

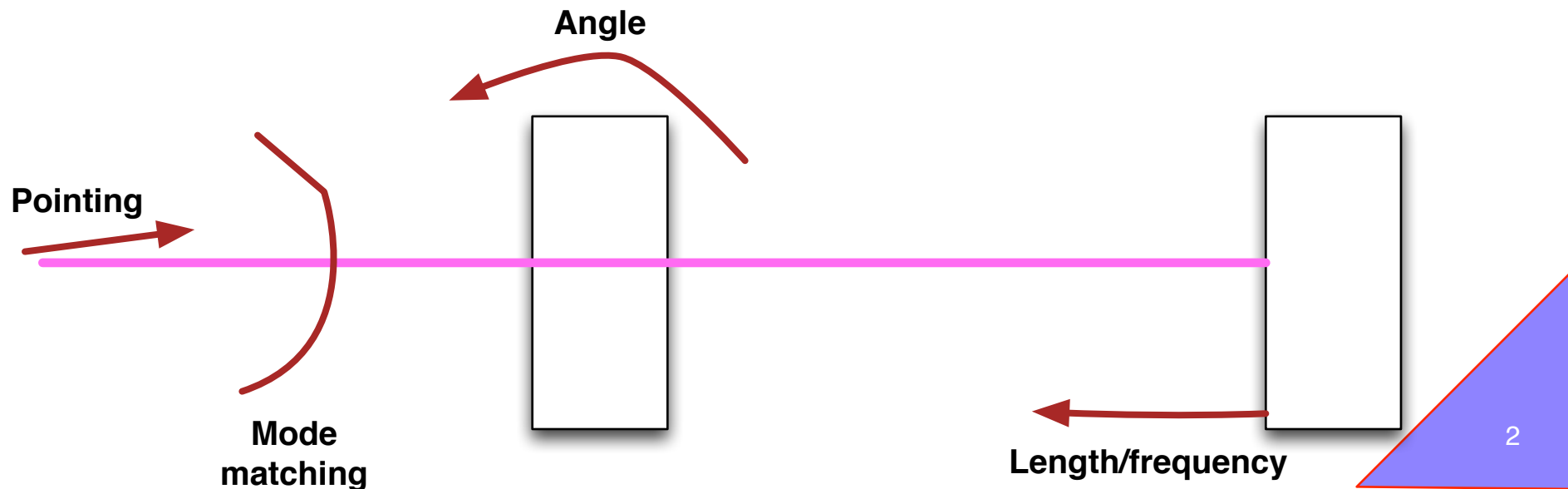
Selected Commissioning Topics



Kiwamu Izumi

This talk

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



Commissioning issues

■ **ALIGO experienced several unexpected (or not-well-thought-through) 