10th Amaldi Conference on Gravitational Waves
July 7 – 13, 2013
Uniwersytet Warszawski, Warsaw, Poland

Progress and Challenges of KAGRA

Seiji Kawamura (ICRR)
for the KAGRA collaboration

JGW-G1301721-v1


Outline:
Review of KAGRA
Current status and lessens learned
Summary


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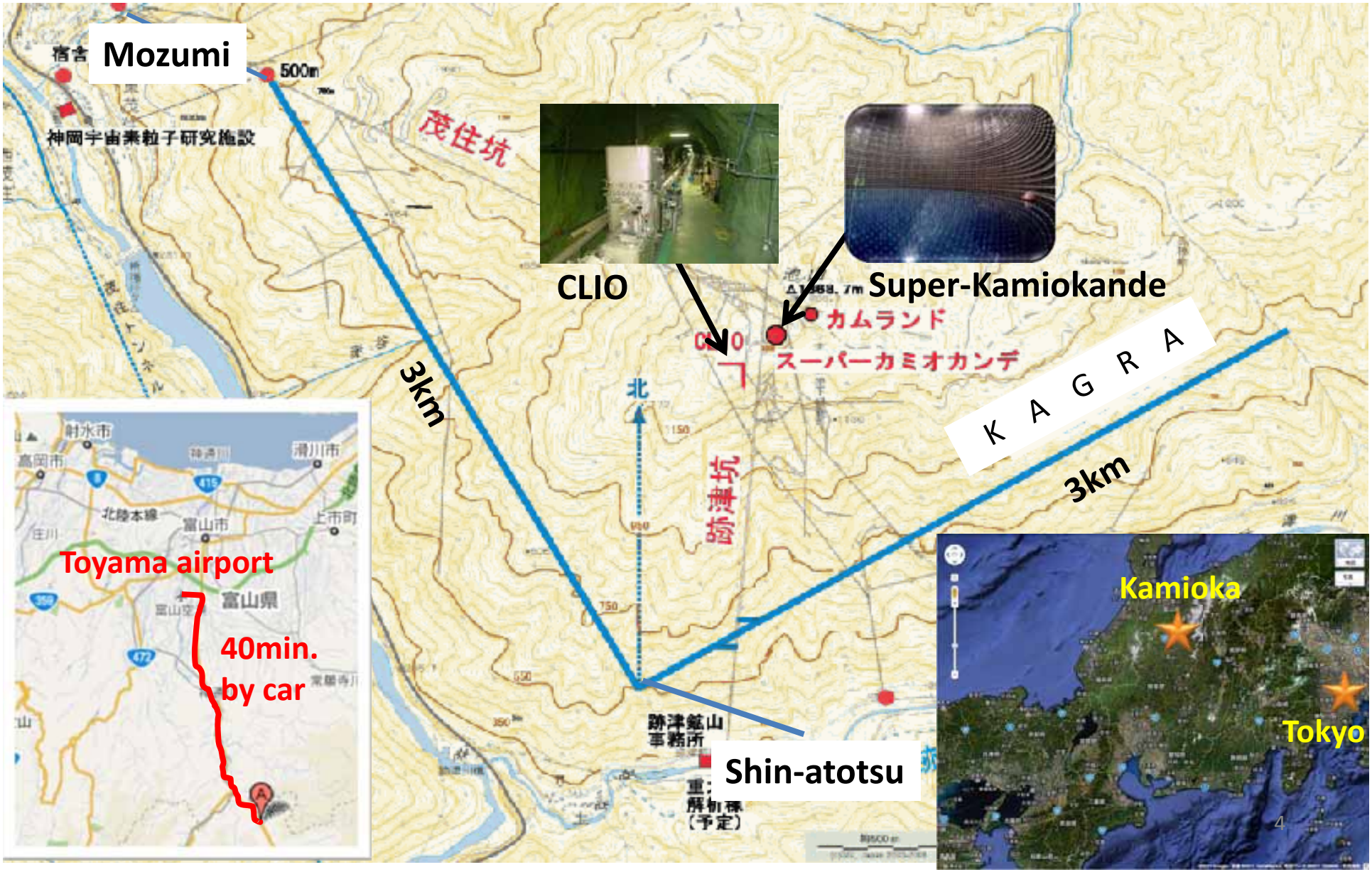
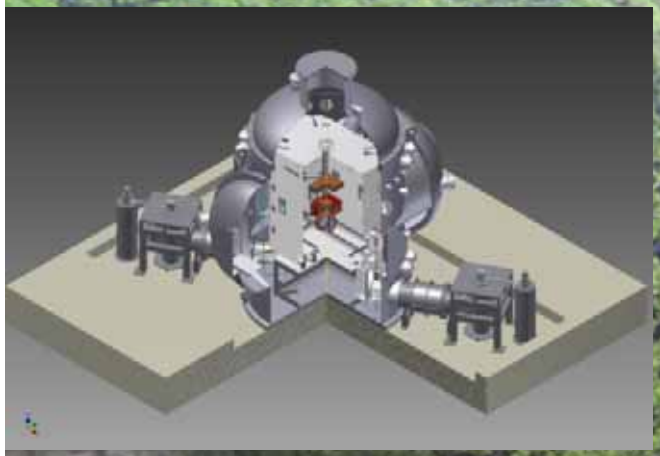
Location (Kamioka)



