3) Current Status & Plan for Japan RSE

-- Stabilization and Installation of PRC & Detuning --

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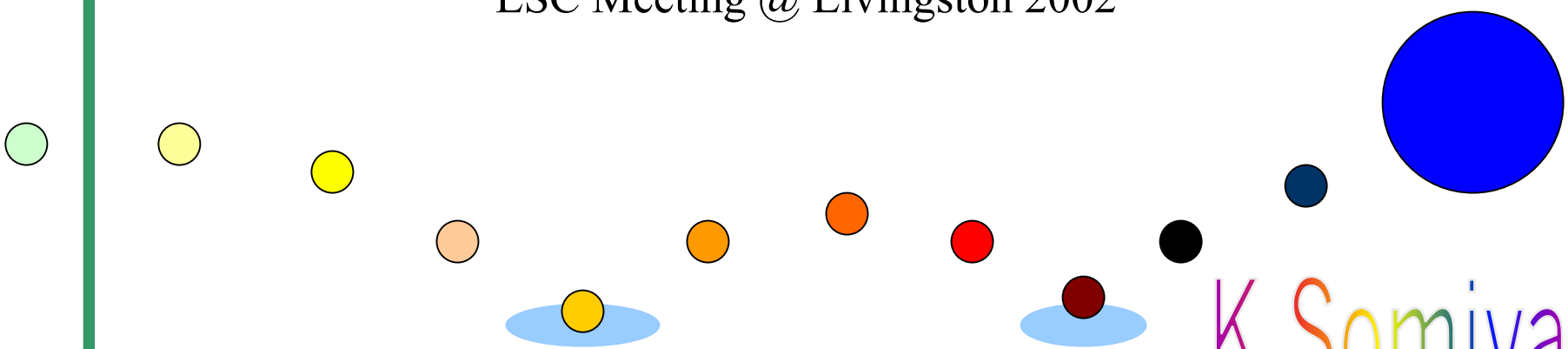
LSC Meeting @ Livingston 2002



