Development of a Narrow-band Interferometer using Resonant Sideband Extraction in Japan

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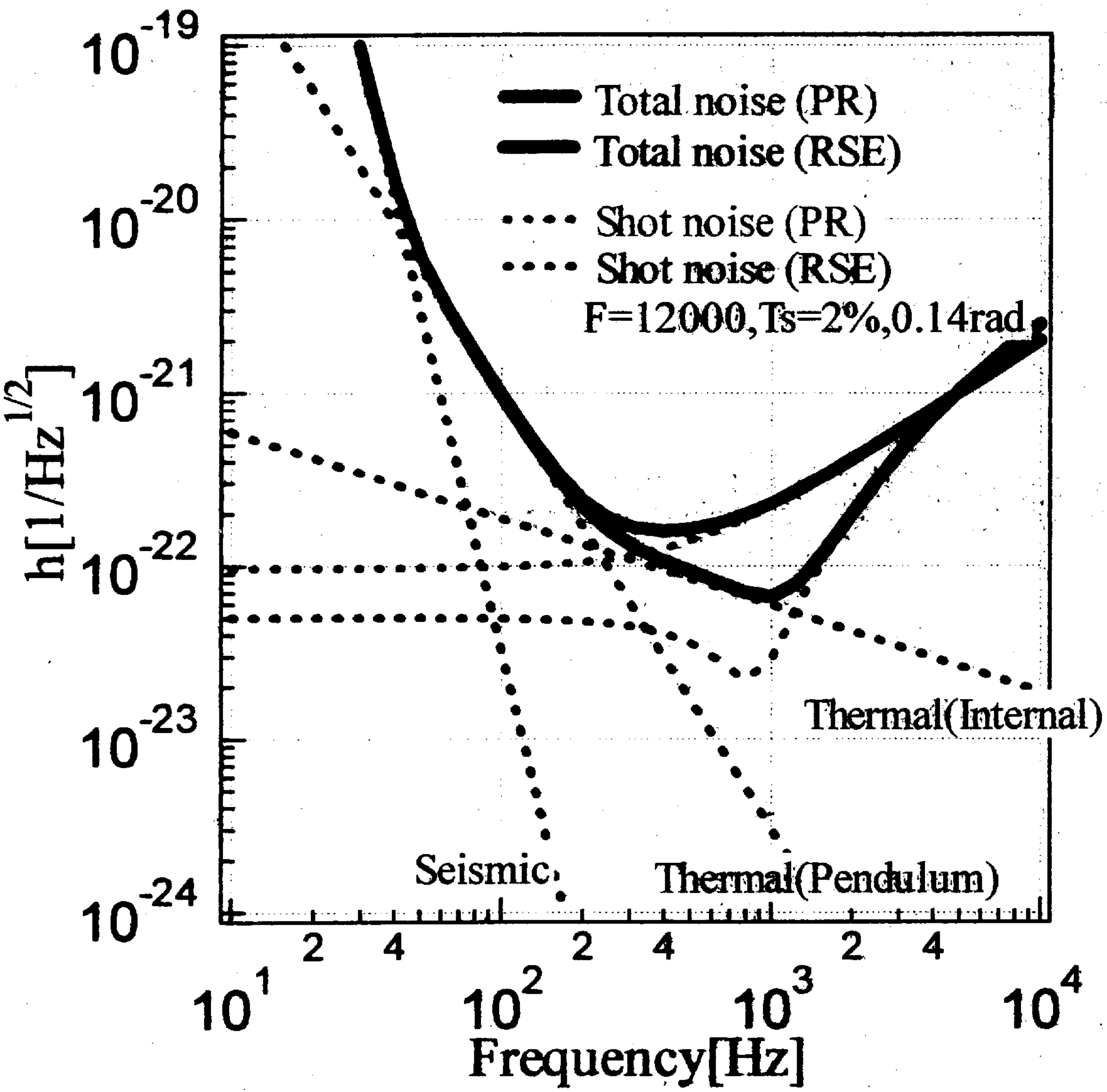
Purpose

