Definitions for the DRMI commissioning

JGW-T1909573-v1

created: 2019, Jan. 14th

Yutaro Enomoto, Yuta Michimura and Kiwamu Izumi

Contents

1 Purposes of the commissioning test

The Dual-Recycled Michelson Interferometer (DRMI) is one of the critical building blocks for running the full KAGRA interferometer. The main purposes of the DRMI commissioning are (1) to demonstrate that a resonance of the DRMI can be robustly acquired by applying a digital feedback control system, and also (2) to demonstrate that the DRMI can reproduce almost the same alignment condition sufficient to proceed with the subsequent full lock sequence.

2 Goals of the commissioning test

The below shows a list of goals that we are aiming to achieve during the DRMI commissioning period. They are listed in the order of the importance – the very top item has the highest priority. The derivations and reasoning for the quantities are described in section 4 in great detail.

1. Achieving simultaneous lock of all three length degrees of freedom in the DRMI and keeping it on the resonance **for a duration longer than 30 minutes continuously** using the standard Pound-Drever-Hall and Schnupp readout schemes using the f1 and f2 sidebands.

2. Development and implementation of an initial alignment process that can be performed on a daily basis to maintain the same alignment condition. Every time after this process, the interferometer alignment must be good enough so that **the DRMI acquires lock within a waiting time of 10 minutes**.

3. Engagement of the wavefront sensors to globally control all the mirrors' alignment **for a duration of 2 hours continuously**. This includes the input beam pointing to the DRMI. **We do not make specific requirement values for the residual angular fluctuations**.

4. Handing the length-sensing signals from the standard demodulation signals over to a set of the third harmonic demodulation signals. The lock must be held for **longer than 30 minutes continuously** after the hand-over.

5. Full automation of the acquisition and initial alignment processes.

6. Production of the calibrated- and unsuppressed- displacement monitor channels for all three length degrees of freedom in the digital system.

7. (OPTIONAL) Control of the Michelson degree of freedom in the carrier-resonant power recycled Michelson interferometer.

3 Parameters to be measured

We will measure several key parameters. The parameters are divided into two different categories; the primary and optional parameters. The primary ones are those we must measure while the optional are those we may measure depending on the progress in the commissioning activities.

3.1 Primary parameters

- Power recycling gains for the sidebands at f1 and f2.

- Sensing matrix for the length signals including the standard demodulation and the third harmonic demodulation signals.
- Power recycling gains for the carrier light by locking the power-recycled Michelson interferometer (PRMI) for the carrier.
- Power recycling cavity length by locking the PRMI on the carrier and sideband at a time [1].
- Sensing matrix for the angular sensing.

3.2 Optional parameters

- The size of the Schnupp asymmetry
- The signal-recycling cavity length although we need to come up with an idea to measure this quantity.

4 Some derivations

4.1 Requirements on Length Fluctuations

TBW.

4.2 Requirements on optical lengths

PRC, SRC and Schnupp — TBW.

References

[1] A. Effler et al., some documents exist?