LSC-Virgo Meeting
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Status of the Japanese Projects

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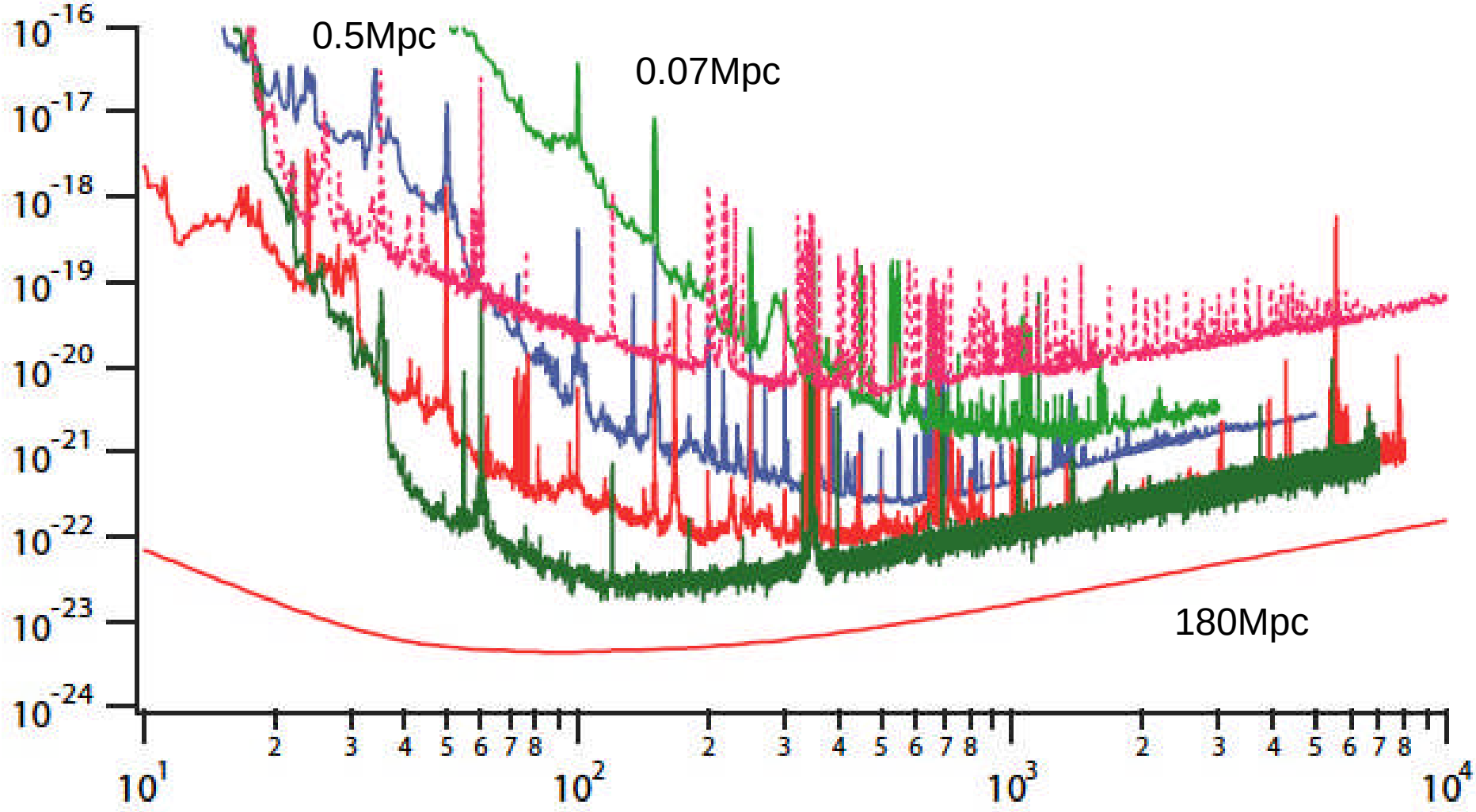
LIGO-G070544-00-Z

Content of This Talk

- Status of TAMA
- CLIO sensitivity Improvement
- LCGT budget --- Request Process


0.5Mpc
0.07Mpc
180Mpc
10^-16
10^-17
10^-18
10^-19
10^-20
10^-21
10^-22
10^-23
10^-24
10^1
10^2
10^3
10^4
2 3 4 5 6 7 8

Status of TAMA

TAMA３００

- **TAMA project (1995～)**

  Consortium of domestic research organizations

  (NAO, Phys.UT, ICRR, KEK, ERI, UEC, Adv.Mater.UT, Tokai U, TEU, NRLM, Kinki U, Kyoto U, Osaka U, Osaka CU, Astron.UT, Niigata U, Tohoku U, Hiroshima U, Hirosaki U, …)

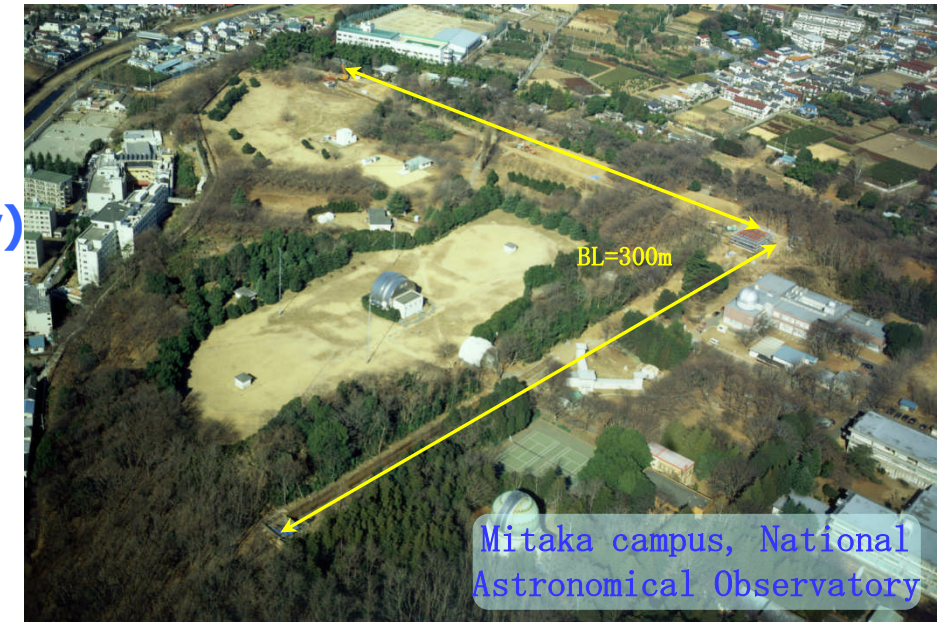
Construction of TAMA300

R&D for ＬＣＧＴ

Practical detector
(Observation of our Galaxy)

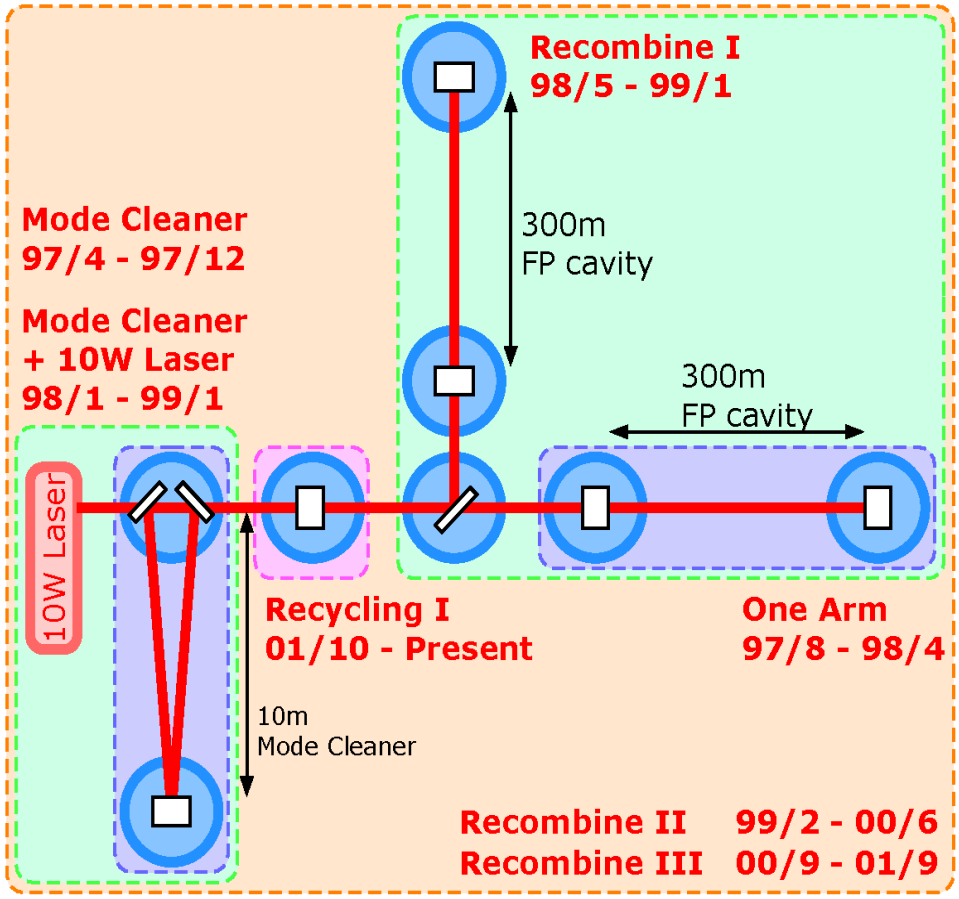
⇩

Sensitivity to detect
Galaxy events
(World best in 2000-2002)
Earlier observation run
(Obs data more than 2000 hr)