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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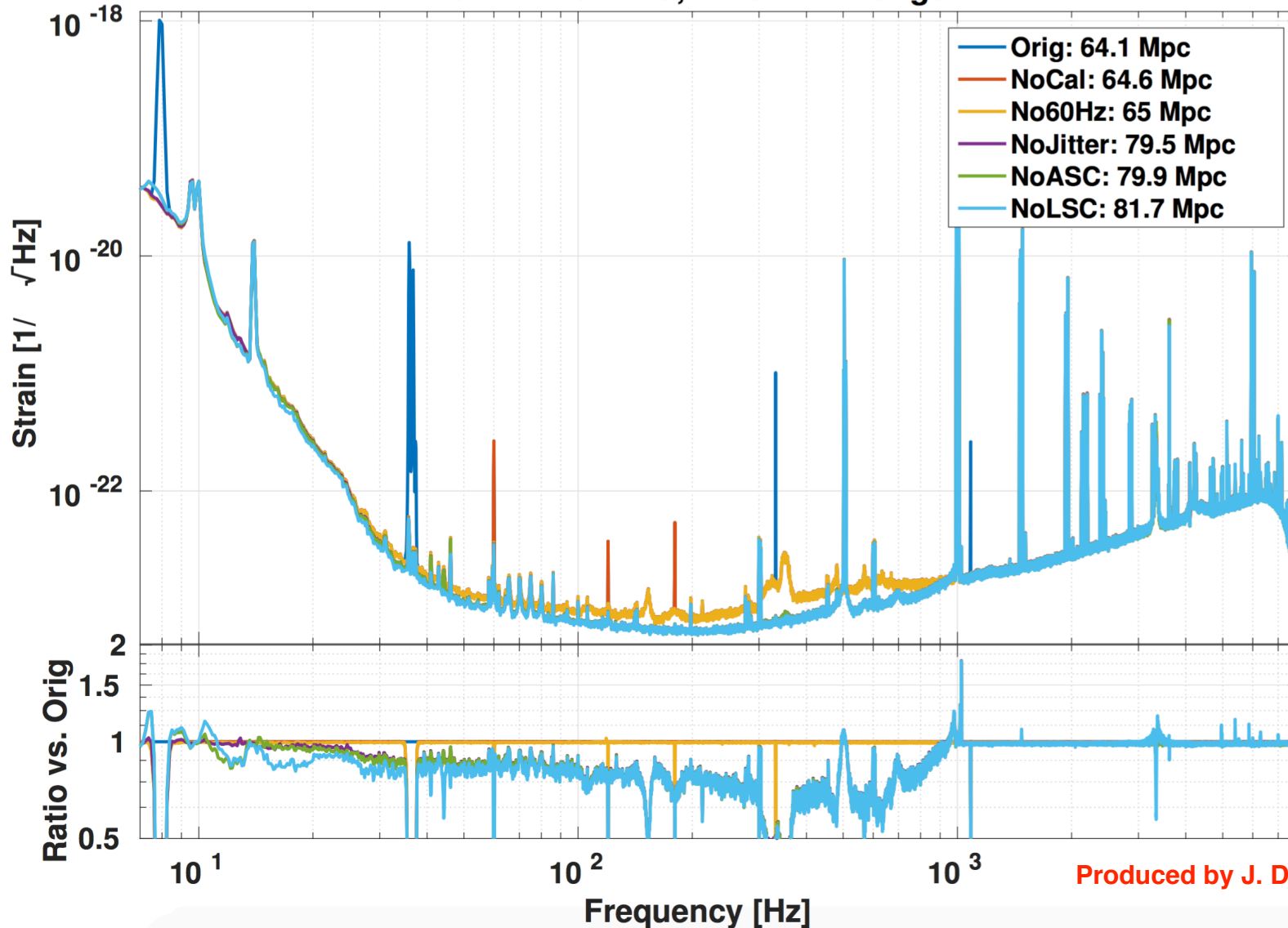
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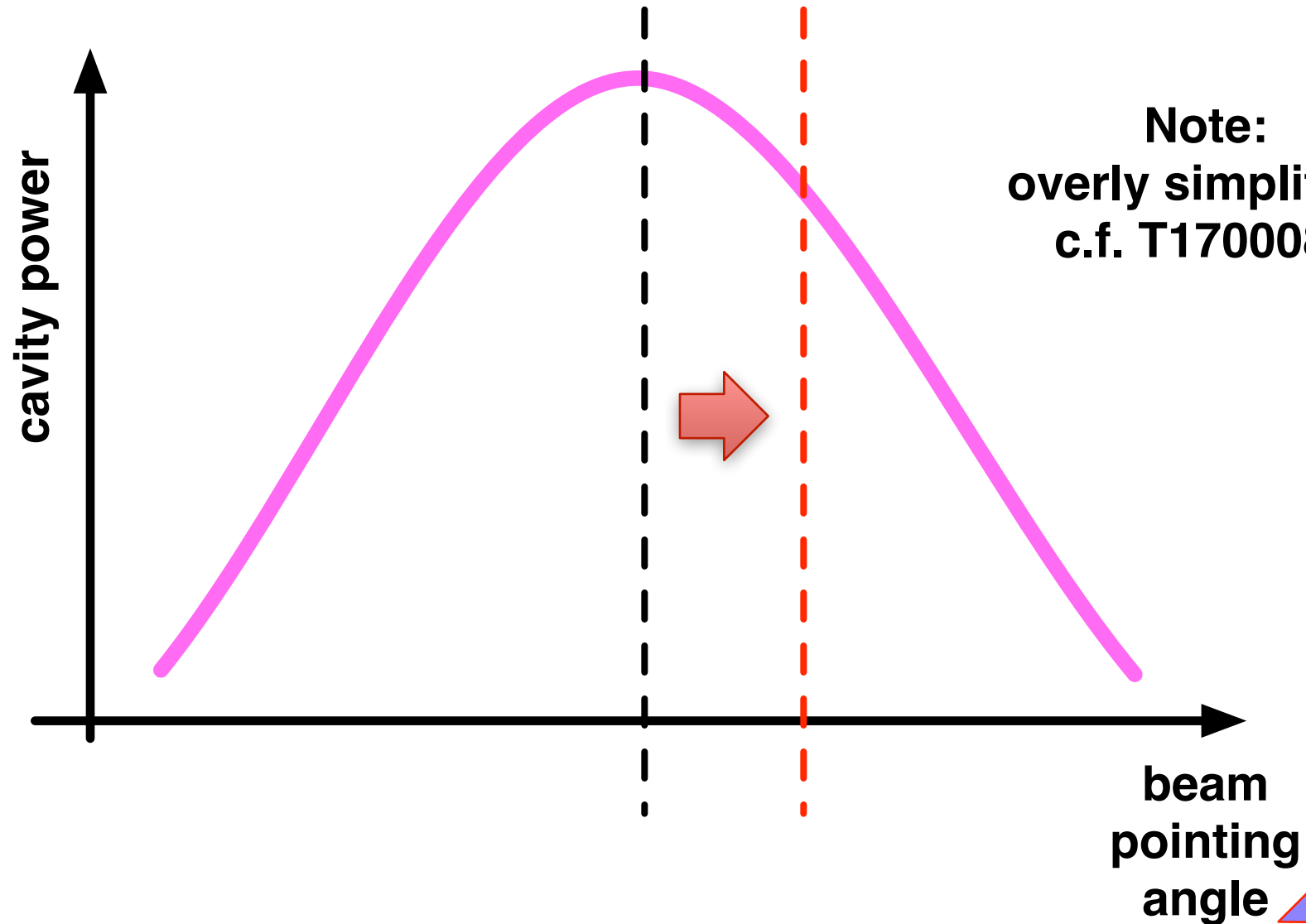
Topics of the day