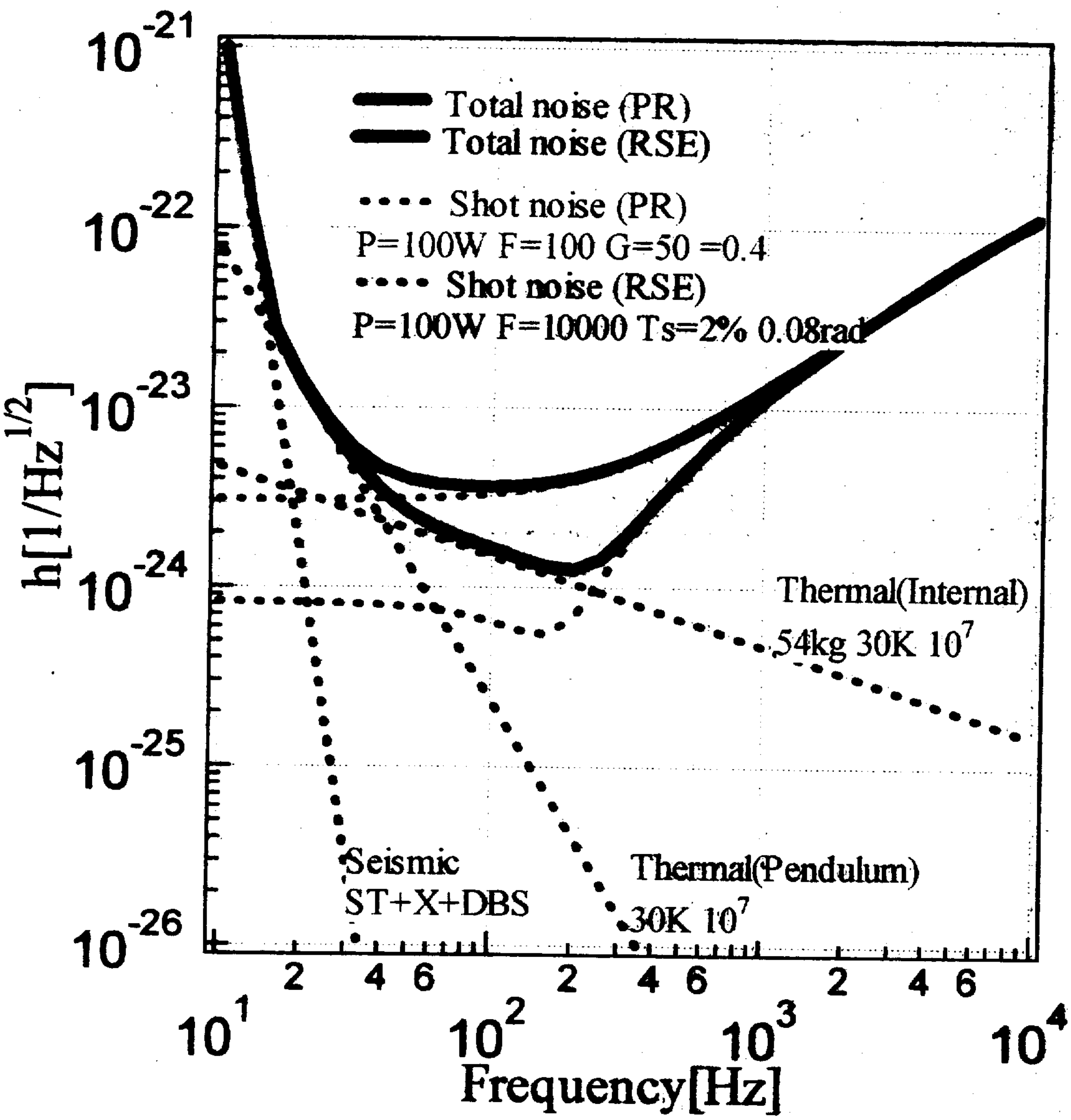
To investigate the possibility of TAMA300 and LCGT with narrow-band operation

- Development of a simple signal extraction scheme for a narrow-band interferometer with one modulation
- Demonstration of a narrow-band operation using Resonant Sideband Extraction (RSE) in a bench-top experiment