LIGO-G020091-00-Z

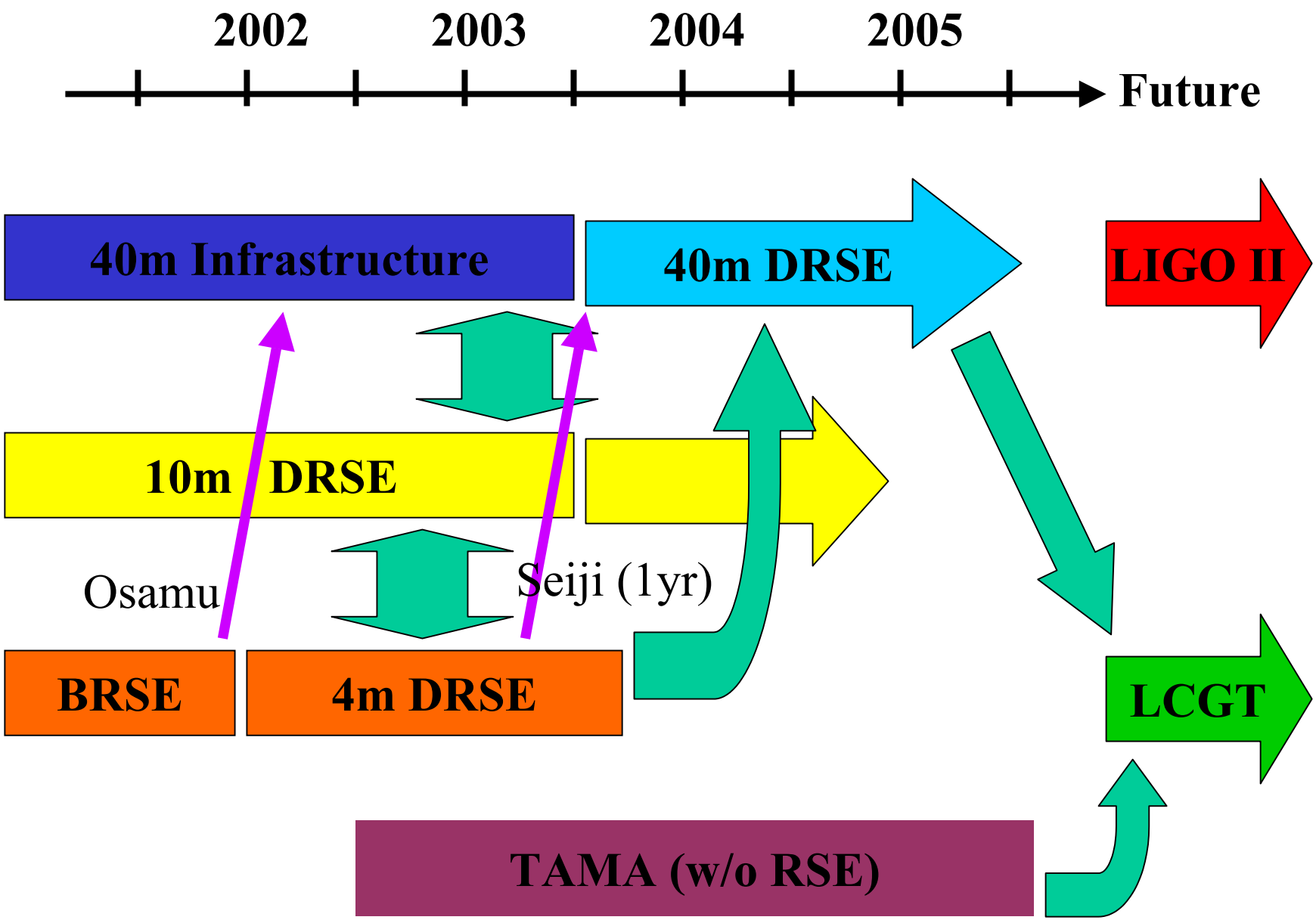
Roles for 3 prototype RSE

- Caltech 40m : Science
- Glasgow 10m : Engineering
- Japan 4m RSE : **Development**
  (With Engineering Support)

Example : One modulation control,
One modulation detuning,
WFS for RSE, USB detection,
Lock acquisition using polarization,
Sweeping, DC readout scheme, , , etc.

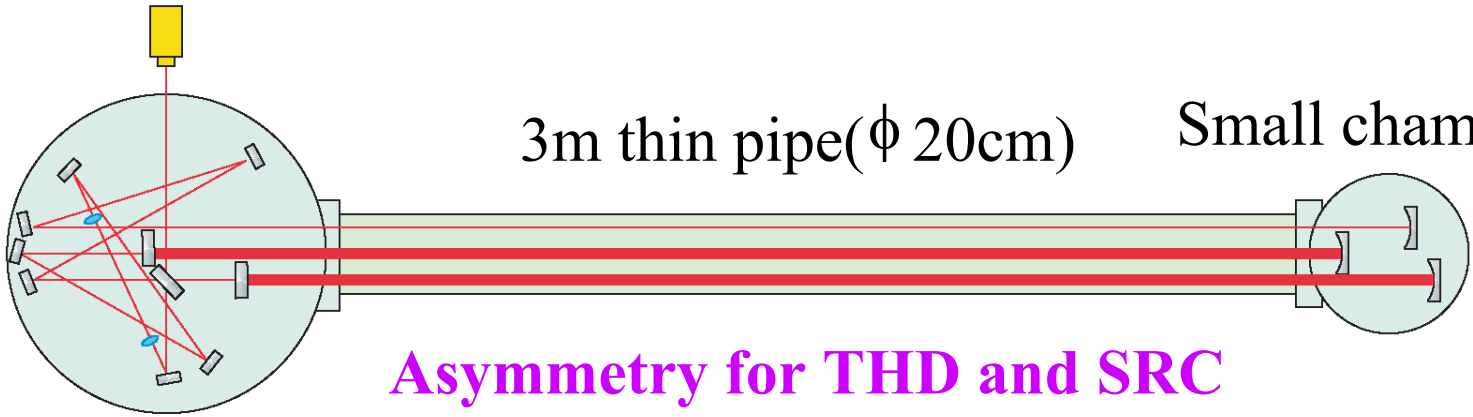
We can try any new challenges for advanced IFO.