Pointing jitter coupling

H1 Darm +27% BNS, +24% BBH range

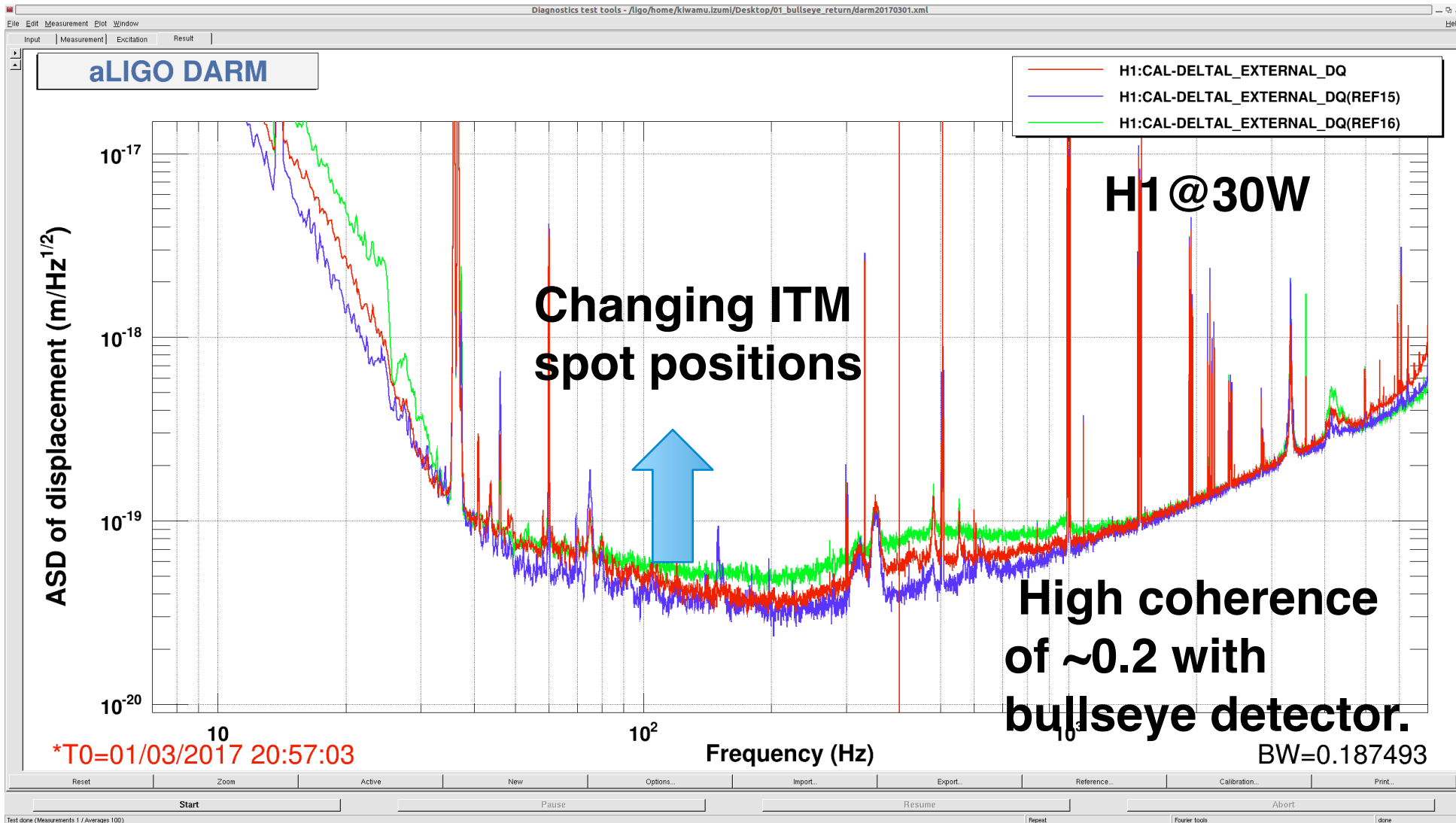


Why does it couple?