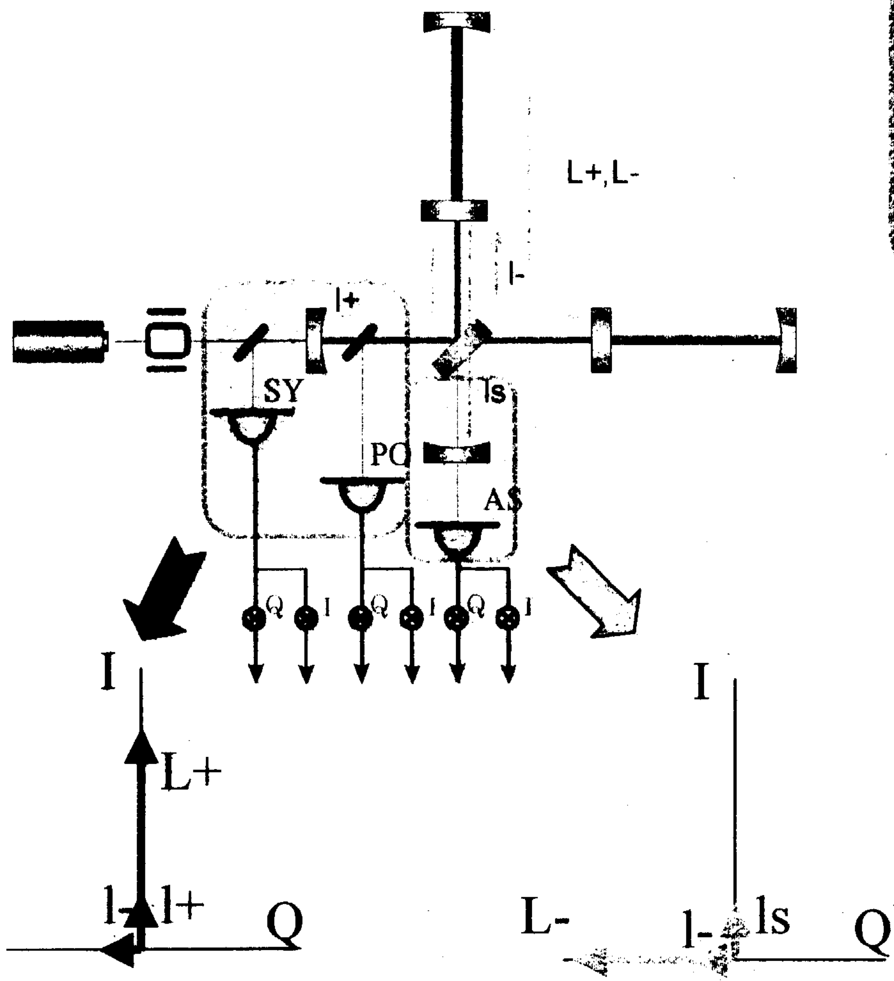
TAMA with RSE



LCGT with RSE



Difficulty of the signal extraction for SEC(ls) by one modulation



- **The problem is that L- signal disturbs** ls **signal if** demodulation phase **has offset.**

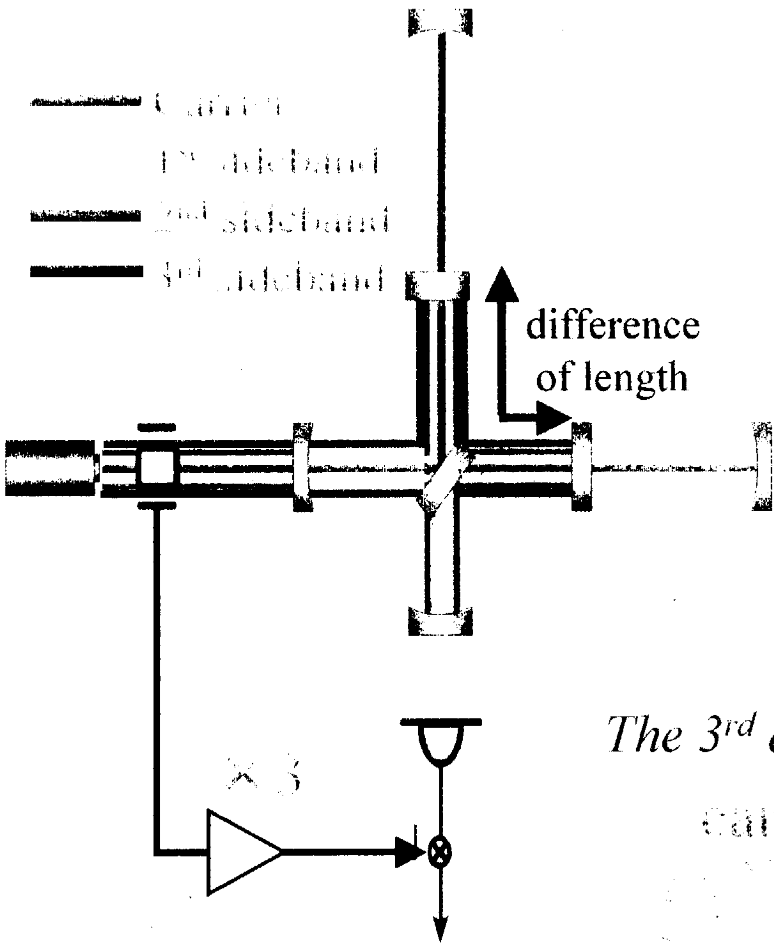
- **How much do we need the** accuracy **for the demodulation phase** ?

  or

- **How can we** disappear L- ?

  ⇒However L- is the gravitational wave itsself ??

