

# Development of an RSE Interferometer Using the Third Harmonic Demodulation

LSC  
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**National Astronomical Observatory of Japan**

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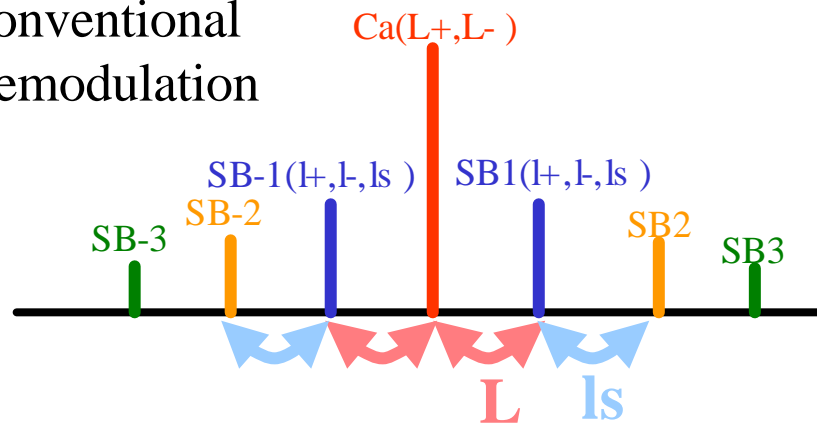
**K.Somiya, and G.Heinzel**