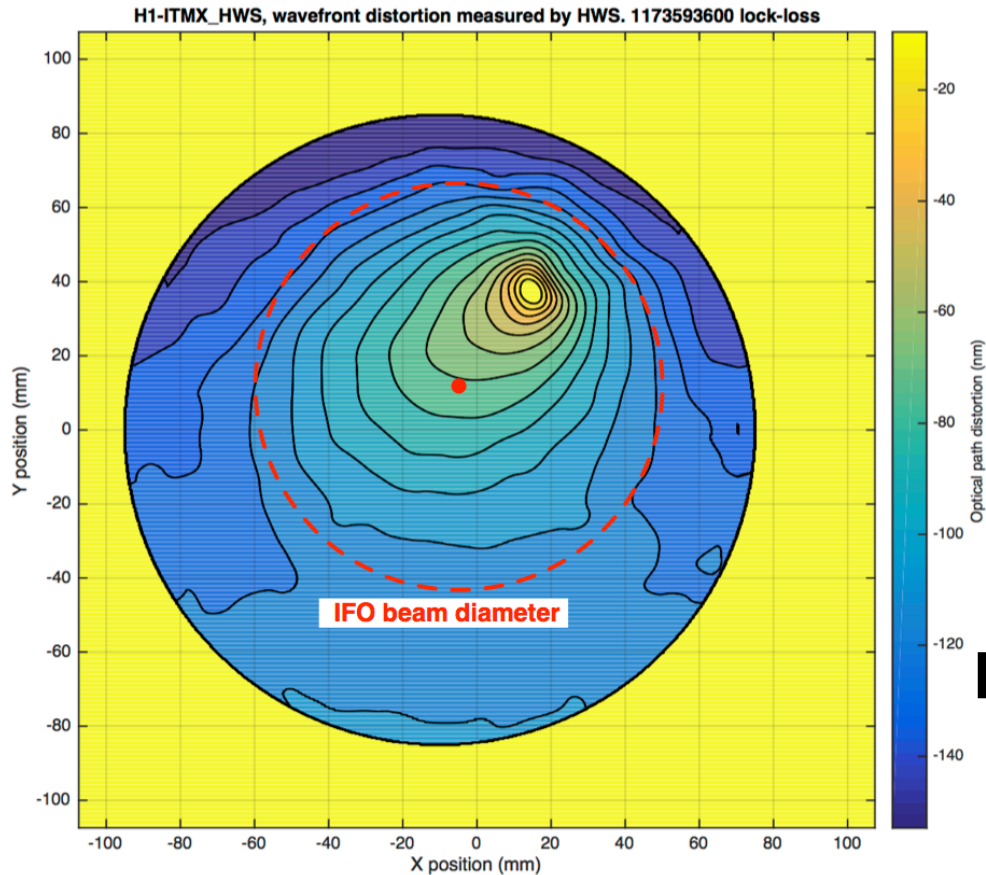
Beam size jitter

 **The same coupling exists.**



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

Mitigations