Calendars

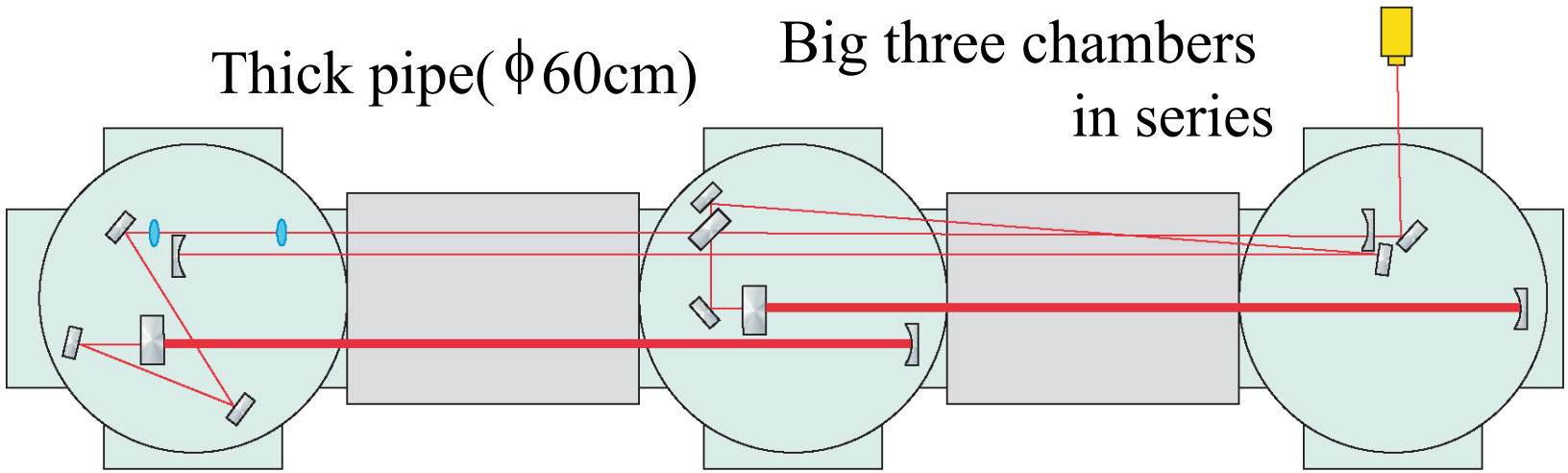

2002
2003
2004
2005
Future
40m Infrastructure
40m DRSE
LIGO II
10m DRSE
Osamu
Seiji (1yr)
BRSE
4m DRSE
LCGT
TAMA (w/o RSE)

We moved to a bigger room,
building a new vacuum system.

Comparison with previous 4m RSE



Asymmetry for THD and SRC for detuning are both less than 3m…



This new system allows us various configuration!

Plan

1. Interferometer Stabilization
2. Power Recycling
3. Detuning

…etc.

Plan (1) : Interferometer Stabilization

1-1) **Suspension Improvement**

- Decrease Q factor of pitch & yaw,
- Negative resistance damping is one way.

1-2)**Servo Improvement**

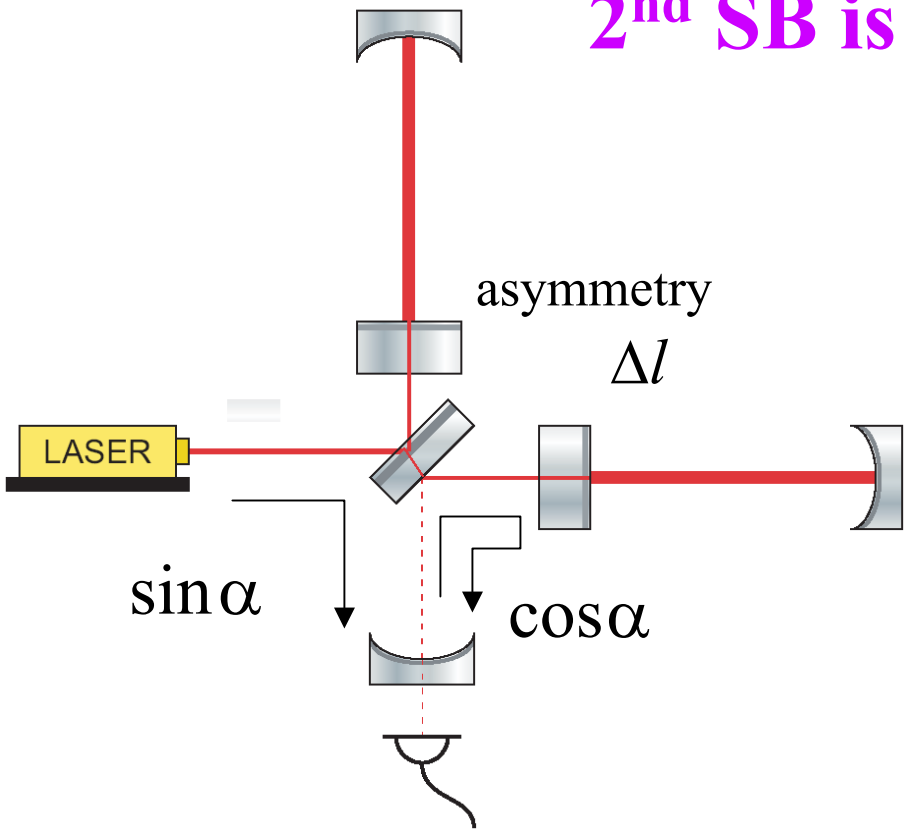
- Increase DC gain.