LIGO-G010167-00-Z

# Signal Extraction of $I_s$

## Using the Third Harmonic Demodulation

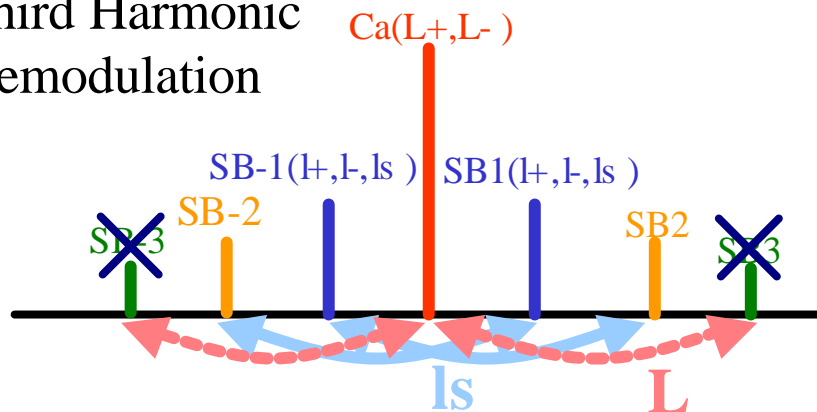
Conventional Demodulation



$I_s$ : Obtained from beat between  $SB1$  and  $SB2$

- Large signal mixture by  $L$