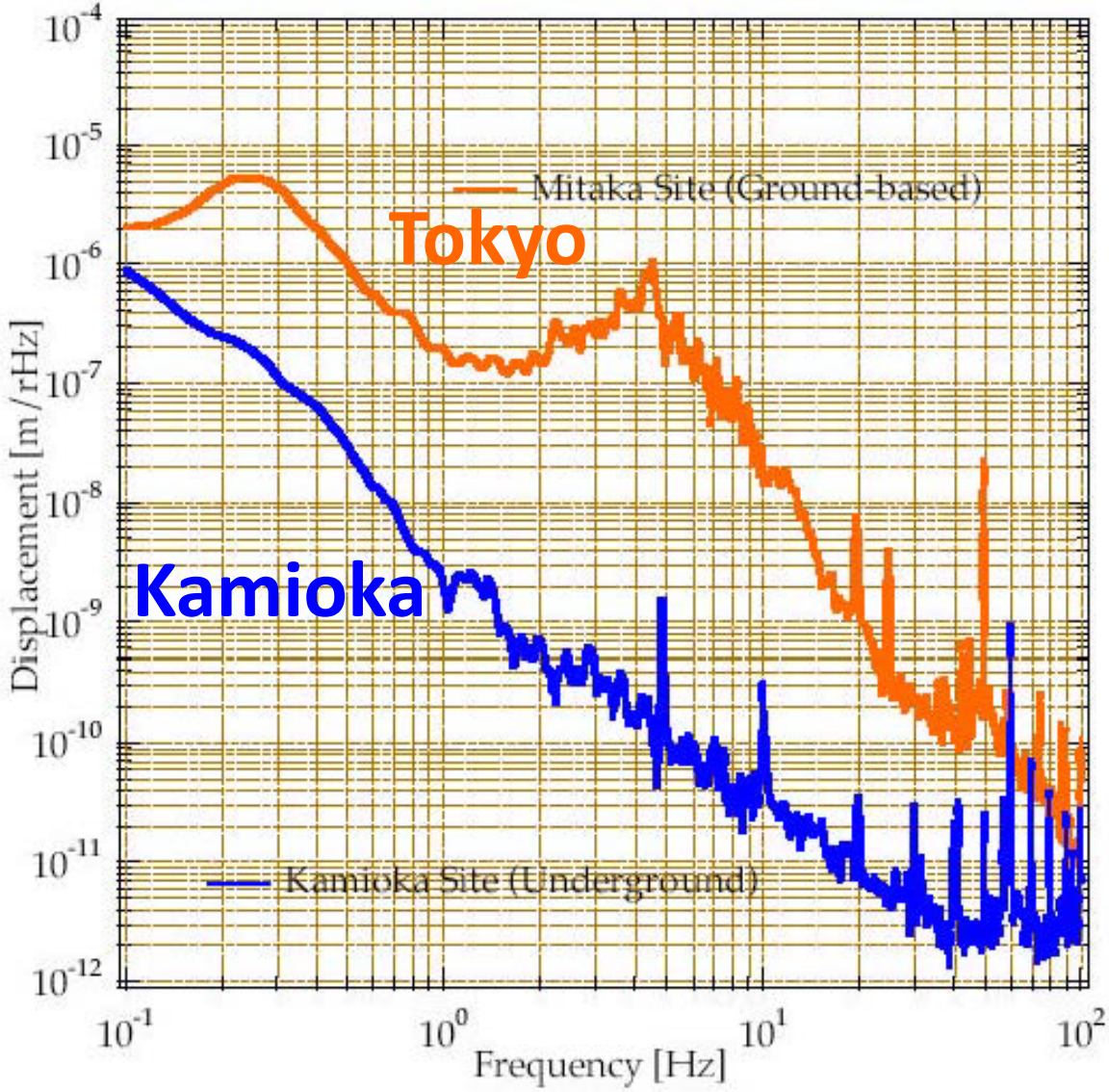
Key features of KAGRA

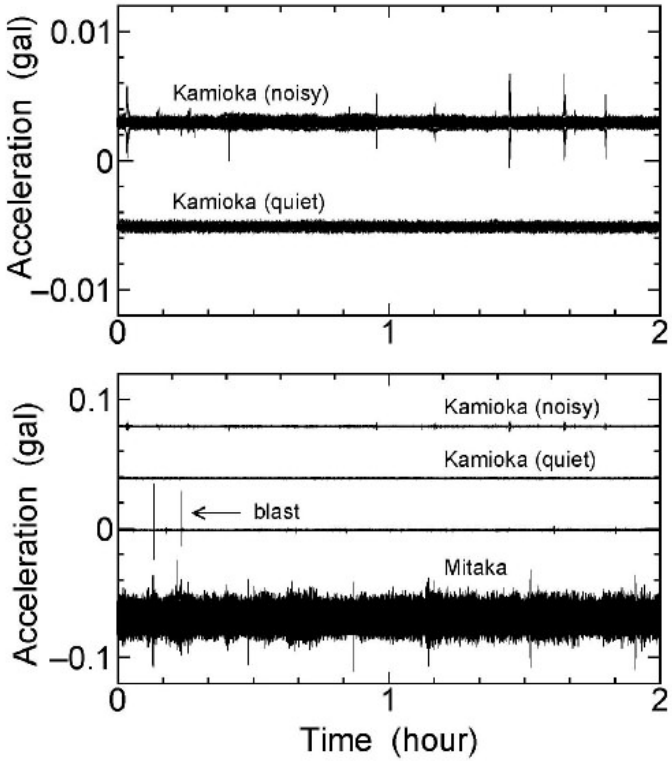
Cryogenic Mirror



Underground

Ground motion in Kamioka mine





Hard rock of Hida gneiss
(5 [km/sec] sound speed)