1-3)**Reduction of the Big Asymmetry**

- I will explain the reason and a way to do.

Why the asymmetry is to be reduced?

2nd SB is anti-resonant in RSEC.



- **FSR for RSEC is equivalent to the modulation frequency.**
- **Carrier becomes anti-resonant as it resonate on the arms.**
- **3rd SB doesn't come through to the dark port.**
- **2nd SB becomes anti-resonant as its cosine is negative.**

α is set to be 60 deg to eliminate 3rd SB on dark port.

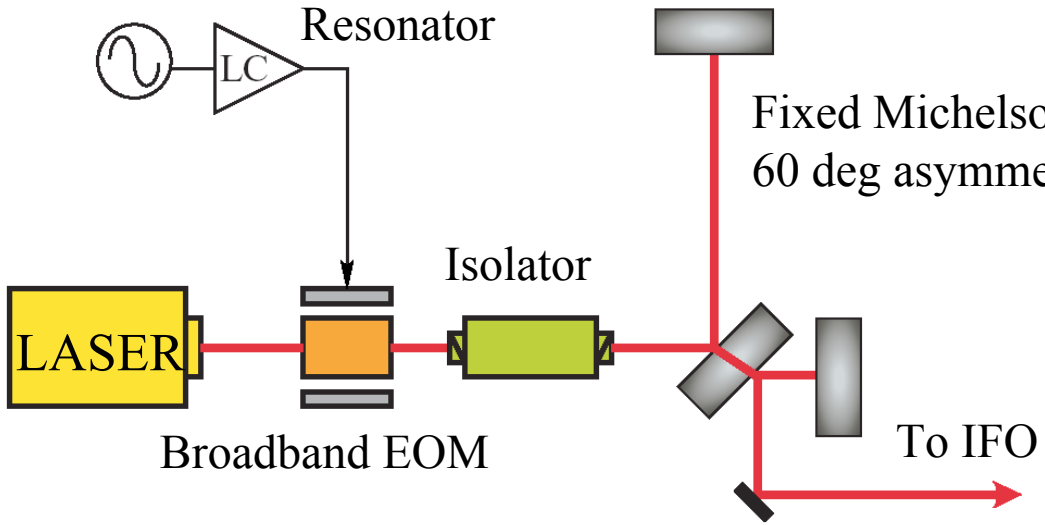
$$\alpha = \omega_m \Delta l / c$$

THD control signal becomes small for high finesse RSEC.

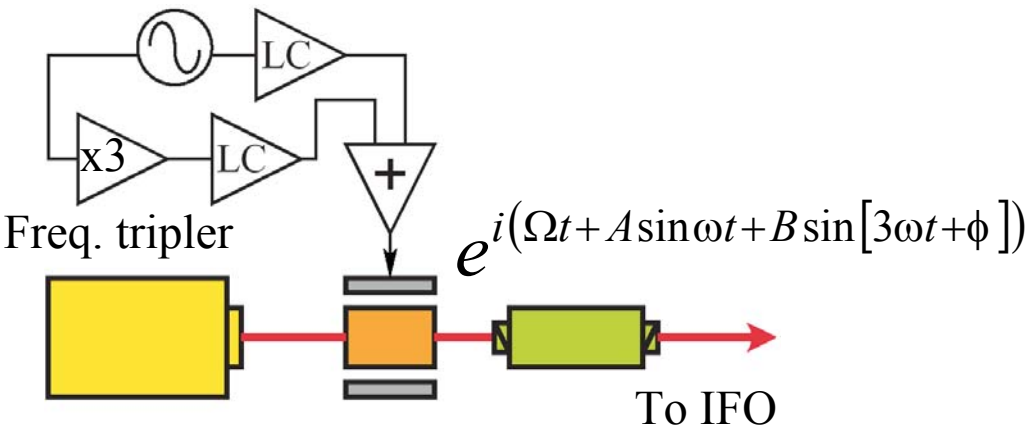
•Asymmetry should be small
•3rd SB should be removed

There are several ways to meet both conditions.