Brief History of TAMA300

1995 Project started
1997 One arm cavity locked
1999 FPMI operation started
DT1(11hr) ,DT2(31hr)
2000 World best sensitivity
h = 5E-21/rHz
DT4(167hr)
2001 DT6(1038hr)
Power Recycled FPMI
2002 First Coincidence Run
with LIGO(S1) and GEO600
2003 DT8(1158hr)
with LIGO(S2)
2003/4 DT9 with LIGO(S3)
and GEO600
Full Automatic Operation
2004— Noise hunting
TAMA-SAS



Observation Summary

TAMA data-taking runs including long-term observations

Run	Term	Year	Live Time (Hour)
DT1	6-Aug → 7-Aug	1999	7
DT2	17-Sept → 20-Sept	1999	31
DT3	20-Apr → 23-Apr	2000	13
DT4	21-Aug → 4-Sept	2000	161
DT5	2-Mar → 8-Mar	2001	111
DT6	15-Aug → 20-Sept	2001	1038
DT7	31-Aug → 2-Sept	2002	25
DT8	14-Feb → 14-Apr	2003	1158
DT9	28-Nov → 10-Jan	2004	558

In 1999, TAMA started to make observations

The world best sensitivity

Continuous observation more than 1000 hr with the highest sensitivity.

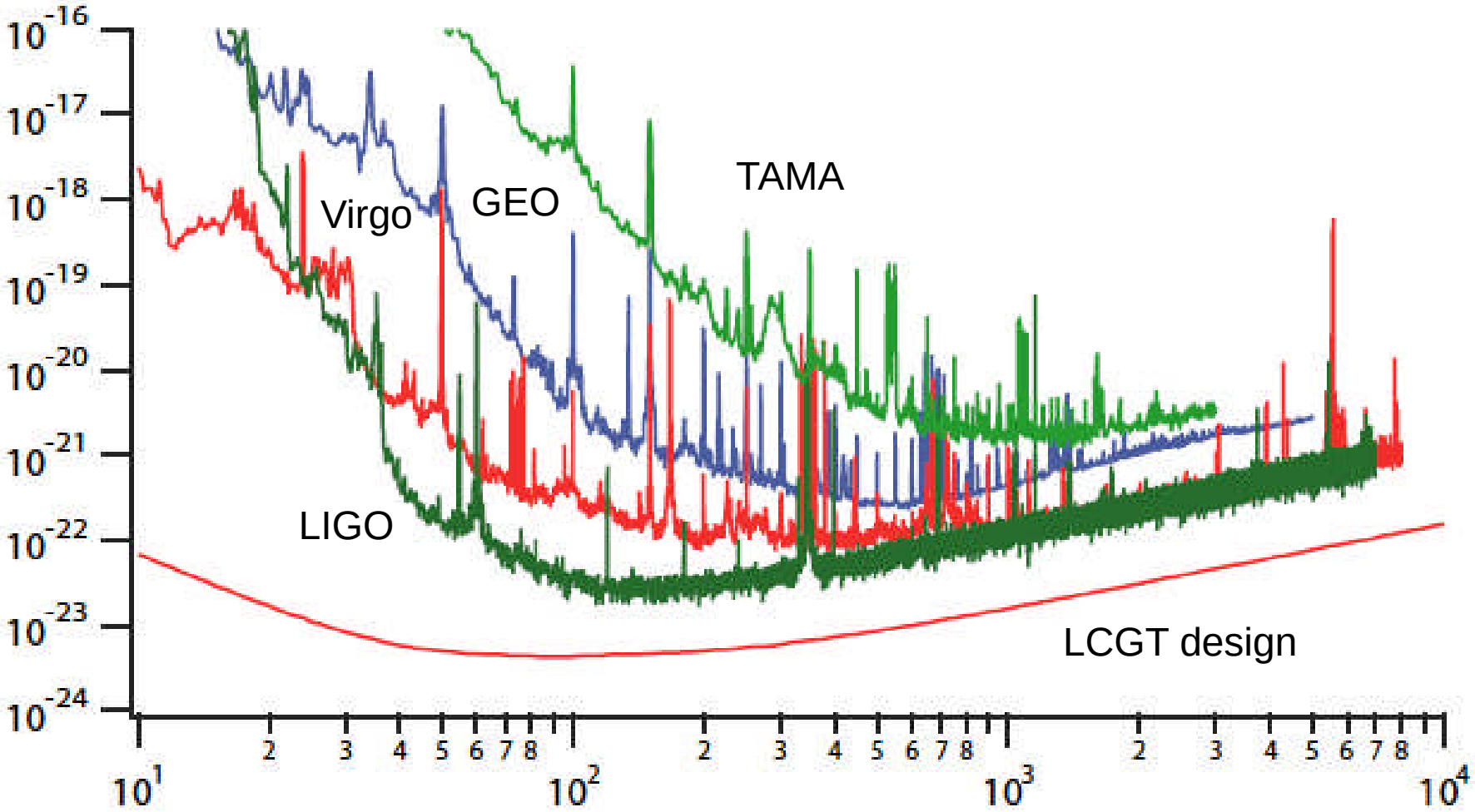
Power recycling

LIGO S1

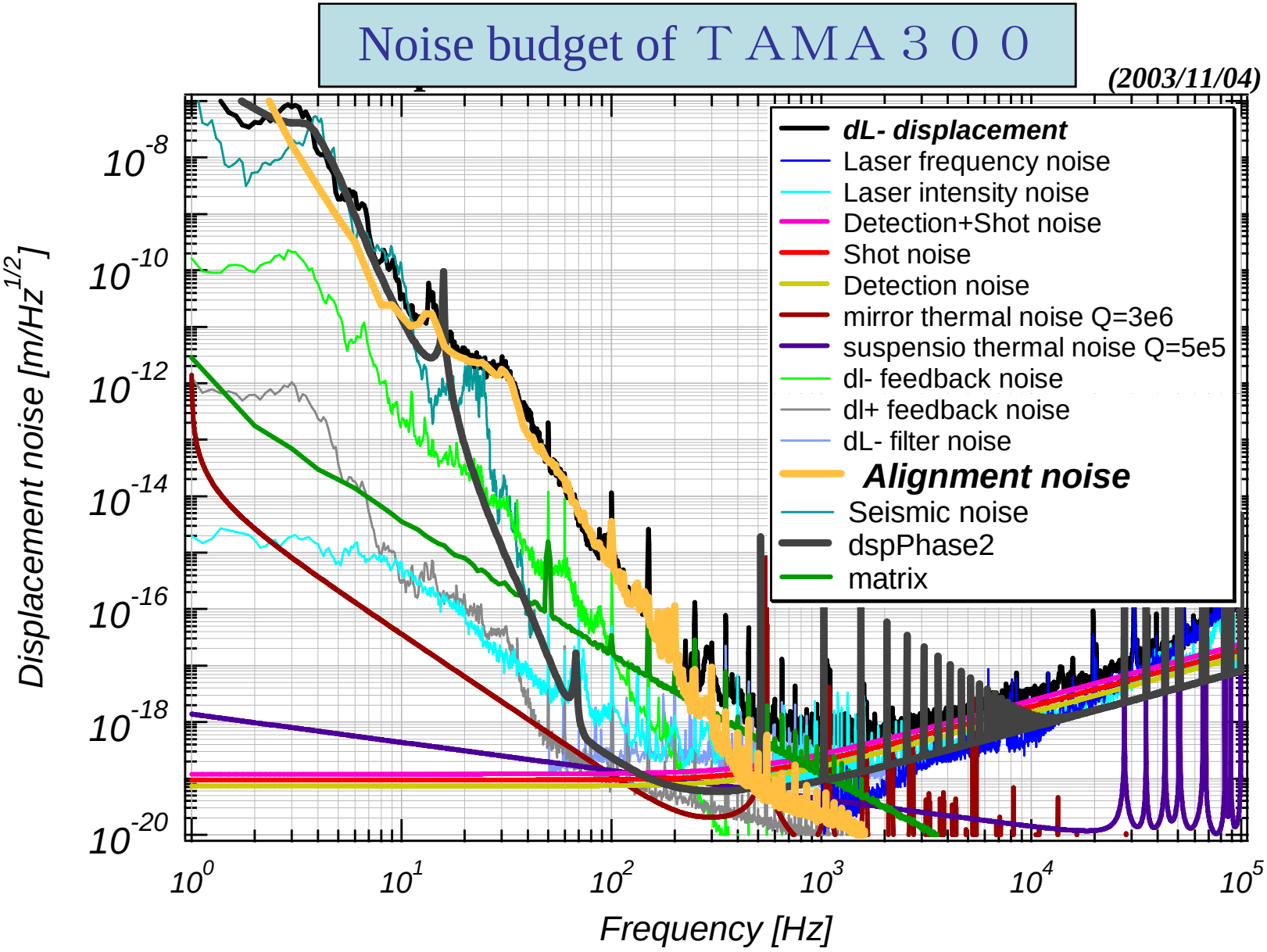
Total 3102 hours data was accumulated.

