

Topologies and Squeezing
Workshop @ GWADW
Tue-We, May 19-20

Organizers: Hartmut Grote, Lisa Barsotti
LIGO-G1500725

Introduction

- ✧ A lot of ideas proposed/tested to reduce quantum noise, with a variety of levels of “realism”
- ✧ Squeezing and input filtering (filter cavity) considered the most plausible options for near term upgrade of advanced detectors
- ➔ see *Enhanced Interferometers* session this afternoon
- ✧ This Workshop: ***where do we go from there?***
(current facilities and new facilities)

Goals

- ✧ **Goal #1:** (re)establish applicability/readiness of quantum noise mitigation techniques to go beyond advanced detector sensitivity, both in **current facilities** and **new facilities**

Workshop Details

✧ Guidelines for speakers:

✧ Is this topology/technology ready to be used in GW detectors 10-20 years from now?

✧ Is this topology/technology particularly useful for a 10-40 km facility?

✧ [Agenda](#)

Tuesday AM, May 19

9:00 - 10:30 **Squeezing now and in the future: the road to 10 dB**

- [K.Dooley/E. Schreiber](#) (25 min talk) focused on losses and control scheme with squeezing injection
- [T. Isogai](#) (25 min talk) focused on input filtering
- Discussion

10:30 - 11:00 Break %%%%

11:00 - 12:30 **“Intra-cavity” filtering**

- Overview ([K. Somiya](#), 25 min)
- White light cavities ([H. Miao](#), 25 min)
- Discussion

Tuesday PM, May 19

4:00 – 5:30 **Output filtering**

- Variational readout ([J. Harms](#), 25 min)
- Output “anti-squeezing” ([G. Cella](#), 25 min)
- Discussion

5:30 – 6:00 **What have we learned today? (All)**

6:00 - 8:00 Posters and reception %%%%

Wednesday AM May 20

9:00 - 10:30 **Opto-mechanical interactions**

- Status and prospects for application in GW detectors
(A. Libson/T. Corbitt, 30-45 min)
- Discussion

10:30 - 11:00 Break %%%%

11:00 - 12:30 More Posters Session %%%%

Wednesday PM May 20

4:00 - 5:30 **Topologies**

- Speed-meter (S. Danlishin, 25-30 min)
- Discussion
- Round table: Topology study for new facilities
(D. McClelland, D. Sigg, S. Hild, M. Evans, S. Ballmer, H. Lueck)

5:30 - 6:00 Break %%%%

6:00 - 7:00 TBD, based on inputs from previous sessions

Goals

- ✧ **Goal #1:** (re)establish applicability/readiness of quantum noise mitigation techniques to go beyond advanced detector sensitivity, both in **current facilities** and **new facilities**
- ✧ **Goal #2:** (re)evaluate these options in the broader context of the “science” we want/need to do, and the necessary R&D

Philosophical Slide



- ✧ Asking ourselves the right questions is sometimes more important than finding the right answers
- ✧ “Right” questions (and “right” answers) change over time
- ✧ What we perceives as “feasible” and “realistic” also changes over time (thanks to experimental results, better models, etc)

There is nothing permanent except change - Heraclitus

Some examples:

near term future “post first-detection” (discussion @ “What’s next for LIGO?” workshop)

Questions inspired by Rai Weiss: “What’s going on with signal recycling detuning for aLIGO? You can’t just remove it from your slides and pretend no one noticed it...what if we need to track a source at 1 kHz?”

→ Shall we revise the option of signal recycling detuning, in the context of having squeezed light, for current detectors?
(Not a new question ... time to re-look at it?)

→ Can a combination of squeezed light, signal recycling detuning, and homodyne detection phase be helpful to react to some pressing needs that advanced detectors might face (like: maximize Binary Neutron Star range, maximize high frequency sensitivity in the 1-4 kHz region)?

Some examples:

Topologies for new detectors

- ✧ Extensive ET design study (2011)
- ✧ Speed-meter topology identified as the most promising of all techniques for quantum noise reduction (beyond squeezing + filter cavities) to be explored in the R&D phase
- ✧ R&D indeed on-going!
- ✧ Recent paper:
 - “We show that Sagnac interferometer has superior potential for broadband sensitivity gain compared to Michelson interferometer for any given set of advanced interferometric techniques [..]”*
- ✧ Shall we re-evaluate this and maybe other topologies in the context of a 10-40 km facility?
 - ➔ round table discussion Wed afternoon

Some examples:

How is the design of future detectors going to be impacted by the first few detections?

What are the “right” questions?

✧ [Wiki](#) : supporting material, forum for discussion