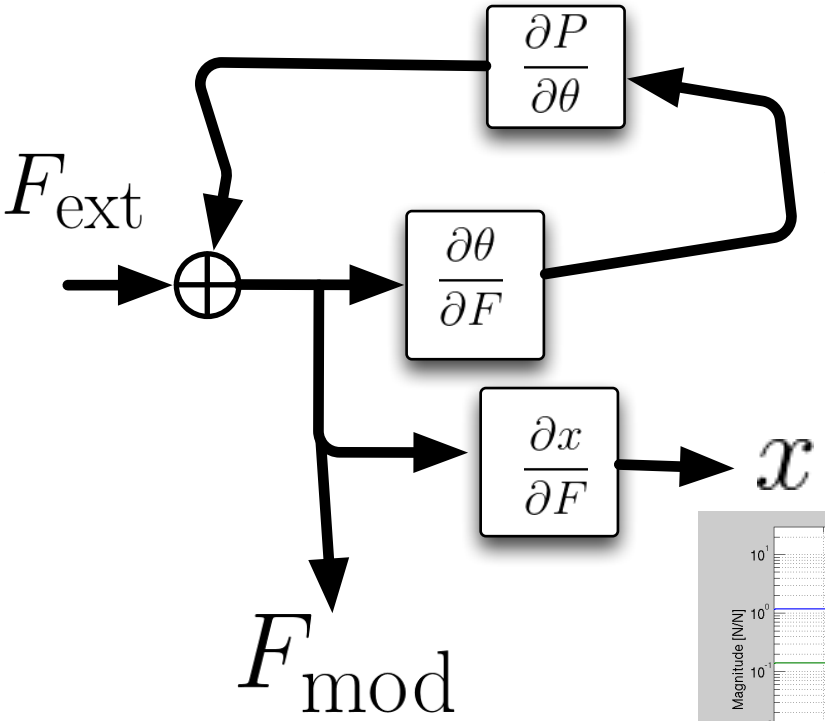
- H1 had been suffering from instability driven by radiation pressure.
- The instability caused lockless many times.





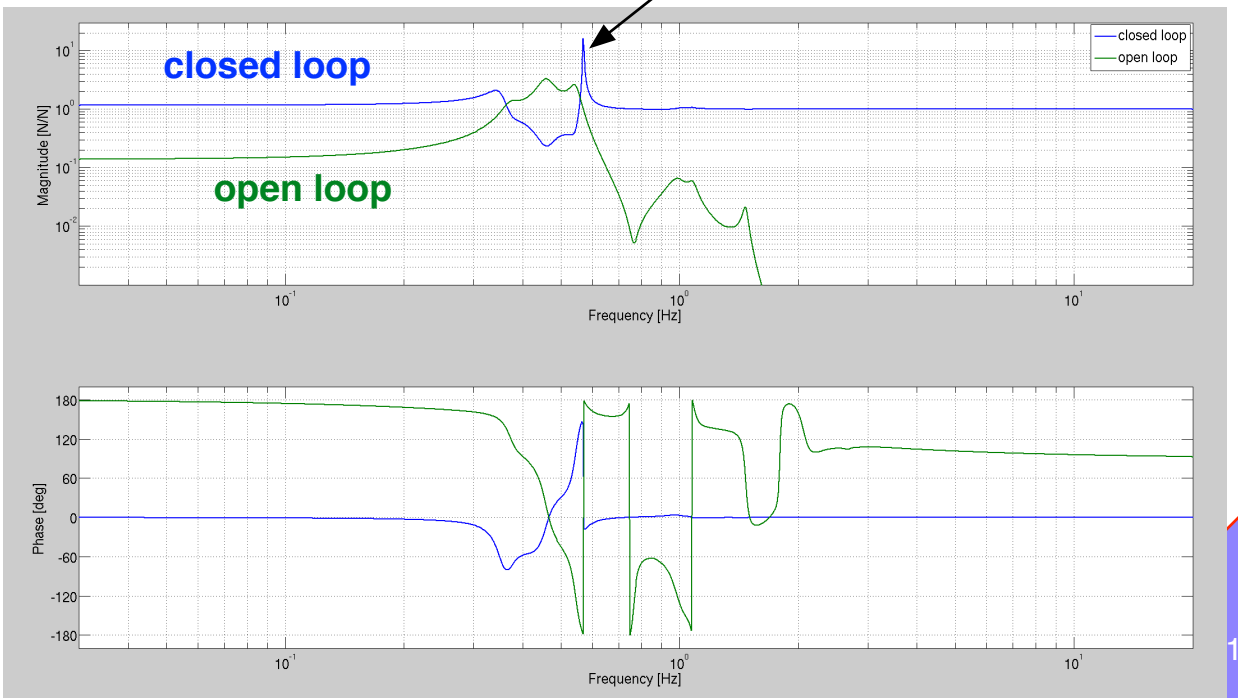
Spectrogram of angle of a test mass (ITMY)