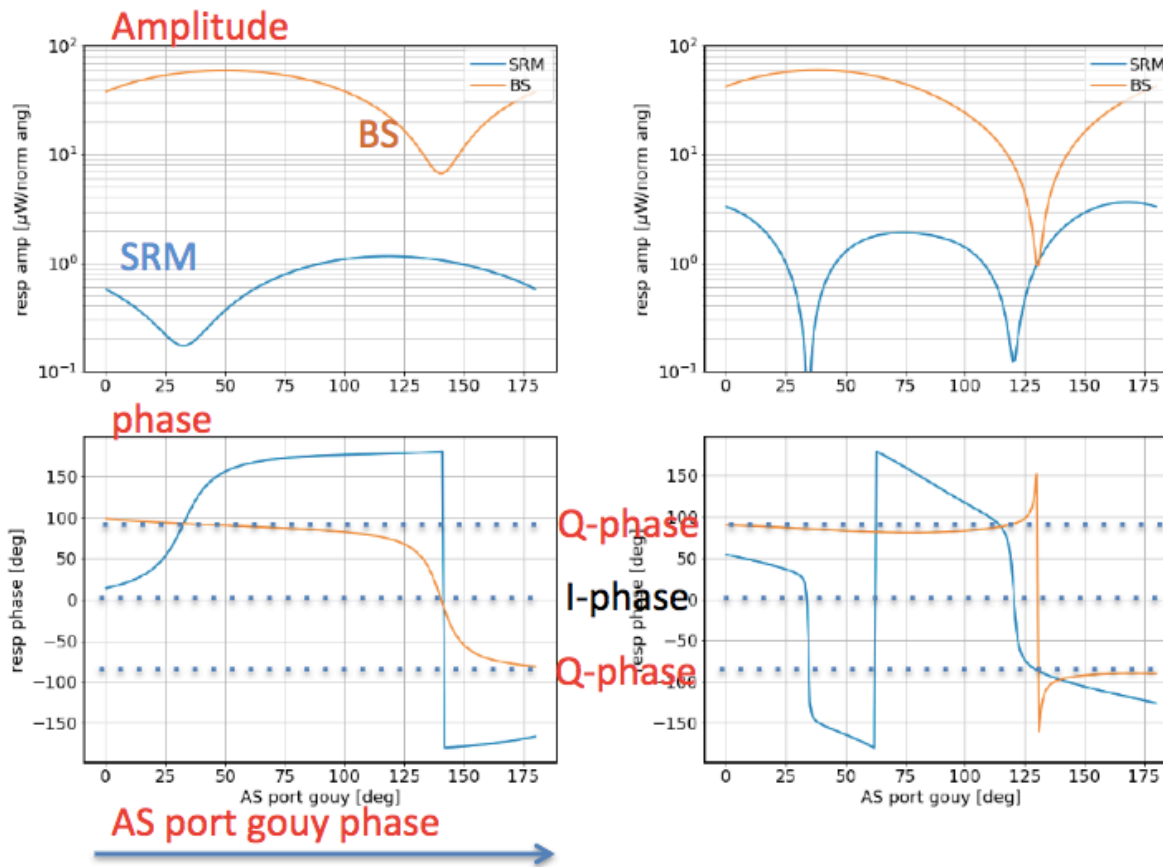
- ▣ **Bring ITMs' beam spots to a point where the coupling minimizes.**
- ▣ **Offline subtraction**
- ▣ **Jitter attenuation cavity(?)**