Third Harmonic Demodulation

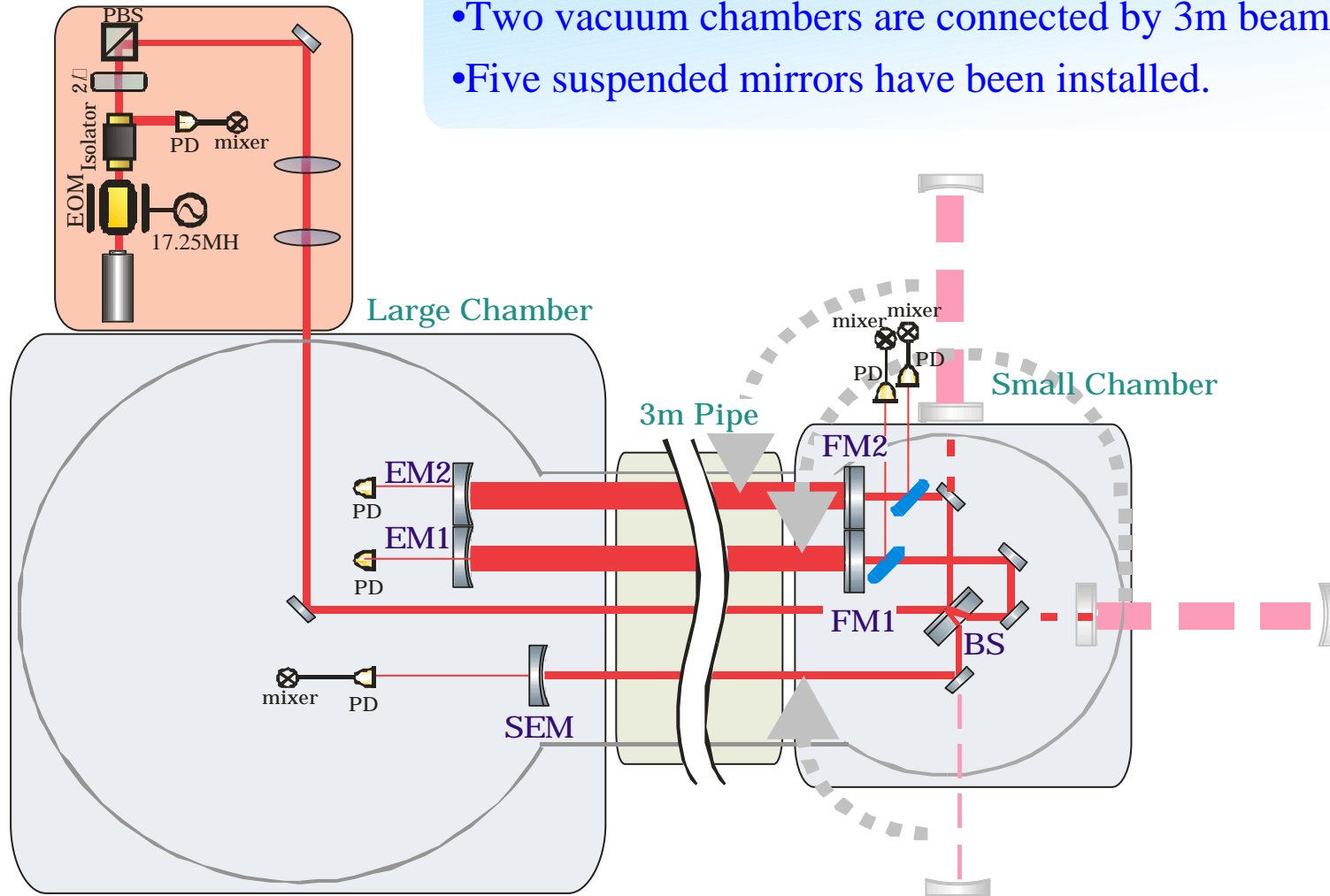


$I_s$ : Obtained from beat between  $SB1$  and  $SB-2$

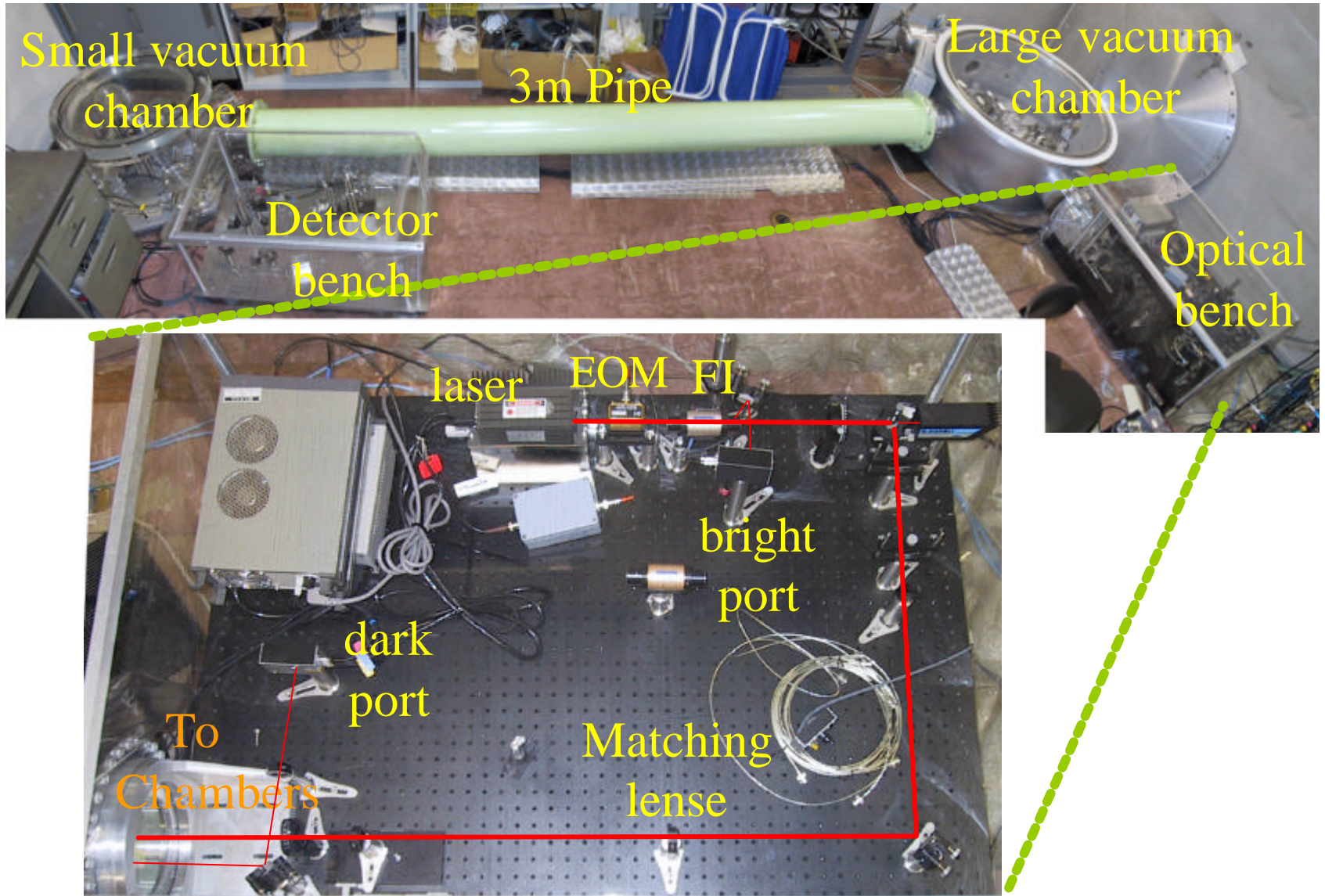
- $L$ : from beat between  $Ca$  and  $SB3$  (already smaller)
- $L$  will vanish if  $SB3=0$