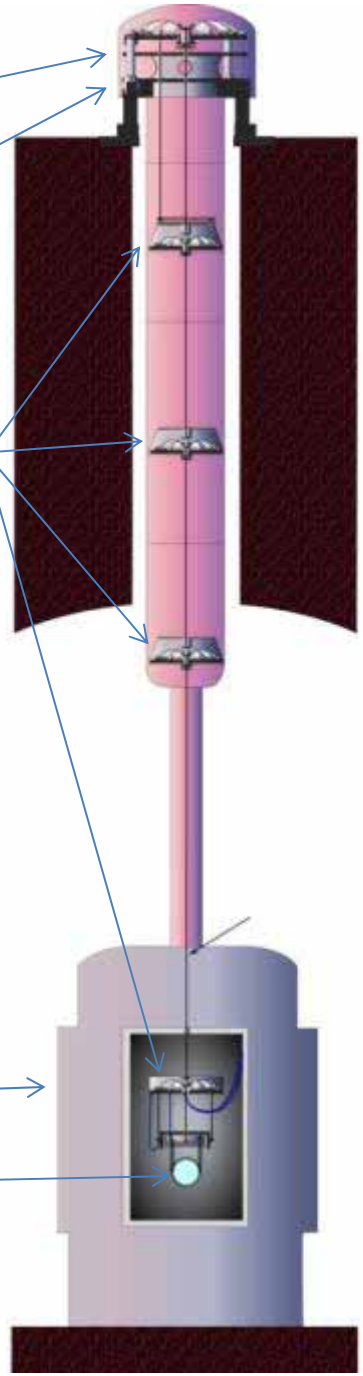
2nd floor

Chamber

Inverted pendulum

Geometrical antispring filter

Vibration isolation system