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

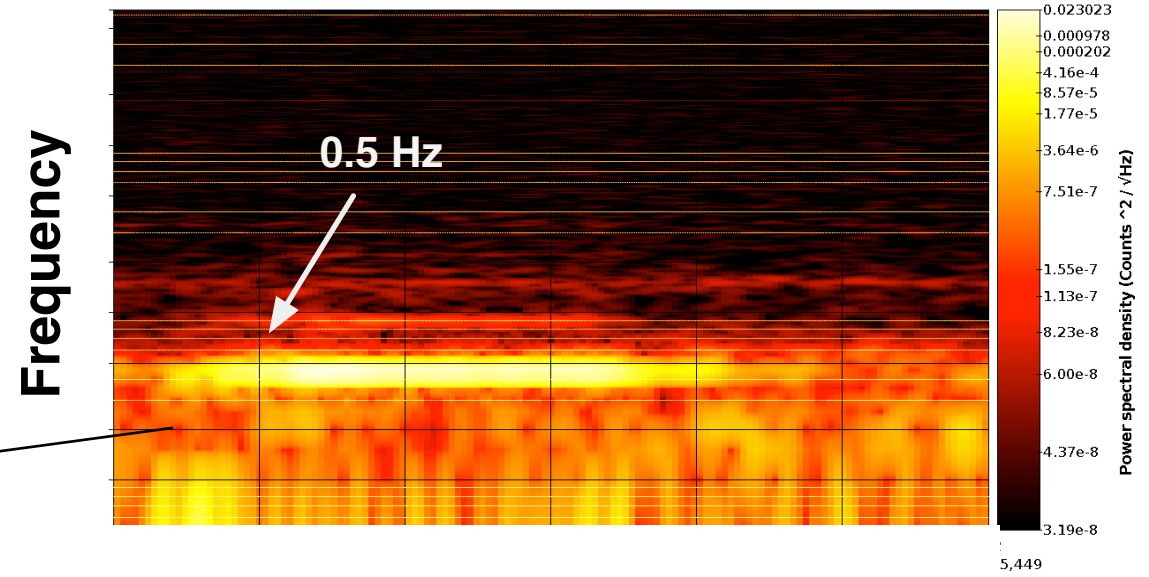
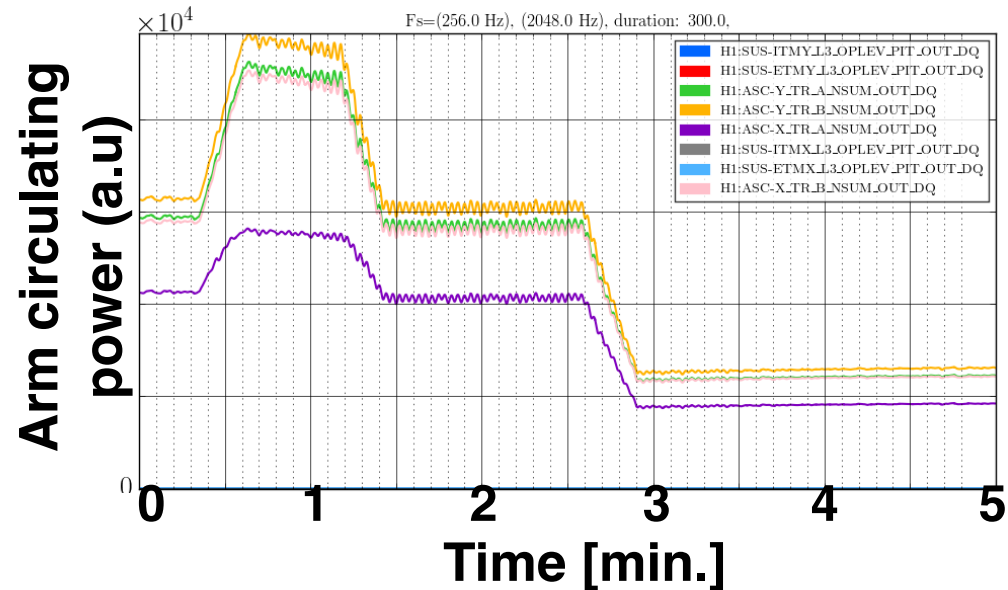
Simulated by H. Yu