# Experimental Setup

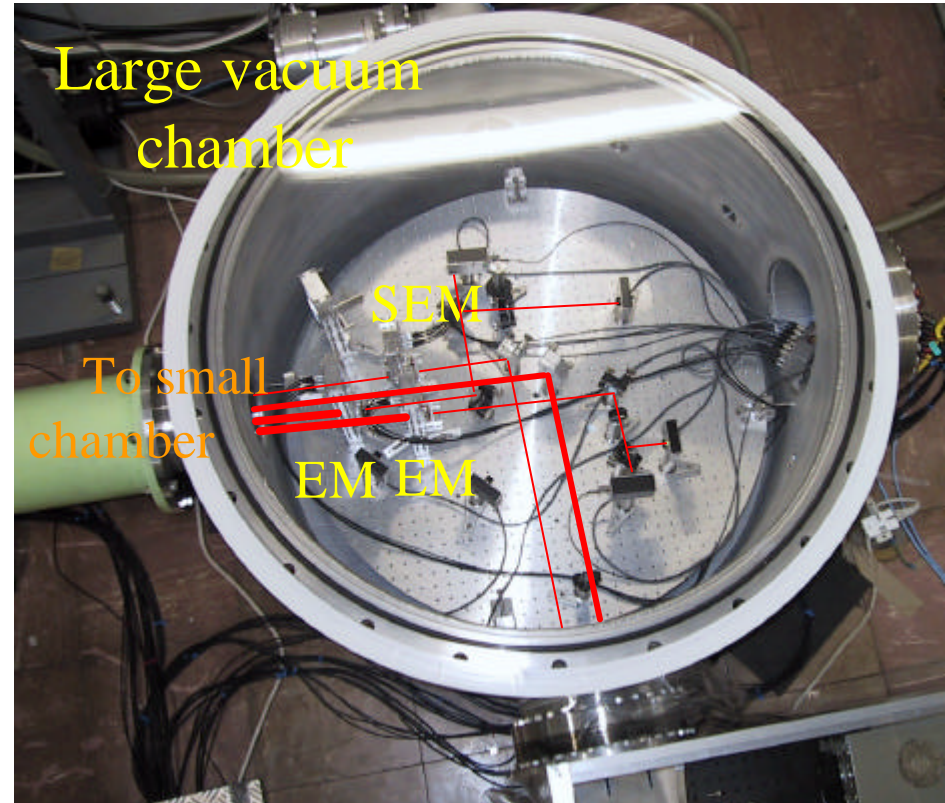
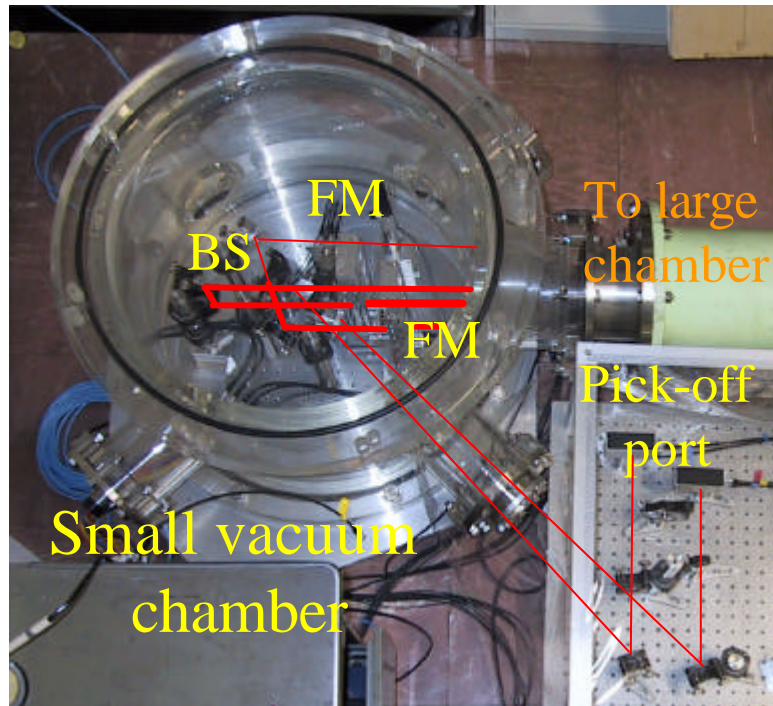
500mW Nd:YAG Laser