Some parts of DT7-9 are overlapped with the science runs of LIGO (GEO) and cooperative two papers have been published to limit the event rates of both coalescence and supernova events in our Galaxy.

Sensitivity of TAMA compared with other interfeornetrs



Improvement at Low Frequencies



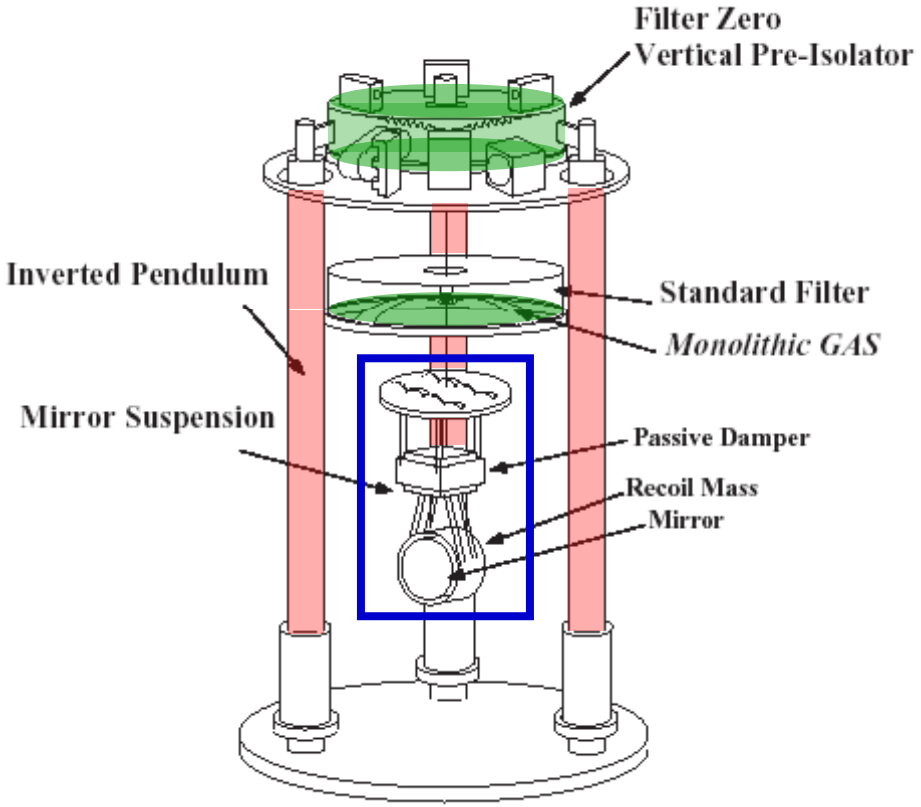
TAMA SAS
(Seismic Attenuation System)

1. Horizontal
   - Inverted Pendulum
   - resonant freq. : 30mHz

2. Vertical
   - Double MGAS Filters
   - Each of 0.5Hz resonance

3. Payload
   - Top mass (Platform)
   - Intermediate mass
   - Mirror - Recoil mass

TAMA-SAS
(IP + GASF + Payload)

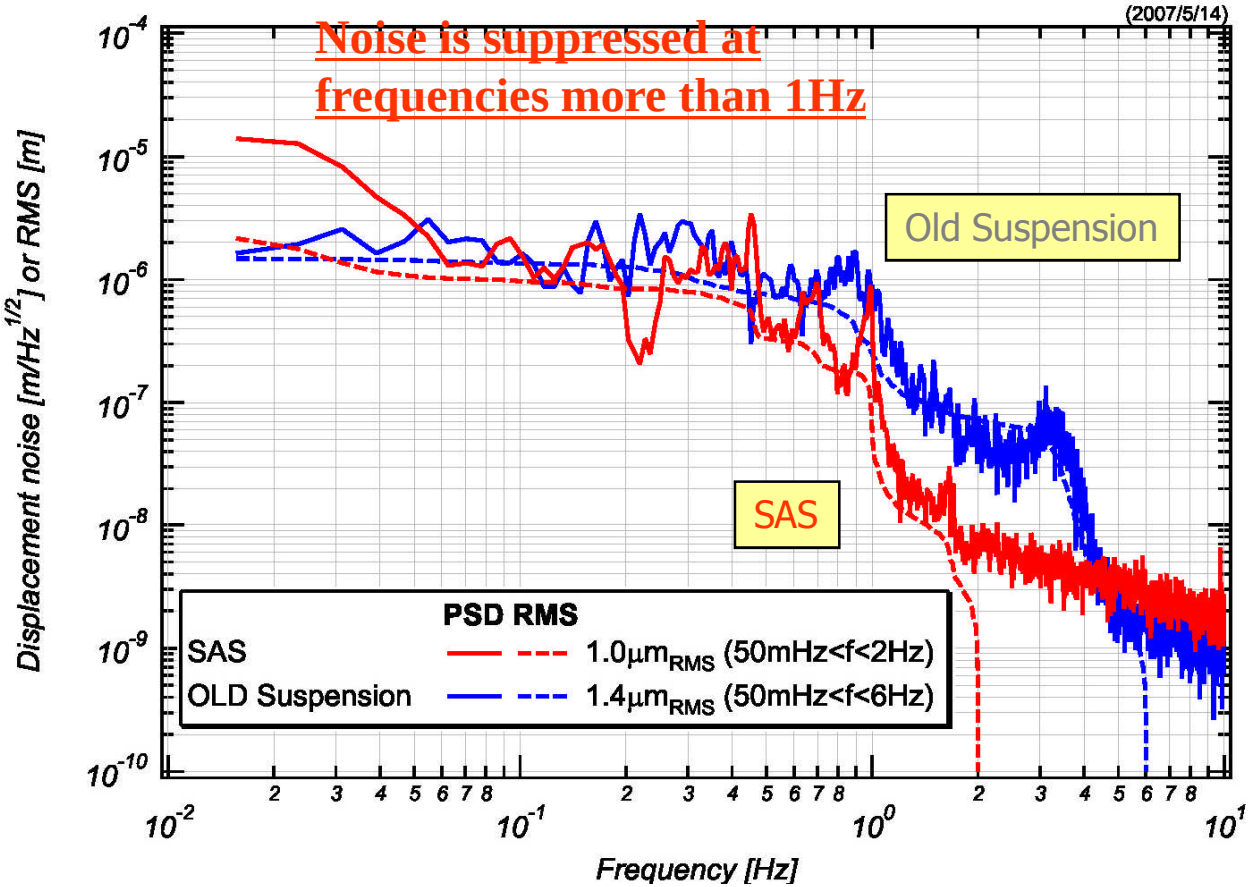


To reduce the seismic noise, new isolation system is being installed.
This figure shows a schematic view of TAMA SAS.
To isolate horizontal motion, an inverted pendulum is implemented.
For vertical motion, double stage MGAS filters are used.
Finally mirror was suspended by a double pendulum.