A new signal extraction method for the SEC with one modulation



- Principle is
  - to make 3rd order sideband at dark condition in the signal port by the difference of the length.
  - to use the 3rd harmonic demodulation

The 3rd demodulation signal is sum of the beat of

carrier and ± 3rd ~~sidebands~~ → arm

and -2nd sidebands
2nd and sidebands } SEC

Extracted signals compared with *ls*

$\alpha = \pi/3\left(=\omega_{3m} l_- / c\right),\ \beta = \pi$ (: demodulation phase)

Demod.	*L+*	*L-*	*l+*	*l-*	*ls*
1st	0.0027	0	0.080	0	0.015
3rd	0.0027	0	0.080	0	0.015

$\alpha = \pi/3,\ \beta = \pi + 0.01$

Demod.	*L+*	*L-*	*l+*	*l-*	*ls*
1st	0.0026	430	0.077	1.1	0.015
3rd	0.0026	3.9E-6	0.077	0.0015	0.015

$\alpha = \pi/3 + 0.01,\ \beta = \pi + 0.01$

Demod.	*L+*	*L-*	*l+*	*l-*	*ls*
1st	0.0027	430	0.080	1.1	0.016
3rd	0.0026	0.0010	0.079	0.0016	0.016

$\alpha = \pi/3 + 0.1,\ \beta = \pi + 0.01$

Demod.	*L+*	*L-*	*l+*	*l-*	*ls*
1st	3.2E-3	400	0.091	1.0	0.019
3rd	3.2E-3	0.15	0.091	0.0026	0.019

$\alpha = \pi/3 + 0.01,\ \beta = \pi + 0.1$

Demod.	*L+*	*L-*	*l+*	*l-*	*ls*
1st	9.2E-6	1960	0.0030	4.9	0.0010
3rd	1.7E-5	0.011	0.0049	0.0034	0.0013

RSE small scale experiment

We are making 4m interferometer for RSE experiment in

in Mitaka near Tokyo

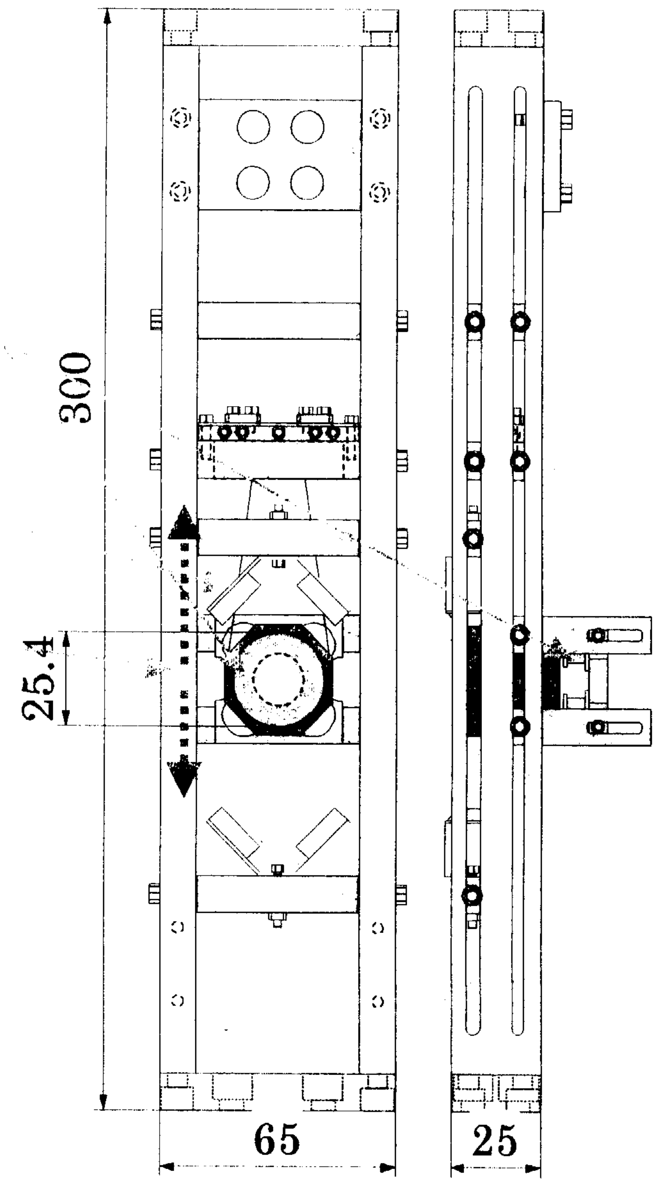
Features of the experiment:

- Mirror is controlled by Small Suspension System (SSS) which has a simplicity like table-top experiment.
- In vacuum to obtain high finesse cavity