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.**

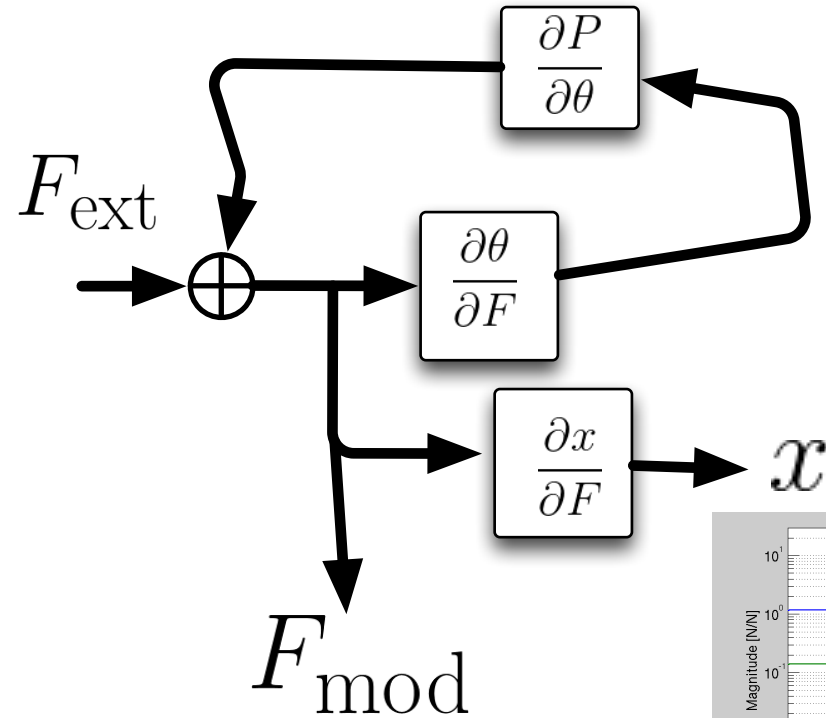
New rad. press. instability

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



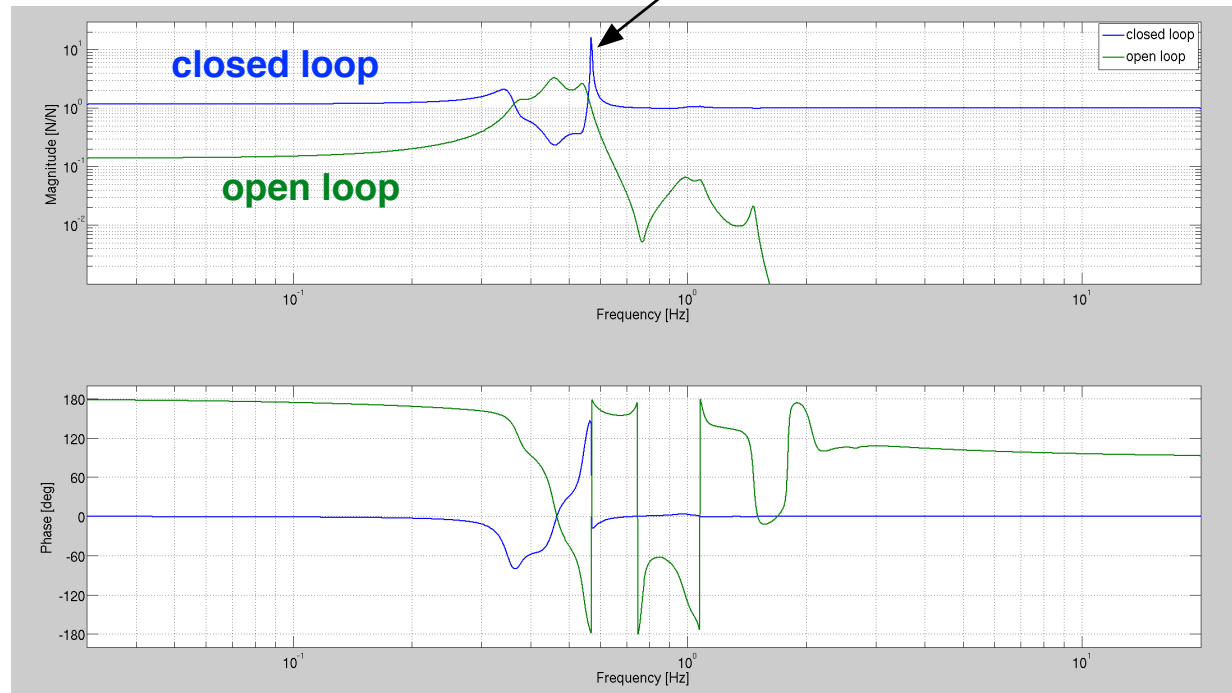
Spectrogram of angle of a test mass (ITMY)