Preliminary result of SAS

Successful lock of 300mFP cavity by a pair of SAS system confirmed the effectiveness

Two other systems are in adjusting phase



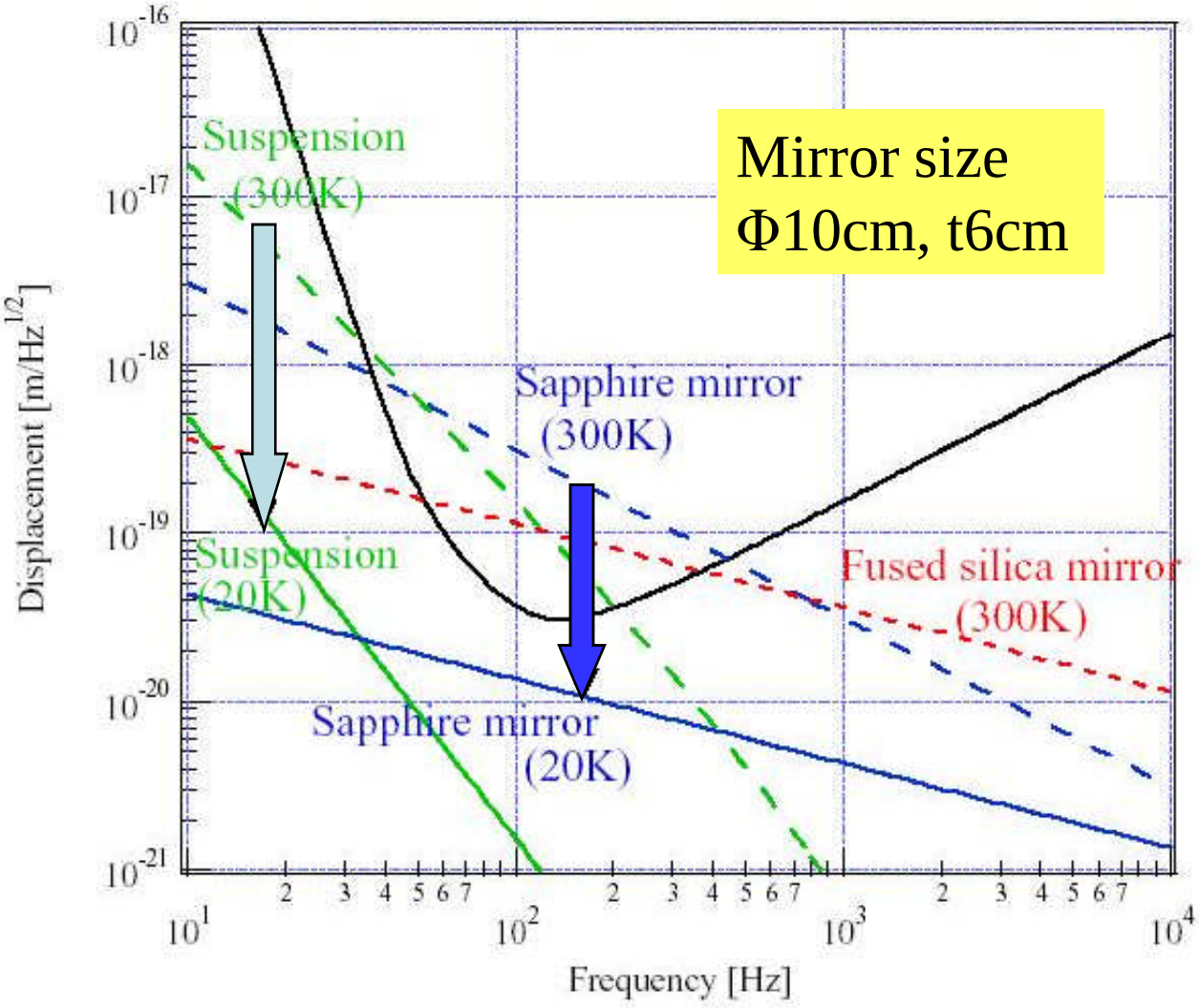
Advancement of TAMA300

- Test bench of technologies of the next generation detectors (LCGT, Adv.LIGO)
  - Introduction of high power laser - (100W)
  - Resonant Sideband Extraction

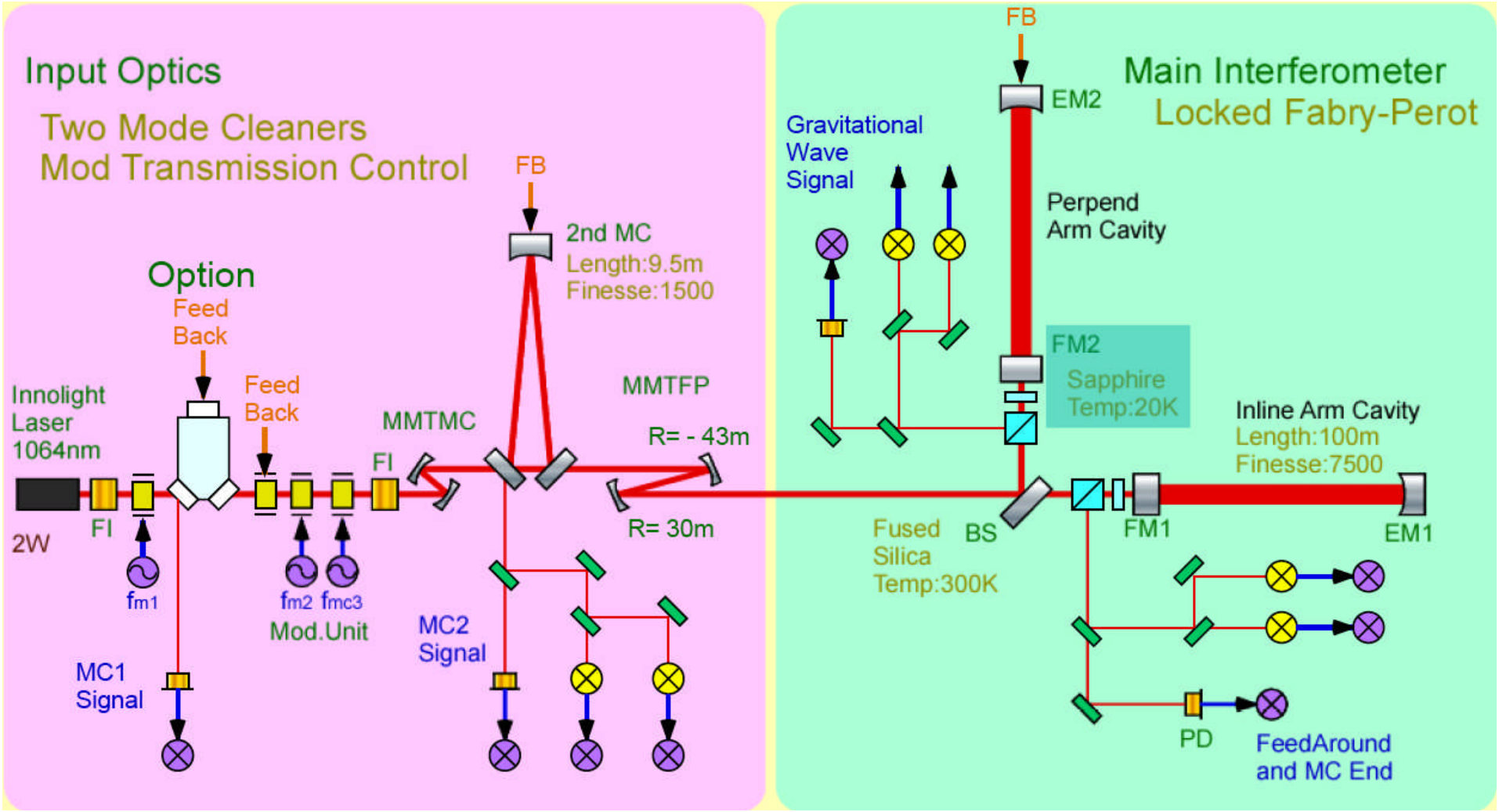
- Contribute to International Observation Network
  - Joint participation by both TAMA & CLIO
  - Formation of Event Alarm Facility