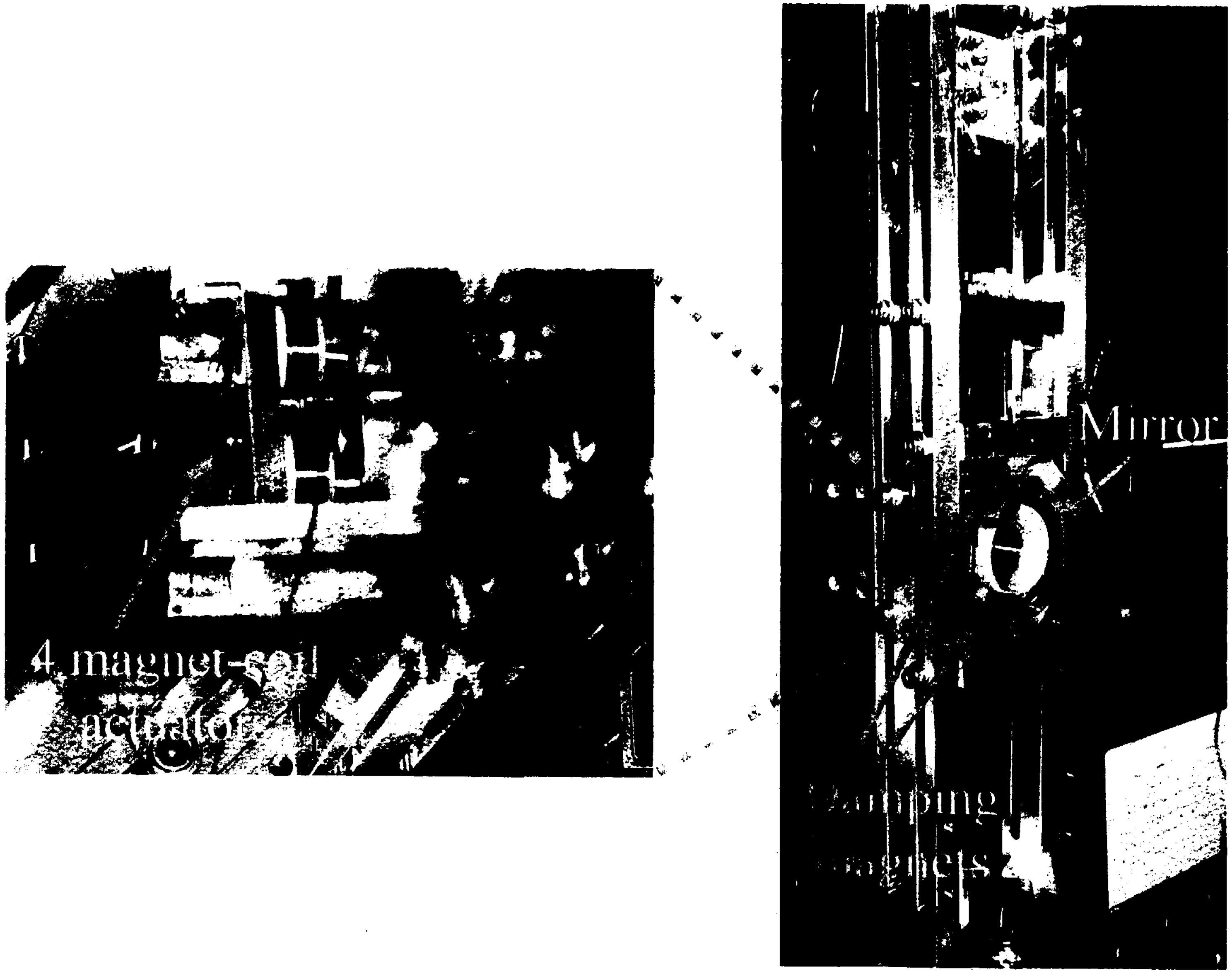
Small Suspension System (SSS)

- 1 inch mirror is suspended by [illegible] [illegible].
- Mirror position and orientation are controlled by [illegible].
- Motion of the mirror at resonant frequency is efficiently damped by the [illegible].
- All parts (mirror, pendulum, damping magnets, and coil) are [illegible] to be adaptable for [illegible].
- The SSS can handle at maximum [illegible] in one beam tube.

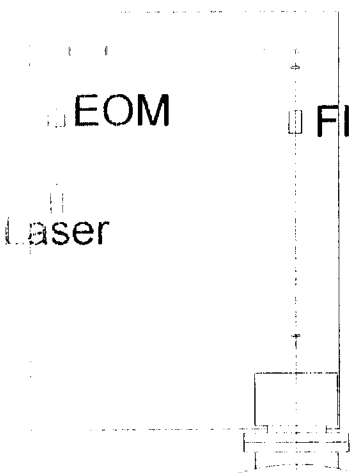
- The SSS has [illegible] like fixed mirror.