Chamber

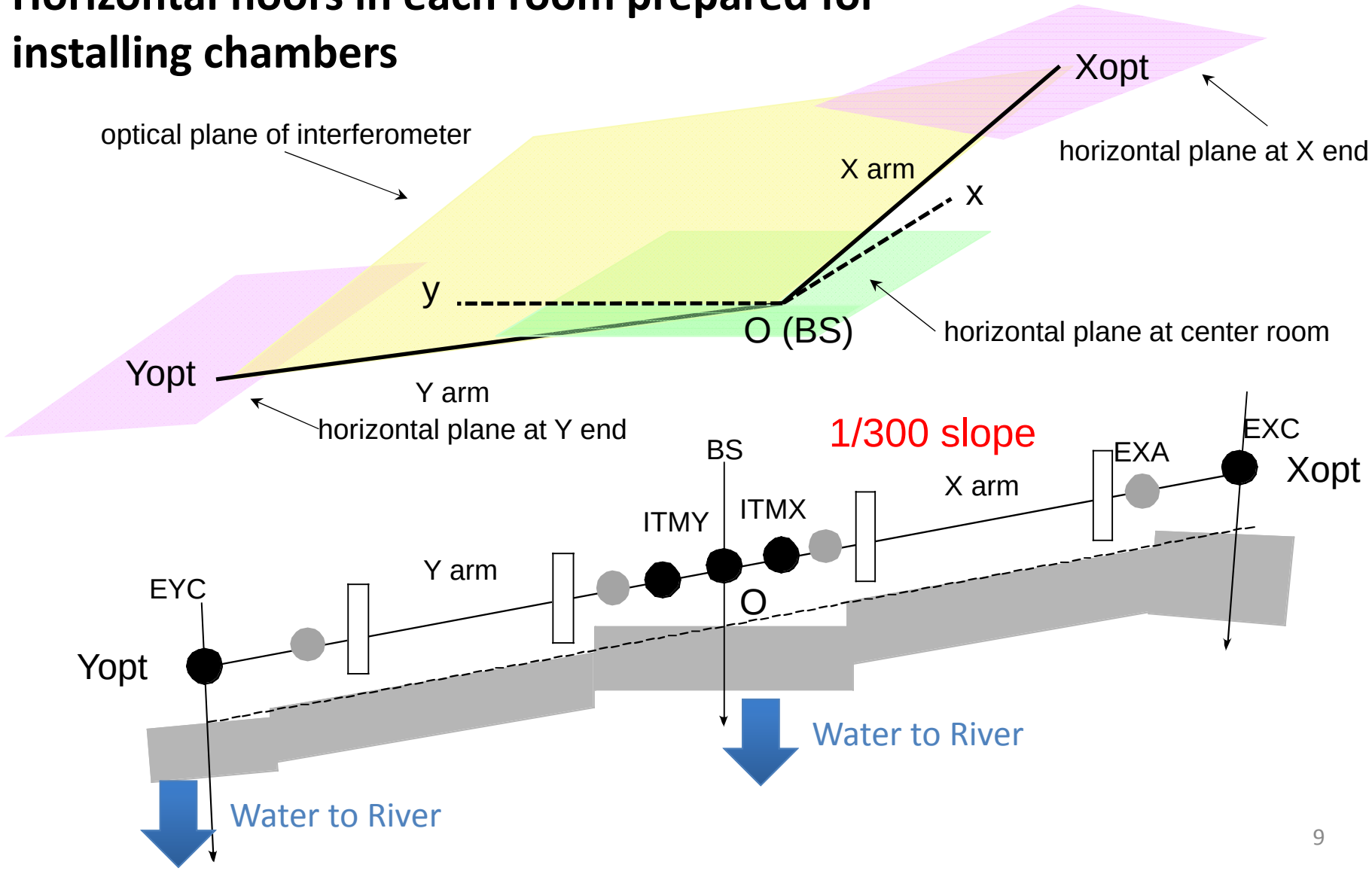
Mirror

1st floor

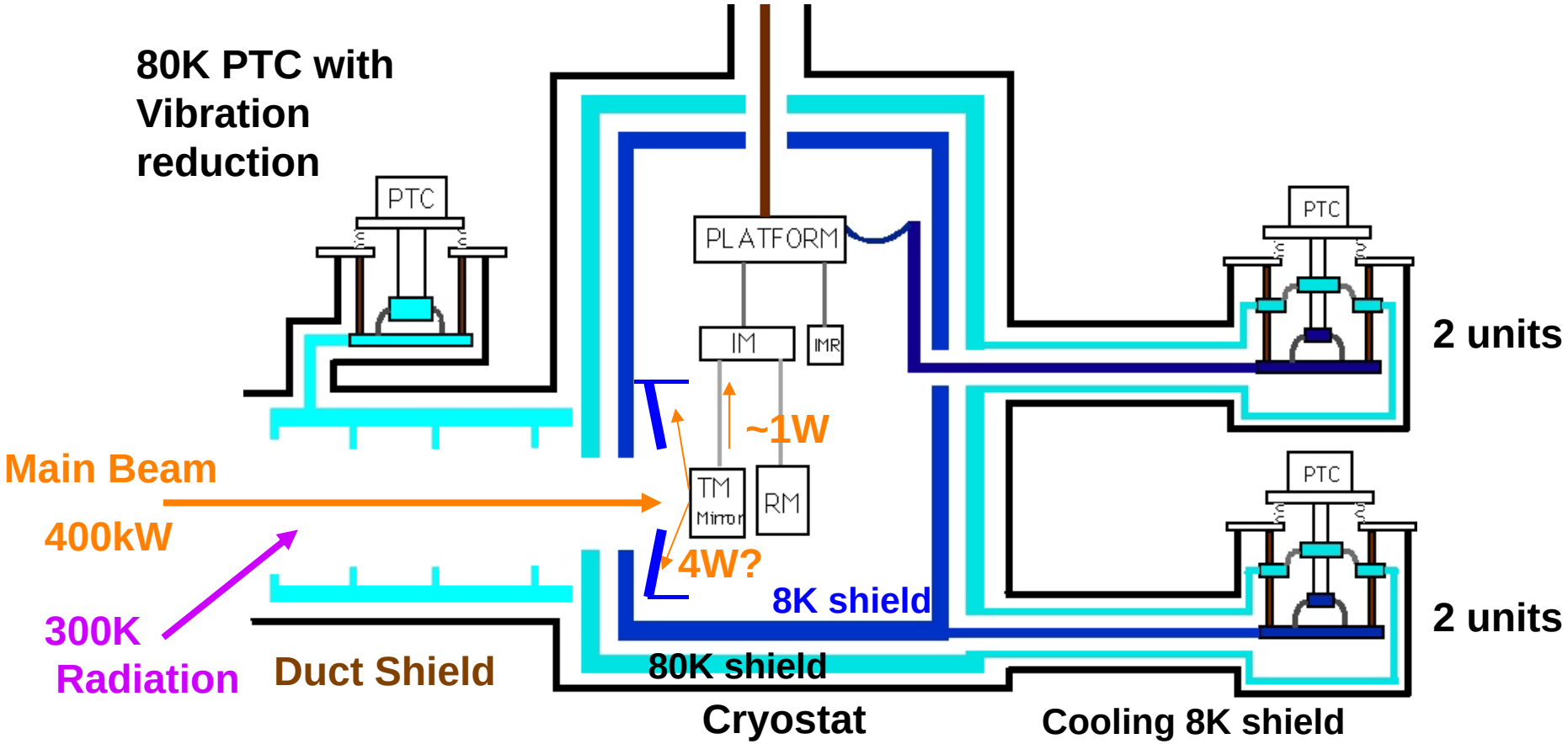
Tunnel (3D movie)