CLIO Sensitivity Improvement

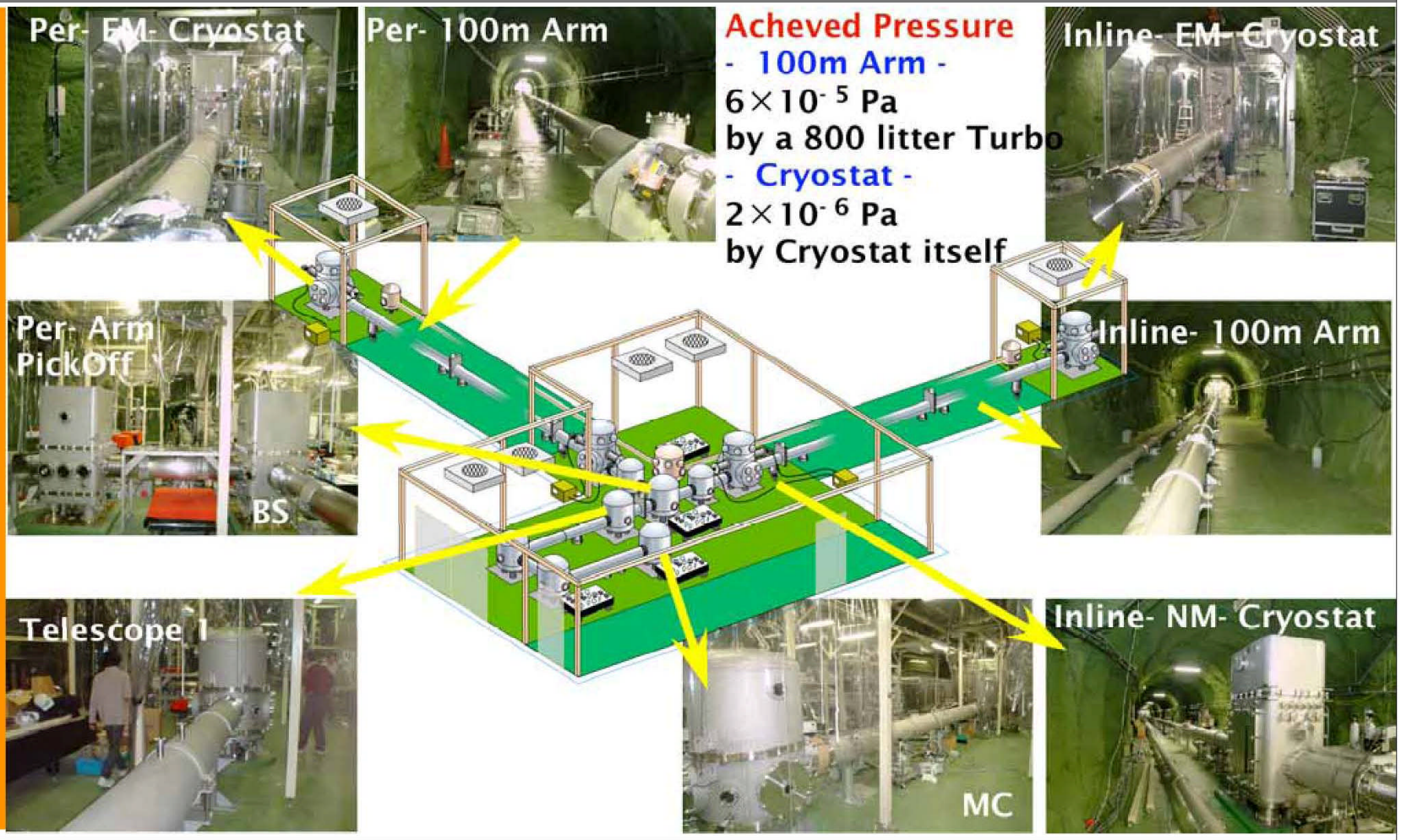
Expected reduction of thermal noise by CLIO (300K – 20K)