# Experimental setup of RSE

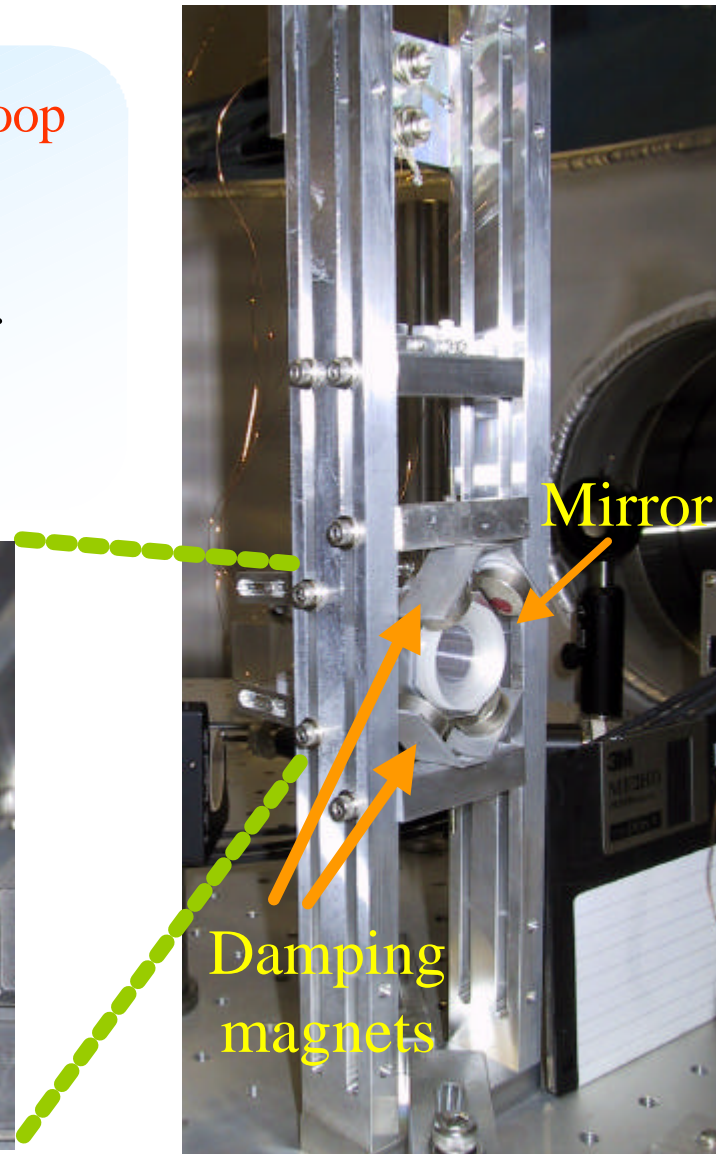
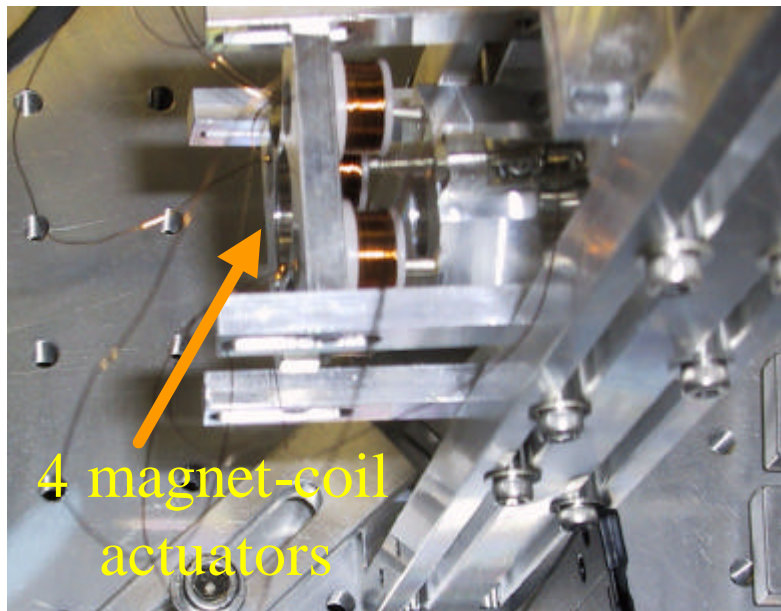