Slope

Horizontal floors in each room prepared for installing chambers

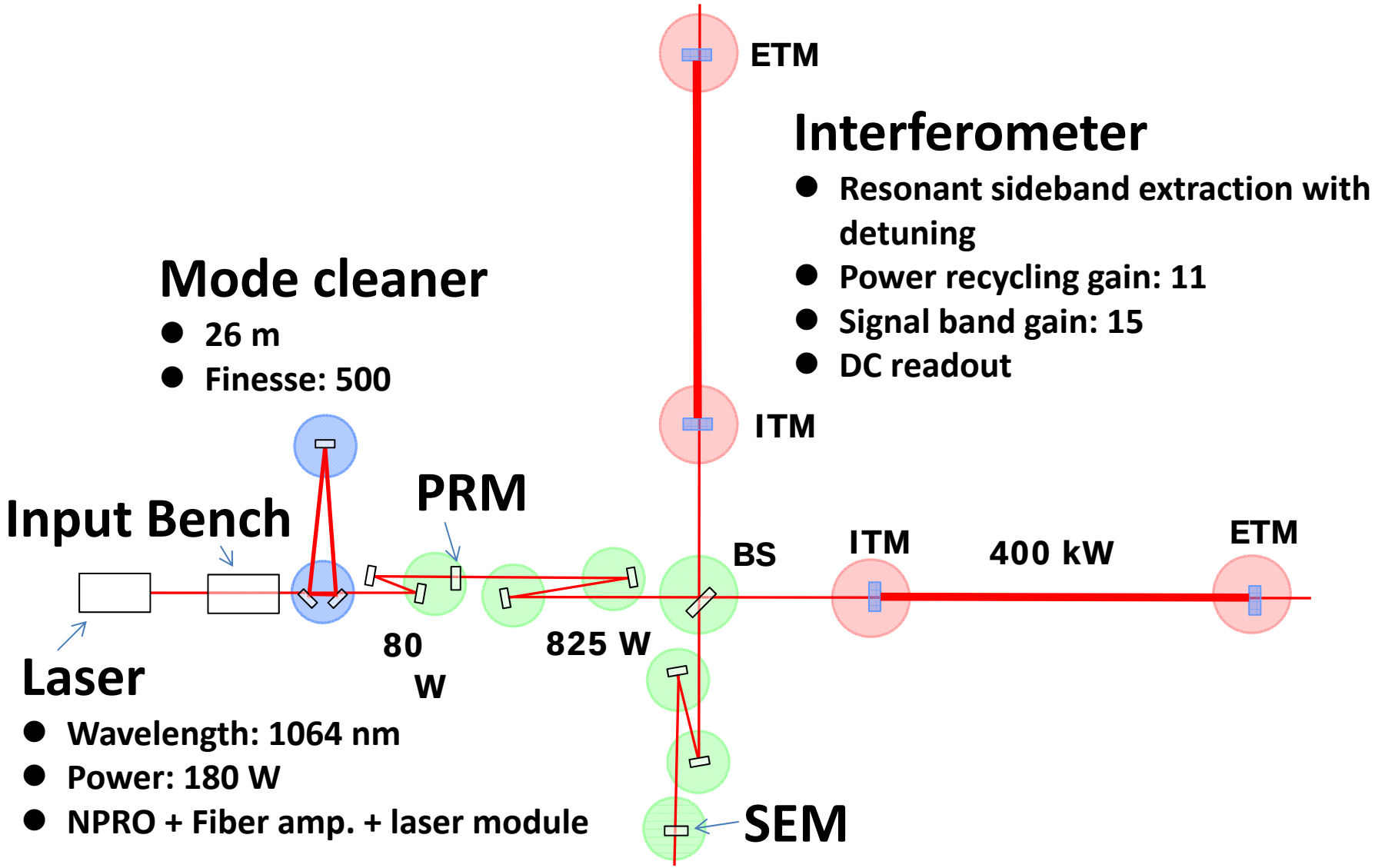