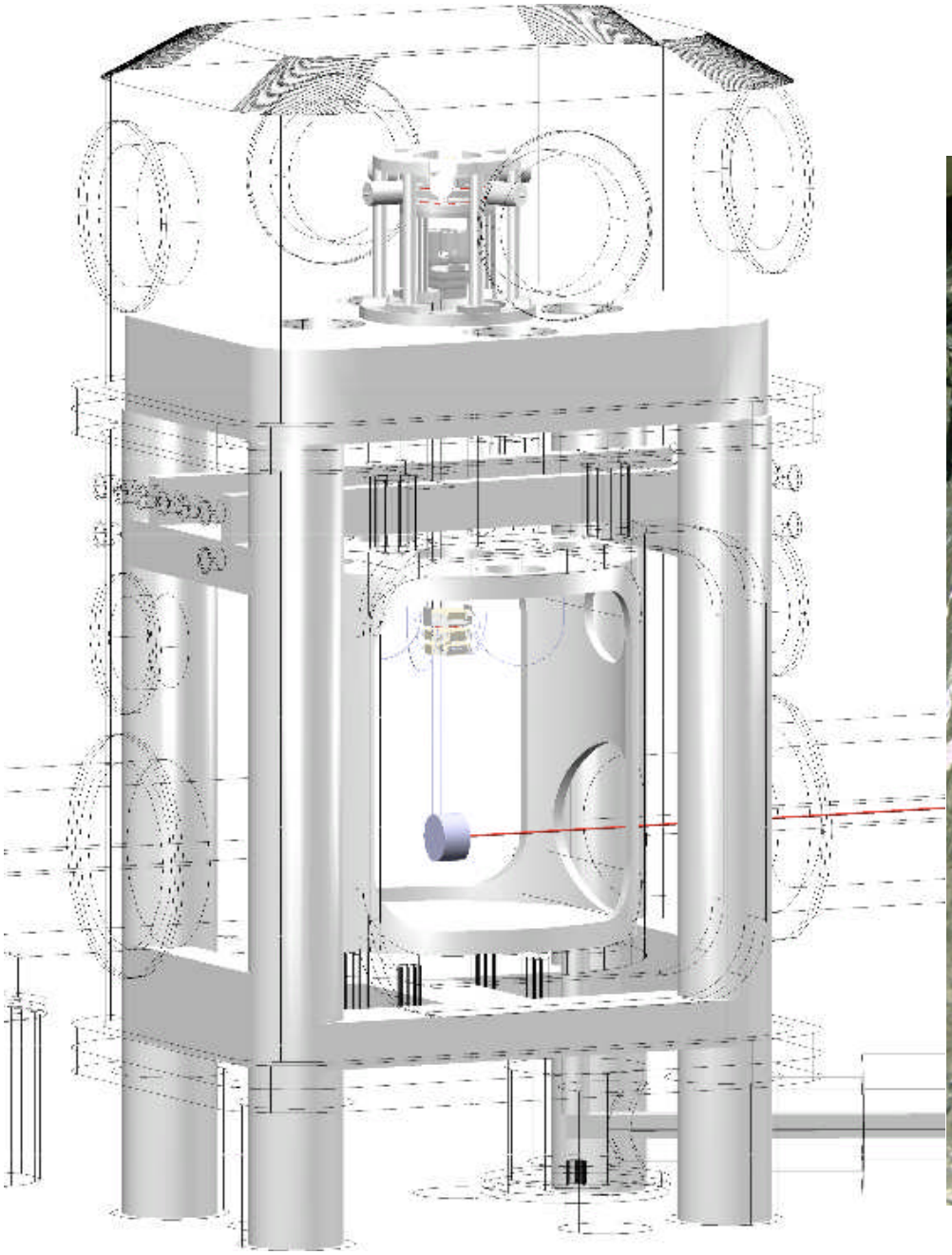


CLIO is a locked Fabry-Perot Interferometer

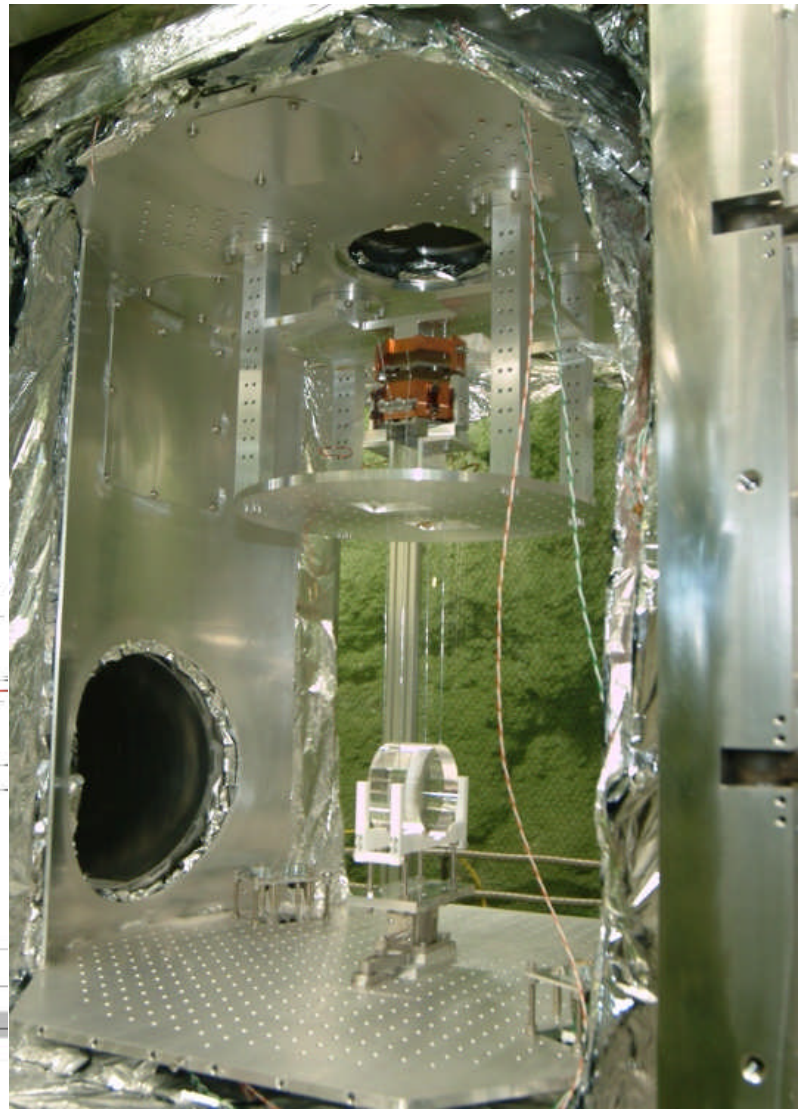


Construction of CLIO

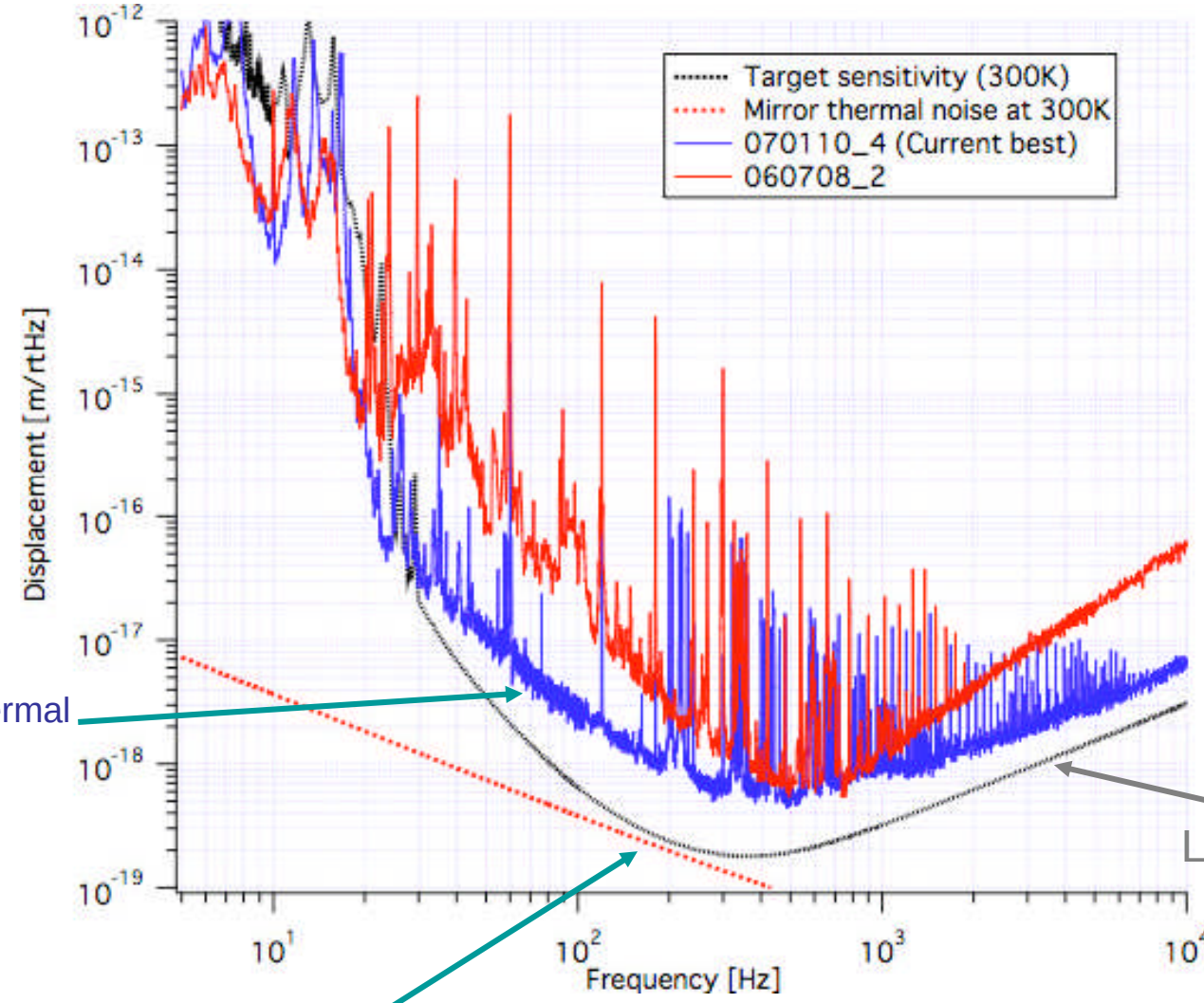




Internal view of mirror suspension



Current sensitivity of CLIO



After reaching thermal limit, start cooling

Limit sensitivity

Mirror thermal noise(300K)

LCGT

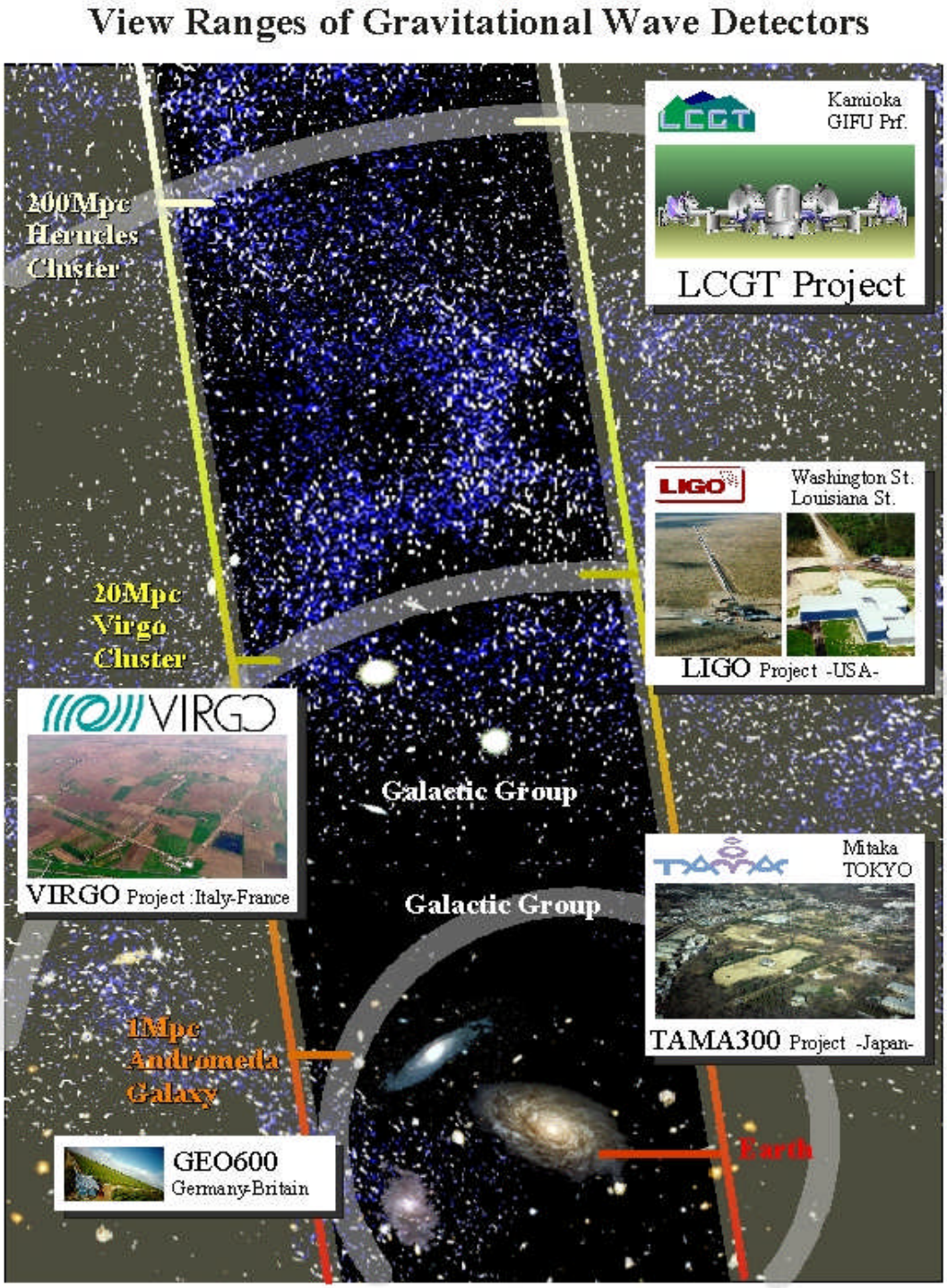
Necessity of LCGT

LIGO (USA), VIRGO (French-Italian), GEO (Germany-England), TAMA (Japan) are in operation.