# Experimental setup of RSE

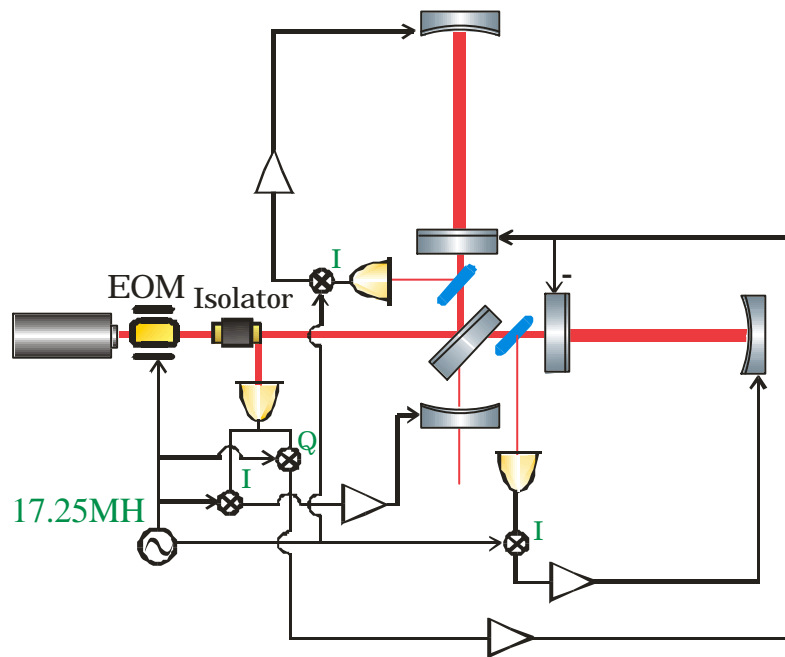


## Small Suspension System

- 1 inch mirror is suspended by **one loop wire**.
- Mirror **position** and **orientation** are controlled by **4 coil-magnet actuators**.
- Pendulum motion of the mirror is damped by **eddy-current damping**.



# Lock of RSE using 1<sup>st</sup> order Demodulation



FP cavity(L1,L2)

Michelson(I-)

SEC(Is)

pick-off

Bright port Q phase

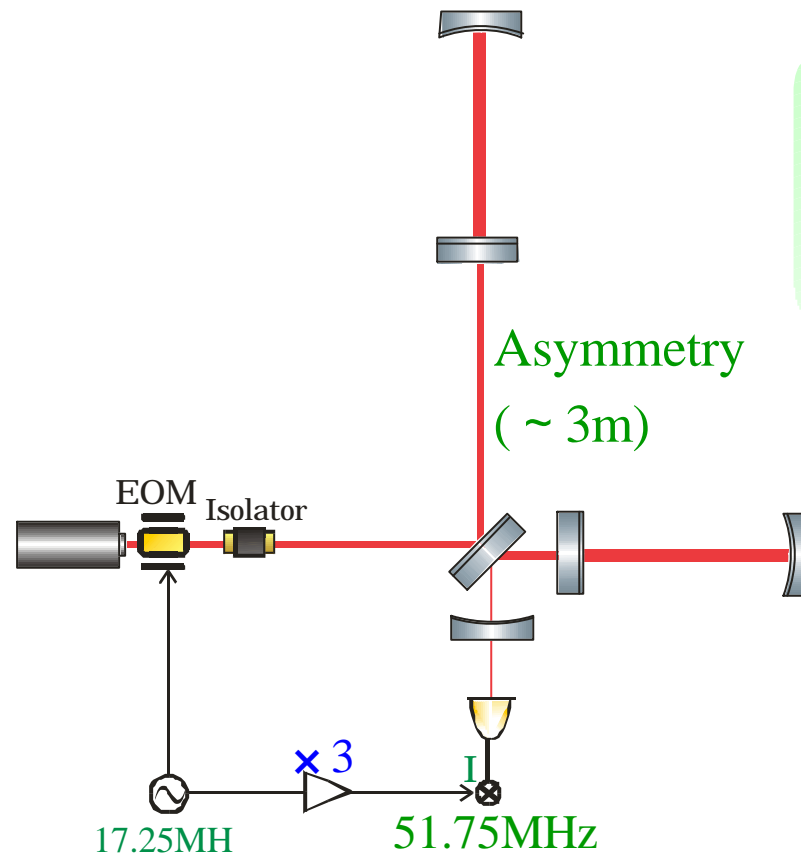
Brigh port I phase

**Successfully locked !**

(But lock holding time <10 seconds

Because of the L- signal mixture)

## Configuration for 3<sup>rd</sup> order sideband method



Asymmetry of 3m is necessary to make 3<sup>rd</sup> order sideband disappear at detection port

**The configuration change: underway**



## Summary

- Suspended RSE interferometer using 1<sup>st</sup> order demodulation: Successfully locked
- Implementation of the 3rd harmonic demodulation method: Underway

## Future Plan

- Lock with L+ L- control
- Detuned RSE
- Move the system into a larger vacuum system