•Pre-Michelson Interferometer



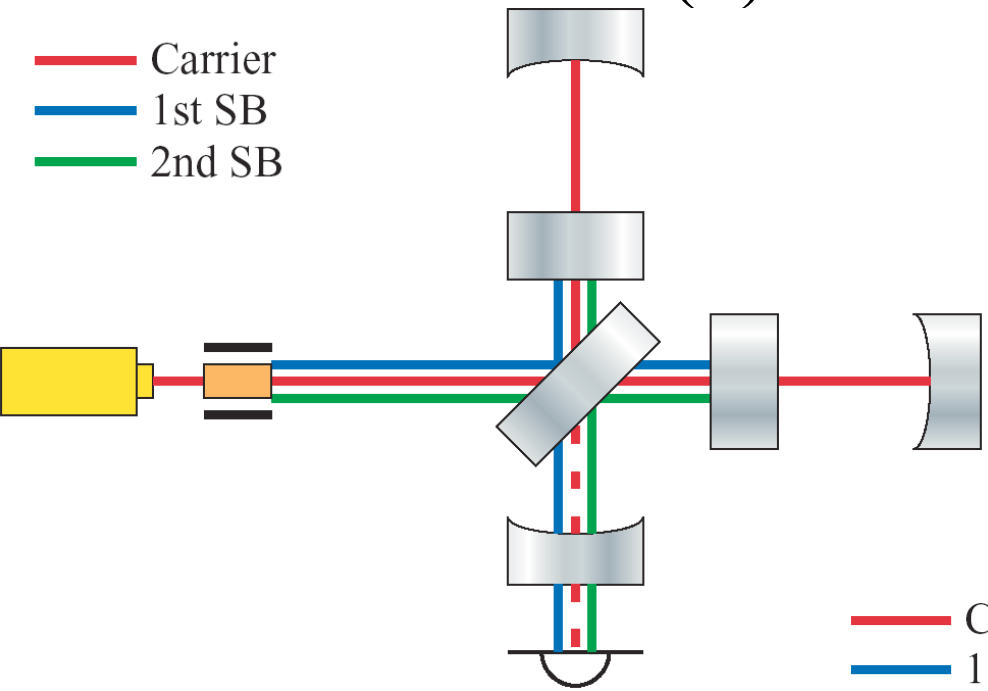
•3rd order Anti-modulation

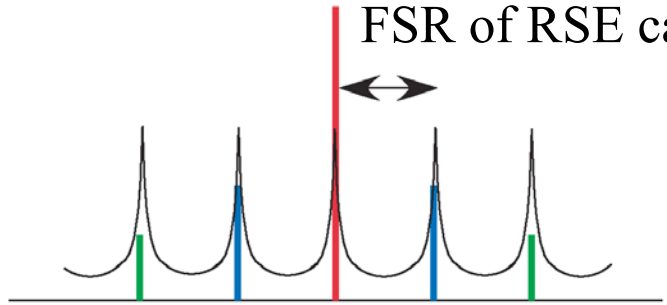


Then,
- Asymmetry can be used to optimize the RSE control.
- We can use THD at sym. port.
- THD control for PRC will be improved.
- RSEC length can be small enough for detuning.
- Contrast will be improved.
- LASER noise will be reduced.

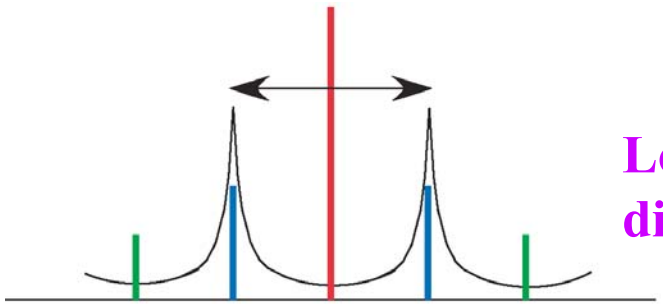
We will try and choose either.

