XGCD June 24, 2024

Presentation by Benno Willke

Slide 5
DaSch: How will the NPRO noise reduction be achieved? BW: Improving power supply to laser pump.
Slide 4
MaEva: Maybe a first cut at eliminating the third question mark would be to use RIN requirements and convert them to equivalent polarization fluctuations.
Slide 8
LiBar: Virgo had problems with fiber lasers and had to revert back? How was this? BW: 2-3 years ago, I said that fiber lasers are not reliable but then saw those being produced and being reliable. Noise in the RF band
MaEva: We tried to build a similar setup at MIT and the folks at Lincoln Lab ran into similar issues. BW: We now seem to have a version that seems robust. Not sure if it will remain robust in the next stage. Fiber lasers are much more efficient.
StBal: How do they compare in terms of damage tolerance? BW: They are more on risk when it comes to contamination. Operating them cleanly with fiber end caps, ours has been operating for over half a year. Surely one needs to learn more about these systems
MiWas: In Virgo, it operated over a year and then some part in the high-power fiber failed. Then it took more than 6 months for the fabricator to fix it. When it came back, in the meantime, the sensitivity of Virgo was improved, we found that the fiber laser was too noisy. Maybe it was connected to noise in the RF band. BW: We see the onset of Brioullin scattering in the MHz band as increased power noise. Maybe that is connected to the RF frequency noise. Needs to be investigated.

LiBar: If CE were up to 400W it would be something like ET, just with one instead of two combinations, right? BW: Yes. This is a good way to look at it.

Presentation by Craig Cahillane
Slide 4
Note: epsilon is the DARM offset.
Slide 6
PeFri: There are no real model predictions for frequency-noise coupling below 100Hz? CC: It could be that frequency noise could impose itself in complex, nonlinear ways. We don't have a good model yet.
PeFri: Is the coupling you see at all a problem? There is a lot of loop gain. Are you running into sensor noise issues? CC: We are running into sensor shot noise limits. We could lower the shot noise a bit. The proper solution forward would be to have a better feedforward to the corner interferometer.
MiWas: At Virgo during O3, we could find what looked like the dominant path for the low-f frequency noise coupling. Frequency noise -> PRC length measurement -> into PRC loop -> into PR mirror -> signal on frequency sensor.
Slide 8
LMcCul: The measured transfer functions have a different slope compared to the model. CC: Between measurements the red coupling seems to agree more than the brown coupling. It

seems to depend on where the dip is, i.e., mixing between two transfer functions. I cannot explain the dips in the low-f part of the green transfer function.
LMcCul: My take-away is that the FF is changing with time and it is going to be very challenging.
MiWas: The UGF in Virgo is at 100kHz. I am surprised that you need to run at a much lower UGF. BeWil: The PSL loop is at 200kHz. The problem must come from the secondary loop.

Reference put in the chat by StBal:
https://opg.optica.org/oe/fulltext.cfm?uri=oe-29-25-42144&id=465617

Presentation by Teng Zhang (Marina Trad Nery for slide 23)
LiBar: About your contrast defect estimates in ET-HF, you assumed a very small contrast defect, 1.4mW. This is lower than what LIGO has now where it is close to twice that with 300kW. You are doing this for 3MW, right? This seems very ambitious to achieve. MiWas: Here the difference comes from a different starting point with Virgo where we measured in O3 120muW contrast defect. Don't know why the contrast defect is so different between LIGO and Virgo.
MiWas: You mentioned photothermal. What is it? TZ: Thermooptic coming from power fluctuations inside arm cavities. It introduces T-fluctuations in the mirror producing strain noise.

LiBar: For CE, some of the work that Teng presented would have to be done still. What are the plans, CC? CC: We have already started using Kiwamu's sideband picture. The semi-analytic stuff is done. This includes some RP effects. They don't come close to what we see today. We have plans to create Finesse models to simulate missing laser-noise couplings, e.g., RIN2FREQ. Some aspects of the problem are hard to model.