Small Suspension System (SSS)

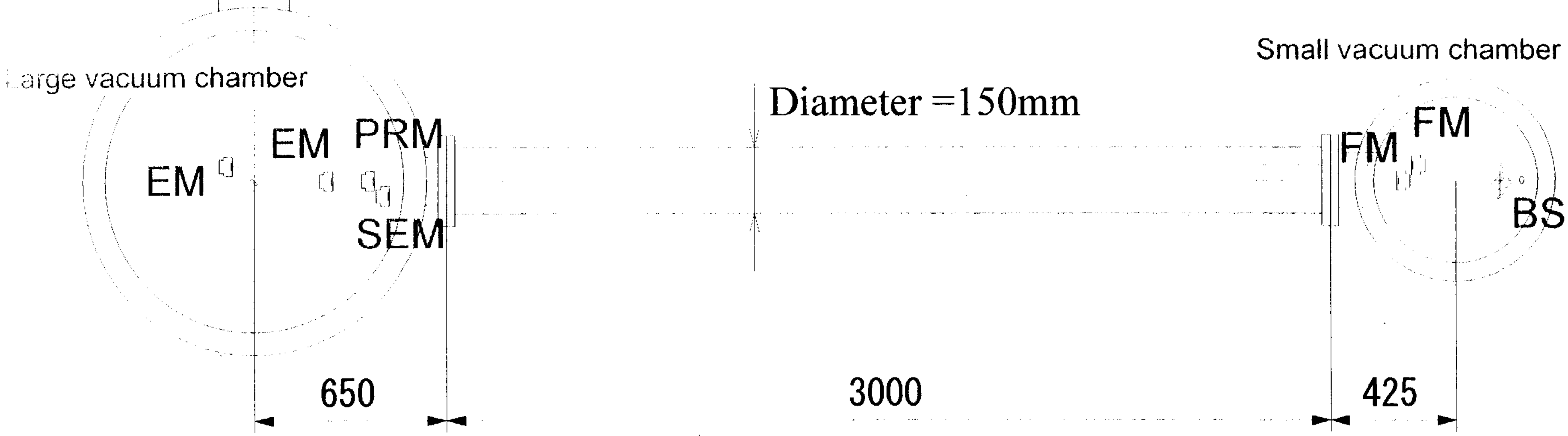


Experimental Instruments

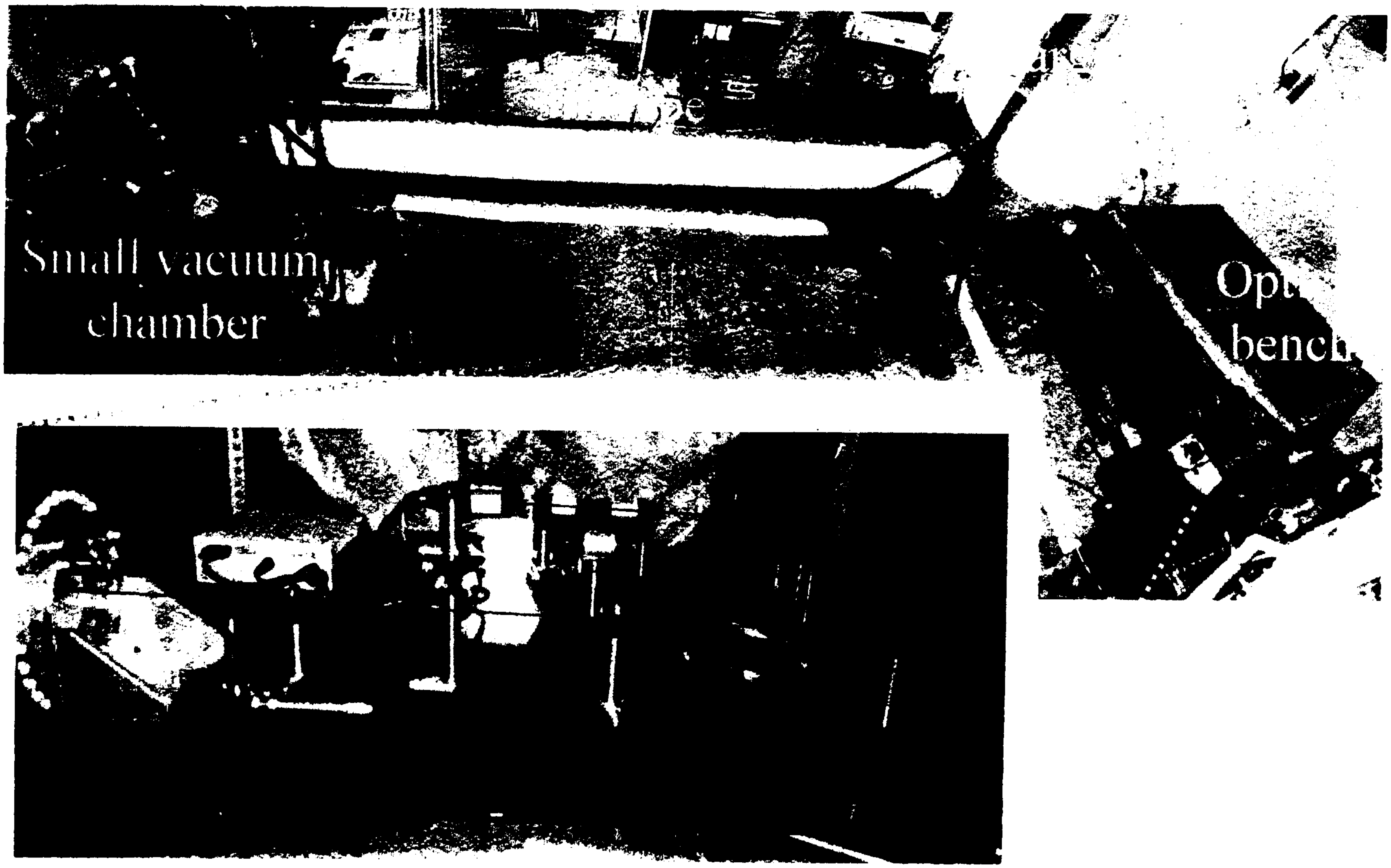


- 500mW Nd:YAG laser
- Two vacuum chamber
- 4 rays in one pipe

- Small mirrors suspended by 1 loop wire

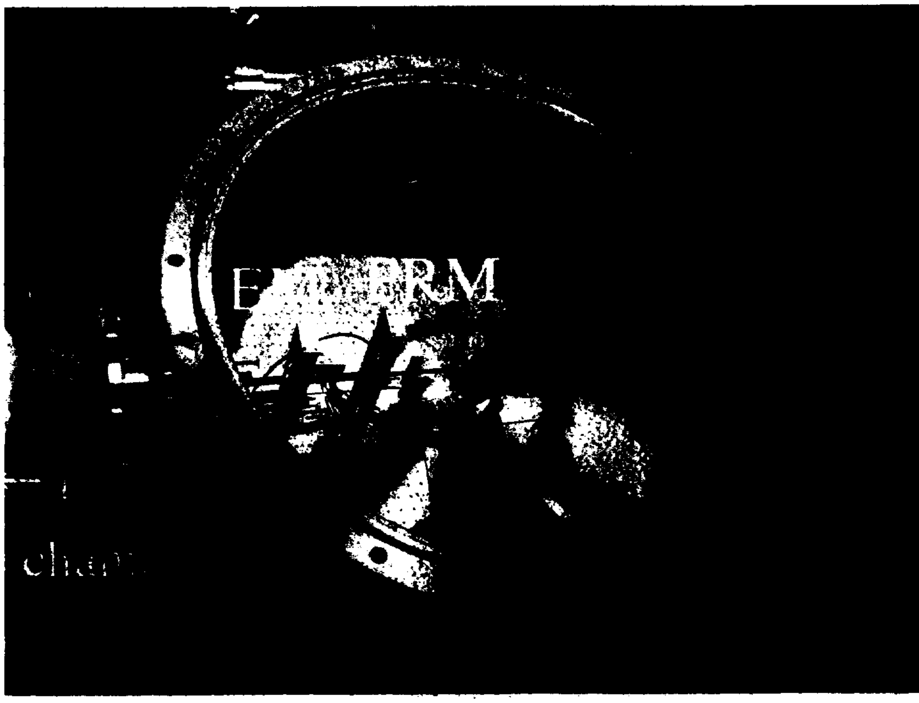