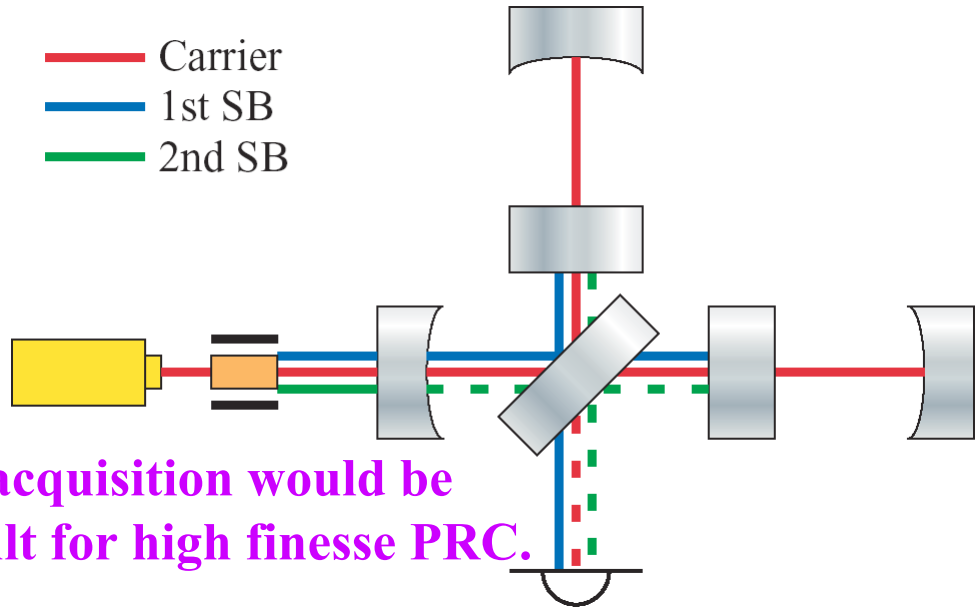
Plan (2) : Power Recycling





2nd SB is anti-resonant in PR cavity.

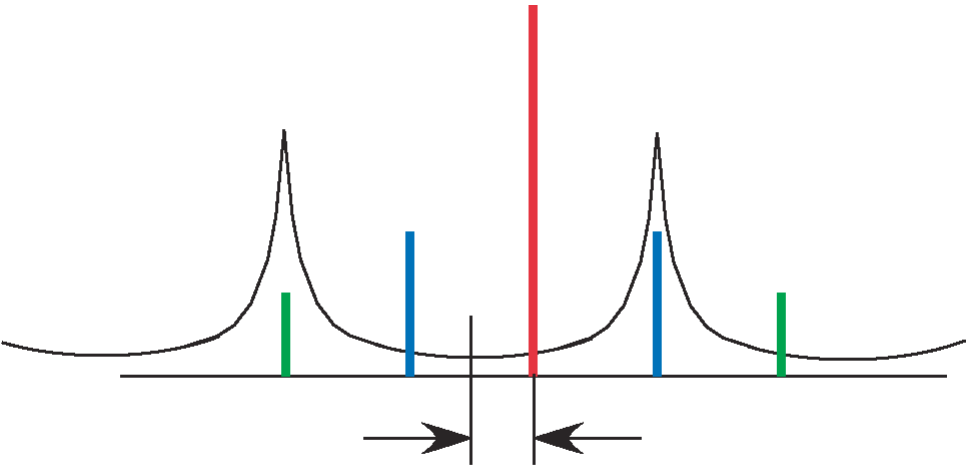




Lock acquisition would be difficult for high finesse PRC.

Peter B. will explain this at the following talk.

Plan (3) : Detuning



Detune Phase

Particular detuning with one modulation using THD control.

(RSE cavity should be short. That's the most inevitable motivation to reduce asymmetry.)

We are planning to also try DC offset detuning.

Milestones accomplished

- Vacuum test (’01 Dec.) : 3.4e-7 torr.
- Osamu finished his experiment. (’02 Jan.)
- We moved the room.
- Three undergrads joined us. (’02 Feb.)
- Eric Black visited, helping us for 2 weeks.
- RSE restoration started : With Osamu’s method in new chamber.
- Broken suspensions are repaired.
- Each arm cavities lock.
- Michelson lock.
- Asymmetry measurement. (’02 Mar.) : error < 0.5mm
- FPMI lock.
- Mode matching improvement.

8 people in lab!

This restoration is being done to (1)Educate undergrads, (2)Share Osamu’s knowledge, and (3)Check the Equipments.

Schedule

April : Restoring completes
Polarization experiment starts
May : Development of 3rd order anti-modulation
Asymmetry reduction and arm cavity extension
June-July : Broadband RSE stabilization
August : Power Recycling installation (using polarization)
September : PR-RSE stabilization
October-December : Detuning installation

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