Indeed unstable



spurious feedback loop

Unstable peak @ 0.57 Hz (c.f. measured freq. = 0.53 Hz)



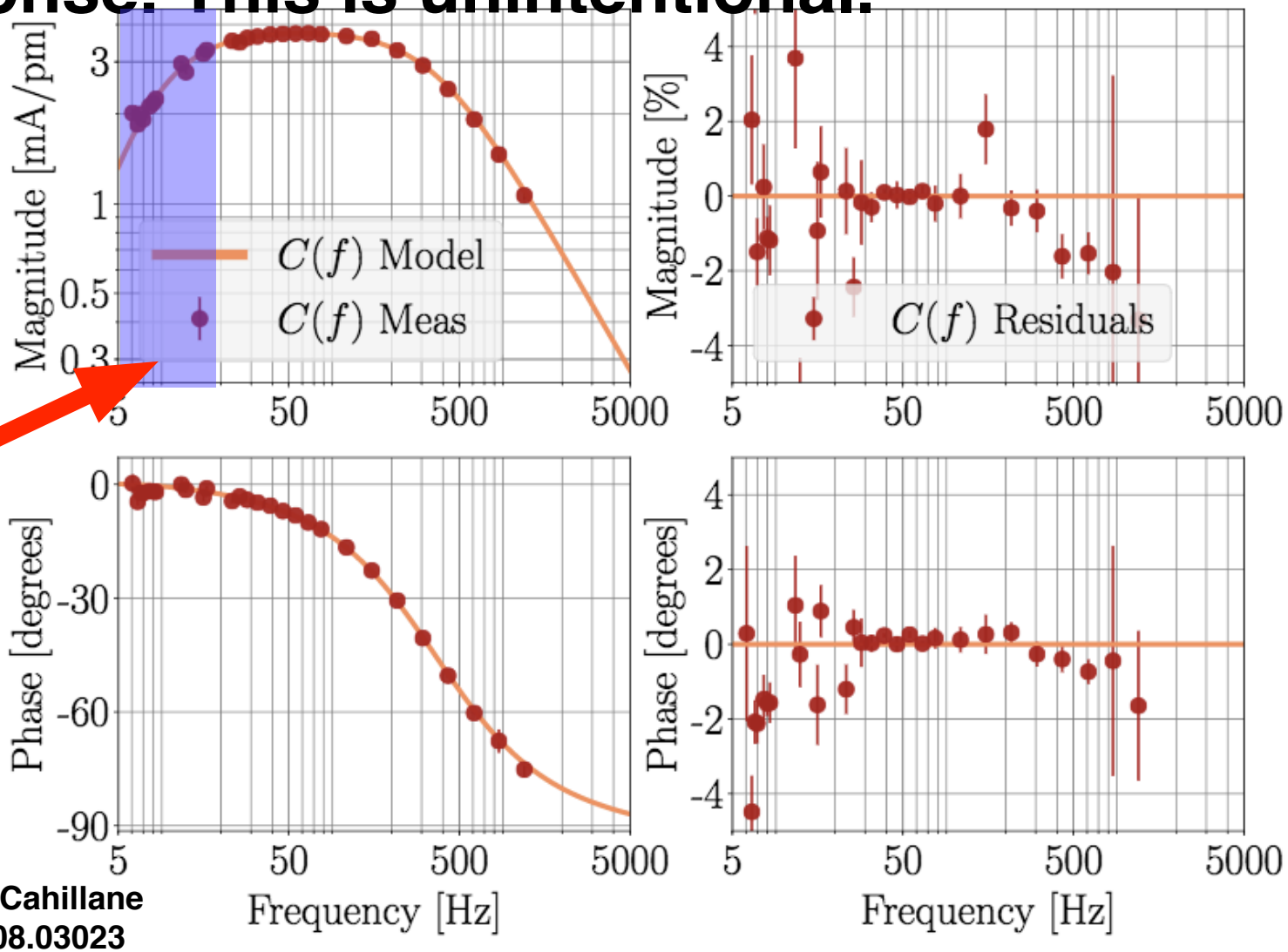
See G1600864

Mitigations

- **Added another ISS loop (called 3rd loop) to stabilize the arm powers.**
- **Increasing ASC loop gains helps too.**
- **Also, bringing the test mass spot positions to a sweet spot helps.**

Unintentional SRC detuning

H1 shows significant SRC detuning in DARM response. This is unintentional.