Cryogenics System

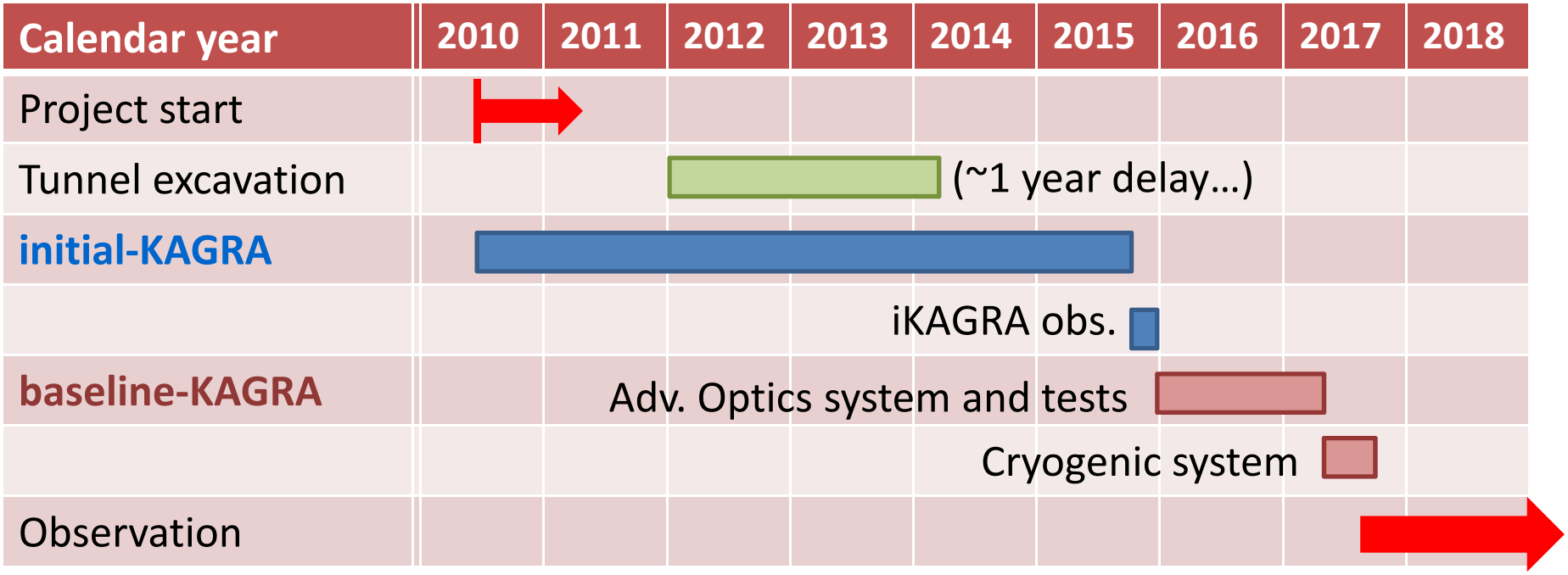


See talk by Nobuhiro Kimura on Tuesday (C3)