Occurrence of neutron star binary is estimated to be 10^{-5} for matured galaxy per year . There are 0.01 galaxies for 1 cubic Mpc. Present detectors (km-scale) cover up to Virgo cluster（20Mpc). More than several years are needed to detect the event.

Therefore, we need more sensitive detector. LCGT can detect an event occurring at 260Mpc at maximum and observes events from 1 to 28 in a year.

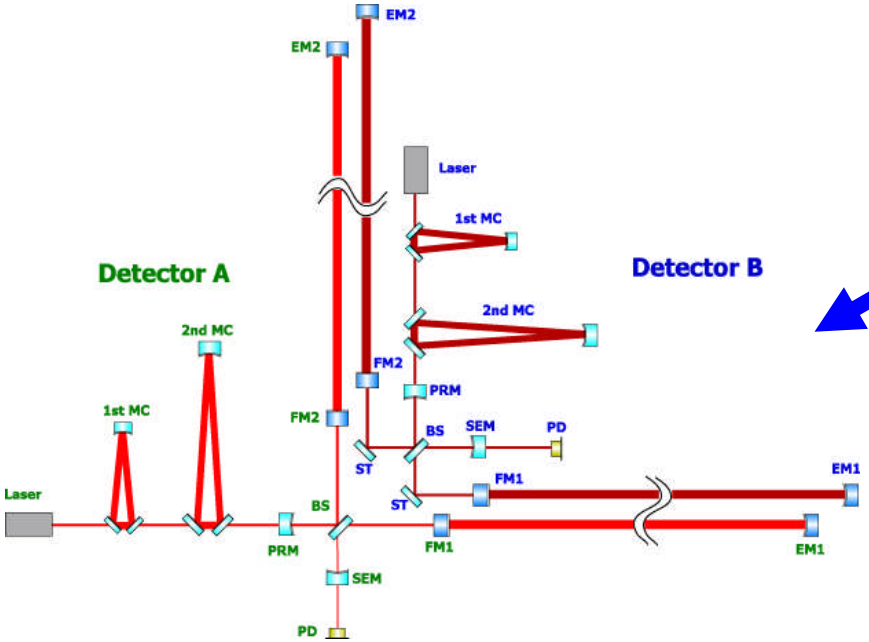
1pc=3.3light year

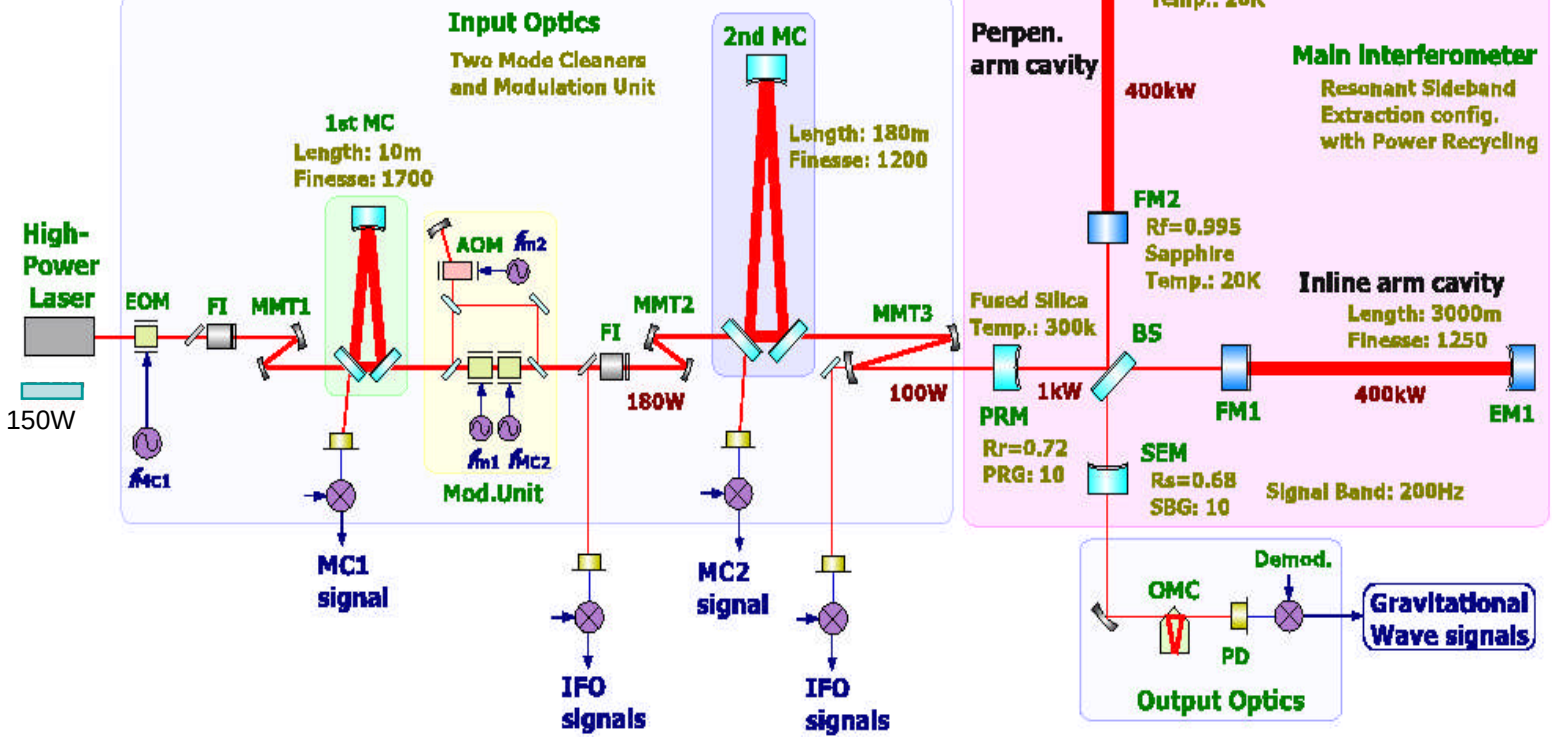


Optical design of LCGT

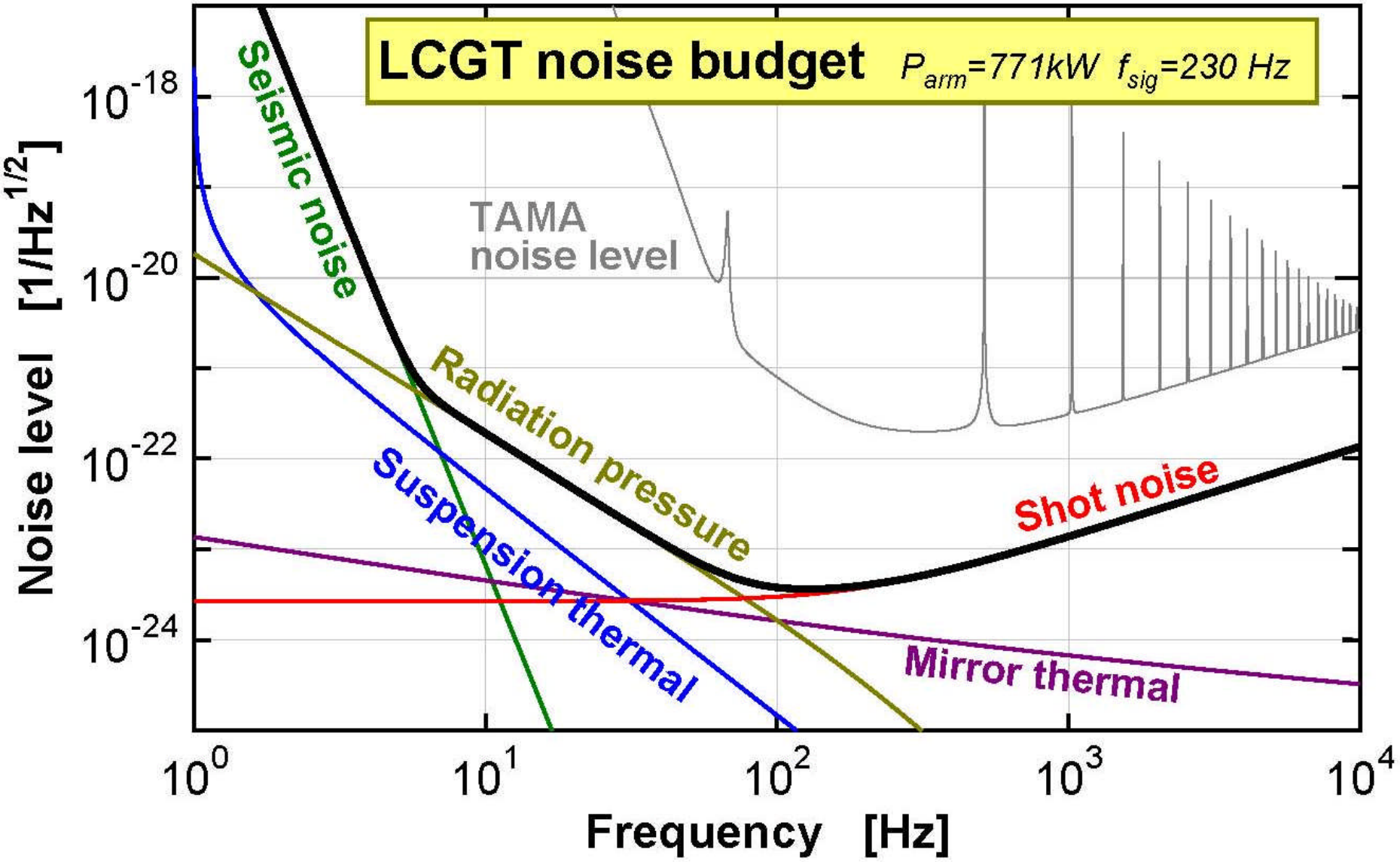
Two interferometers are arranged not to interfere in the same vacuum system.