Indeed unstable



spurious feedback loop

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



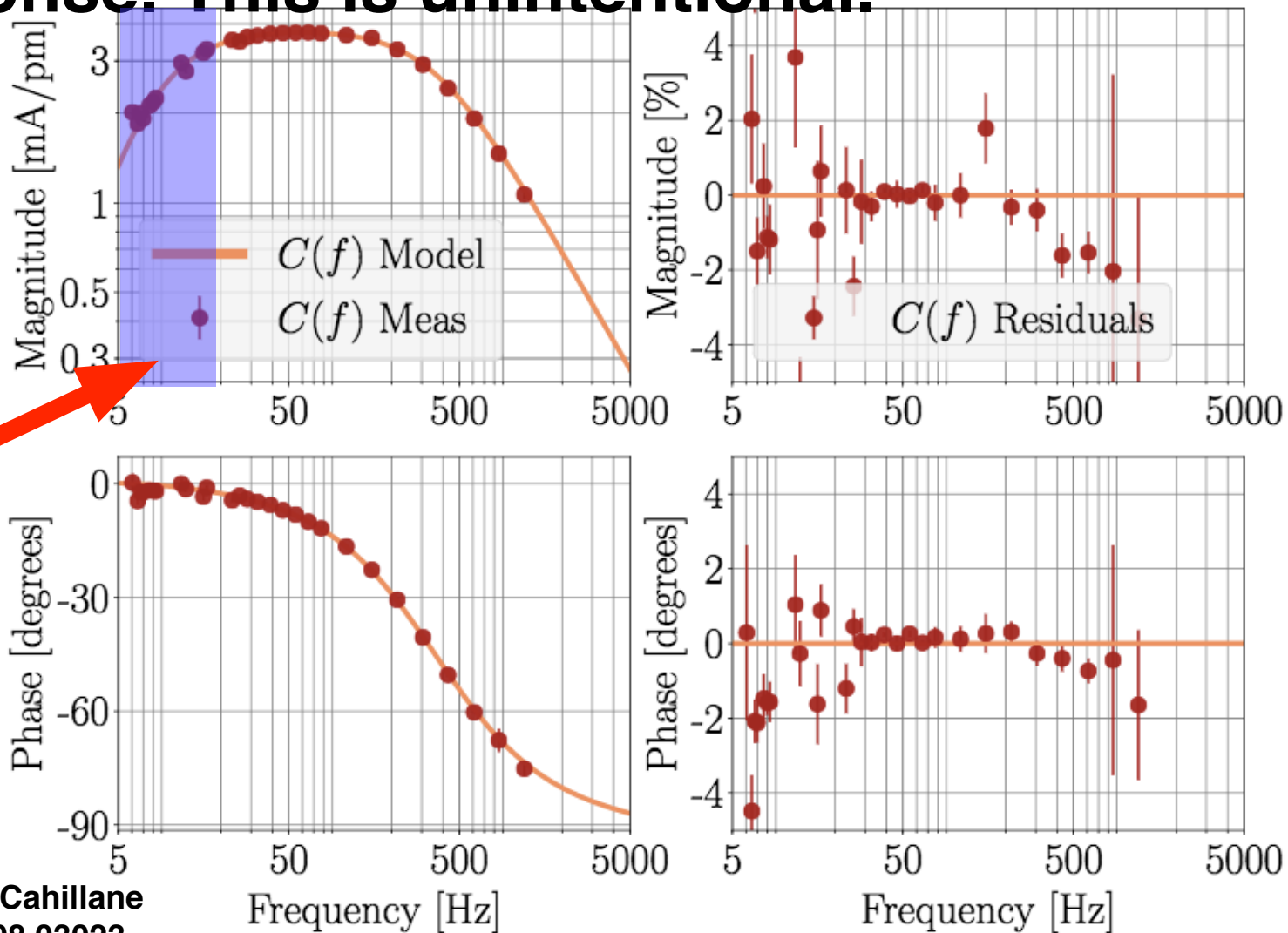
See G1600864

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

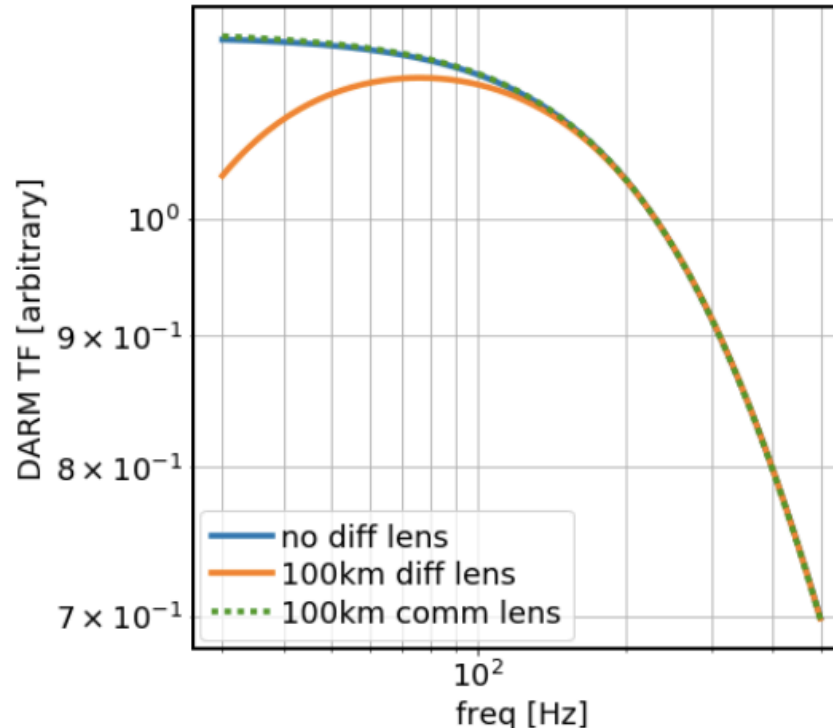
H1 shows significant SRC detuning in DARM response. This is unintentional.



smaller
magnitude

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.**