Experimental setup

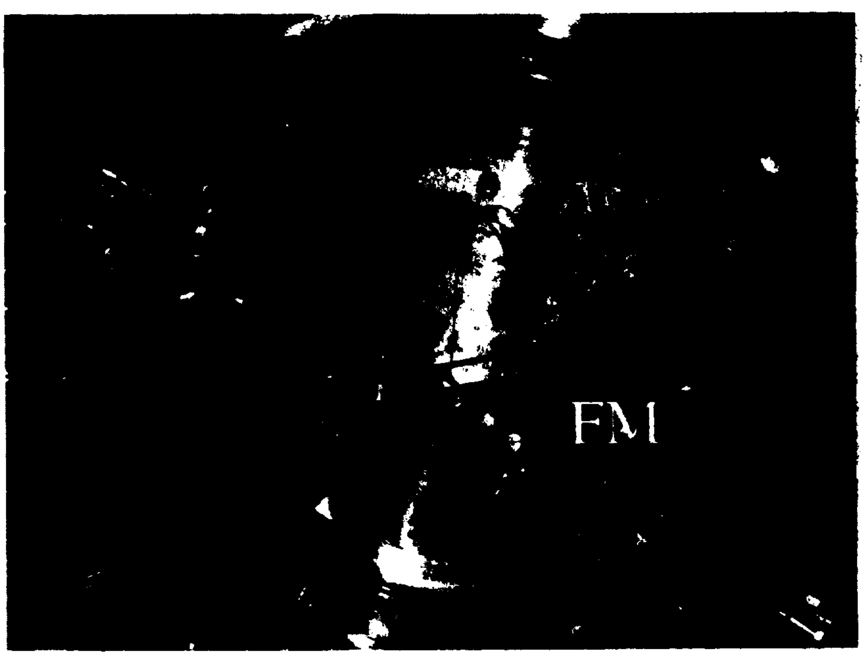


Experimental setup

Inside the large chamber



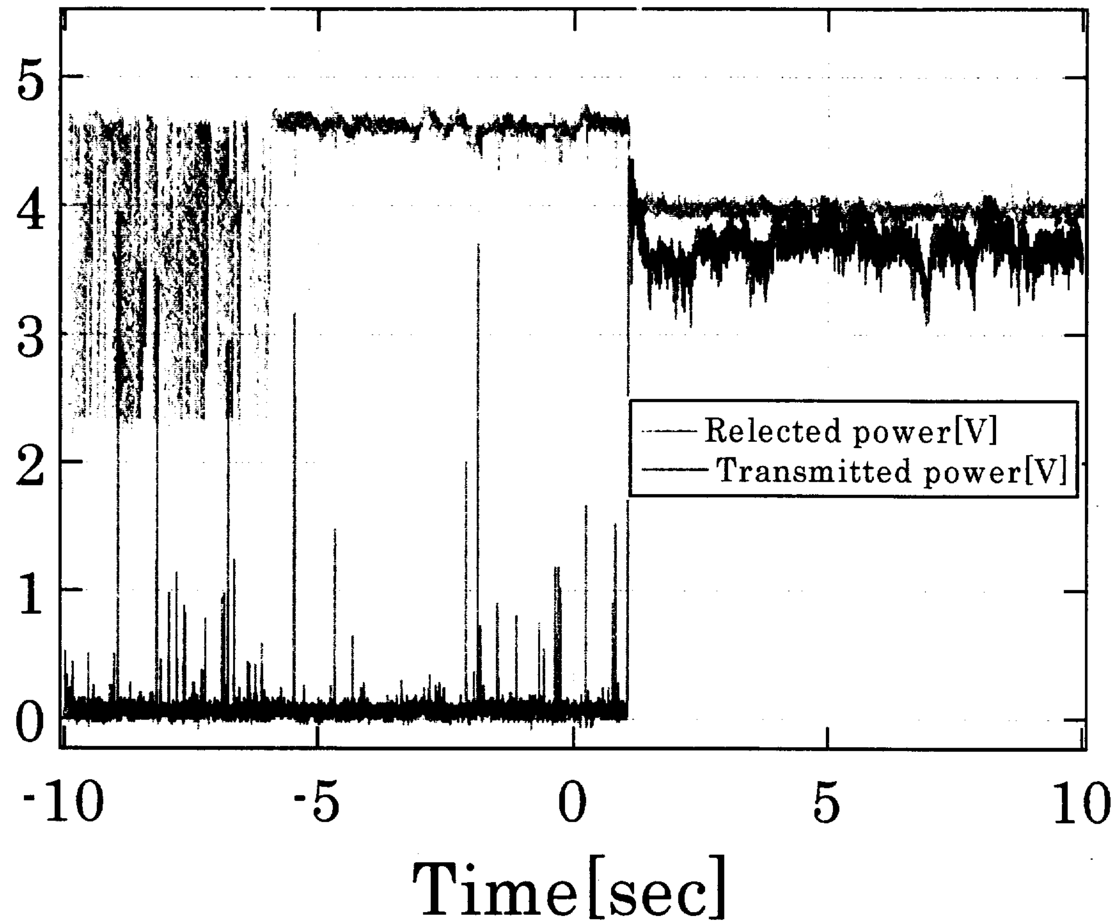
Inside the small chamber



Locking of the 3 mirrors coupled cavity

Sidebands are locked in PRC

Carrier is locked in FP arm and PRC



- We have locked the [illegible] stably with the [illegible].

  → Power Recycled gain is still low (1.2) because a reflectance of the PR mirror is 60% and the PR cavity includes a beam splitter.

Note 1, Linda Turner, 05/09/00 02:10:21 PM
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