Optical design of the basic interferometer

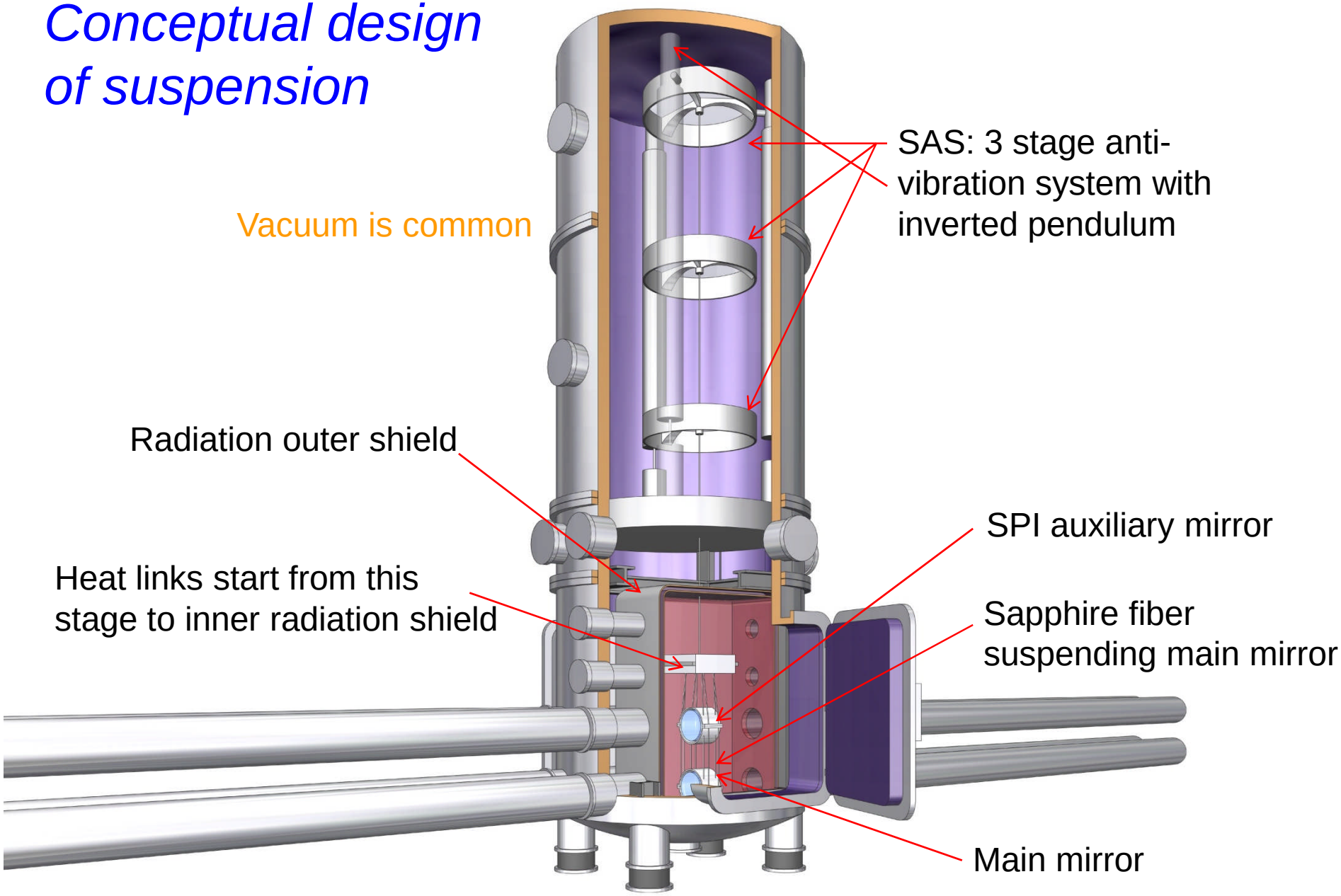




Design Sensitivity



Conceptual design of suspension



Schedule in the budget request for FY2008

110 JpnYen=1 US$

Item	Financial Year								Cost
	2008	2009	2010	2011	2012	2013	2014	After 2015	(thousand yen)
Tunnel construction									3586000
Building construction									210000
Making Vacuum Parts									3308000
Vacuum system Install									2205000
Optical System									902716
Optics Install									98784
Laser source									793210
Laser Install									9040
Cryogenic Suspension									2615720
Suspension Install									17430
SAS Isolator									229400
SAS Installation									12600
Main mirror									312900
Mirror Installation									2100
Data-taking system									315000
Data Analysis									21000
PD Salary									200000
Commissioning									
Observation									
Total	413500	3407320	4147240	4078080	3772760				14838900

US$ 135M

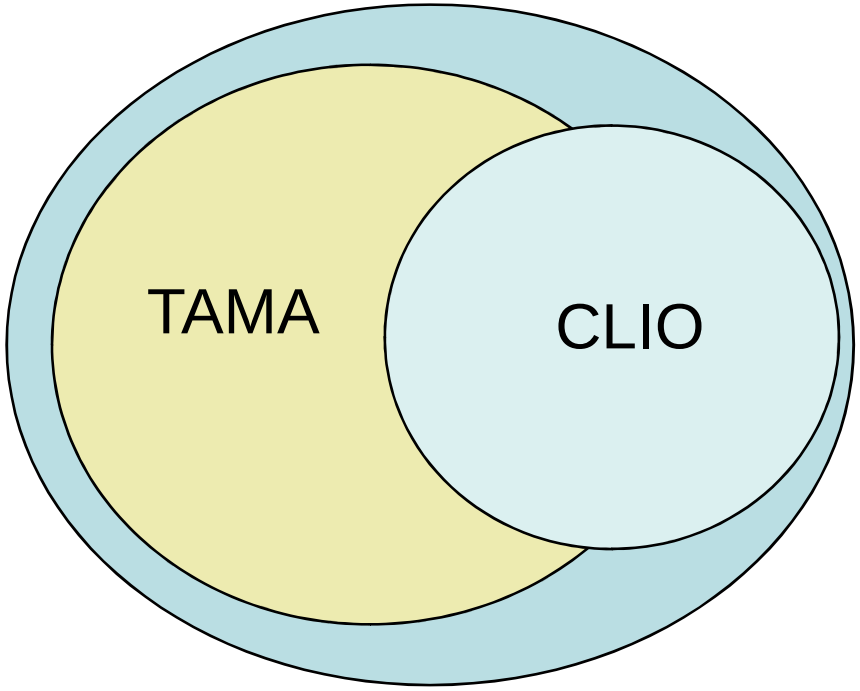
It does not include salaries & maintenances of facilities.

Man Power organization

7 Institutes &
Research Laboratories
39 researchers

8 Universities
17 researchers

13 Oversea Universities
23 researchers



LCGT Collaboration

Three directors have signed on MOU promoting LCGT on 28th, February for FY 2008. (ICRR, NAOJ, KEK)

International Collaborations

- TAMA-LIGO
  - Attachment 1 (Locking system, 1997)
  - Attachment 2 (Mirror imperfection, 1998)
  - Attachment 4 (e2e simulator, 2000)
  - Attachment 5 (SAS technology, 2000)
  - Attachment 6 (sapphire, under process, 2007)
- TAMA-VIRGO (Pwr Recycling, 1998)
- LCGT-ACIGA (R&D, 2001)

Outreach activities for LCGT

Summary

- We have acquired interferometer techniques (power recycling, Fabry-Perot Michelson, control system) by TAMA.
- LISM confirmed underground significance.
- CLIO proves the feasibility of cryogenic mirror, soon.
- LCGT will certainly detect gravitational wave events in a year.
- We will do the best for funding of FY 2008.