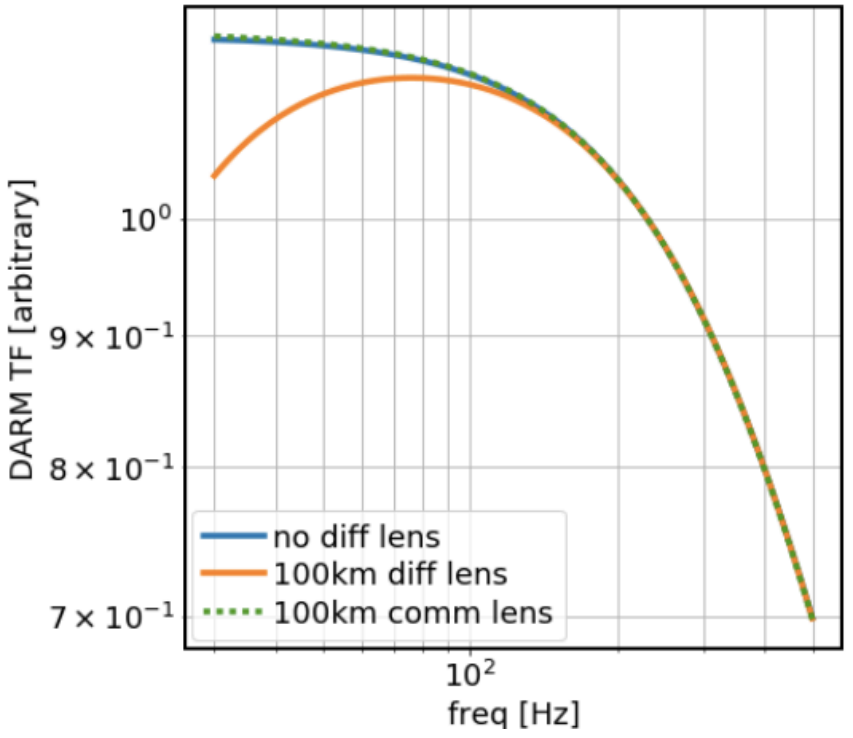


smaller magnitude

Plot by C.Cahillane
arXiv.1708.03023

Diff. lens can be the cause

- **Differential thermal lens on ITMs pulls the operating of SRCL control through POP45(f2). [1]**
- **Similar to the mode hopping issue [2].**



Simulated by H. Yu

[1] G1701584
[2] G1401340

Conclusions

- **There will be unexpected issues no matter what.**
- **We need to be ready for these kinds of nontrivial issues.**

⊗ **Interferometer simulation is the key.**