Optical configuration



Schedule of KAGRA



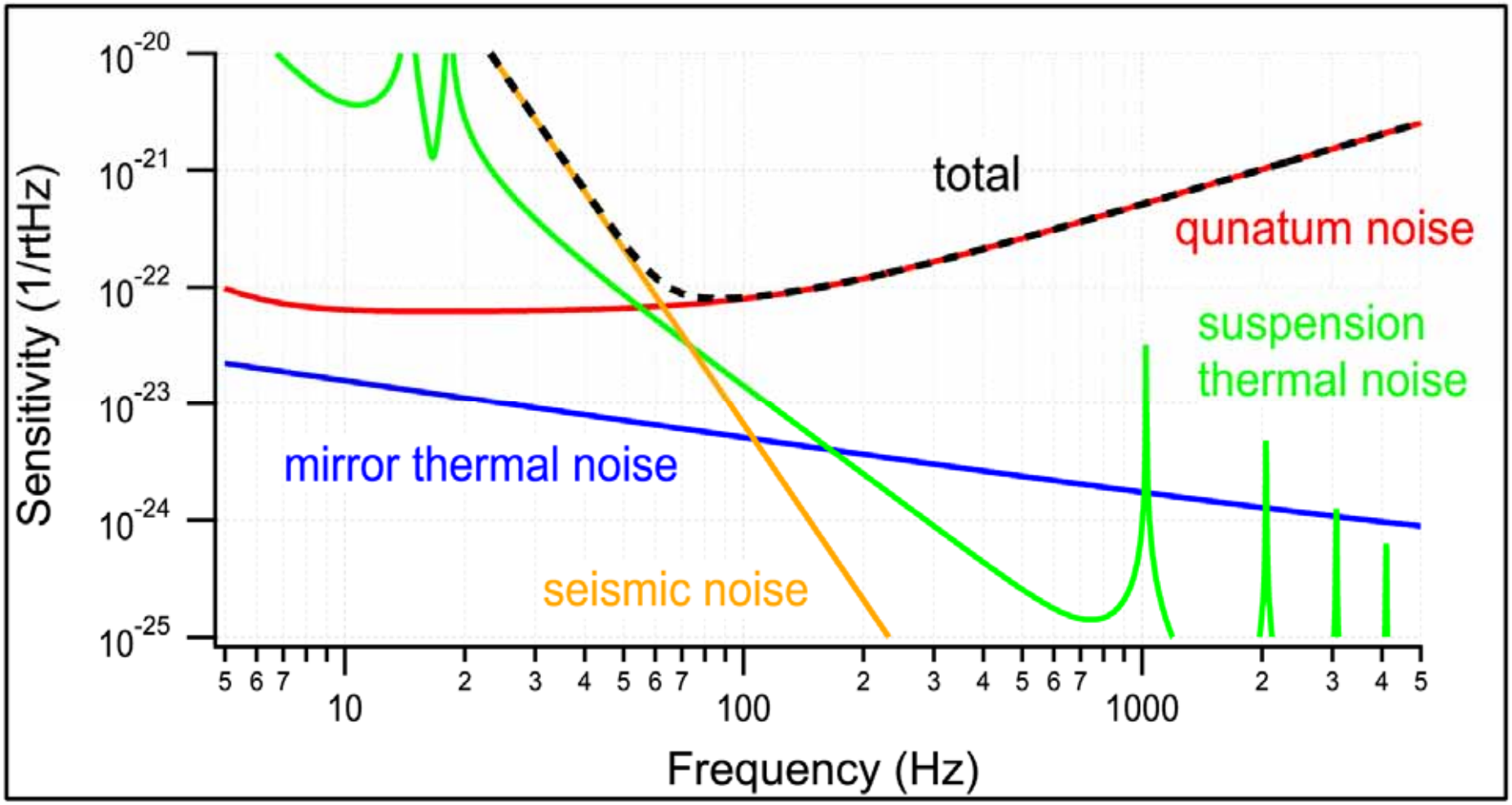
iKAGRA

- Fabry-Perot Michelson interferometer
- Room temperature
- Simple seismic isolation system

bKAGRA

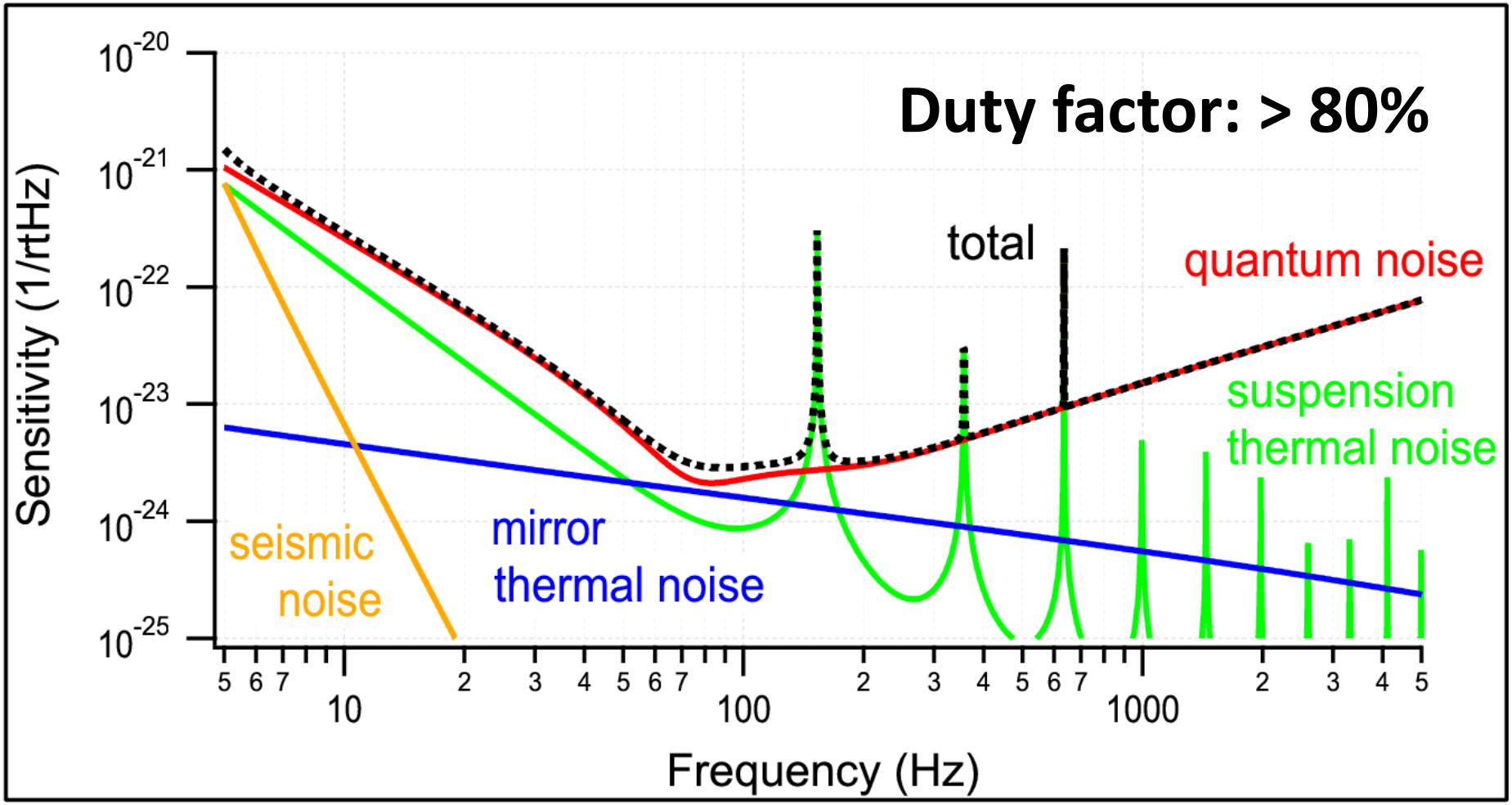
- Resonant sideband extraction with detuning
- Cryogenic temperature
- Advanced seismic isolation system

Expected (not required) sensitivity of iKAGRA



Inspiral range: 6 Mpc, Laser power: 5W, Finesse: 200, Seismic isolation system: Type-B fix

Target sensitivity of bKAGRA



Inspiral range: 167 Mpc, Mirror mass: 30 kg

Expected event rate for NS-NS coalescence

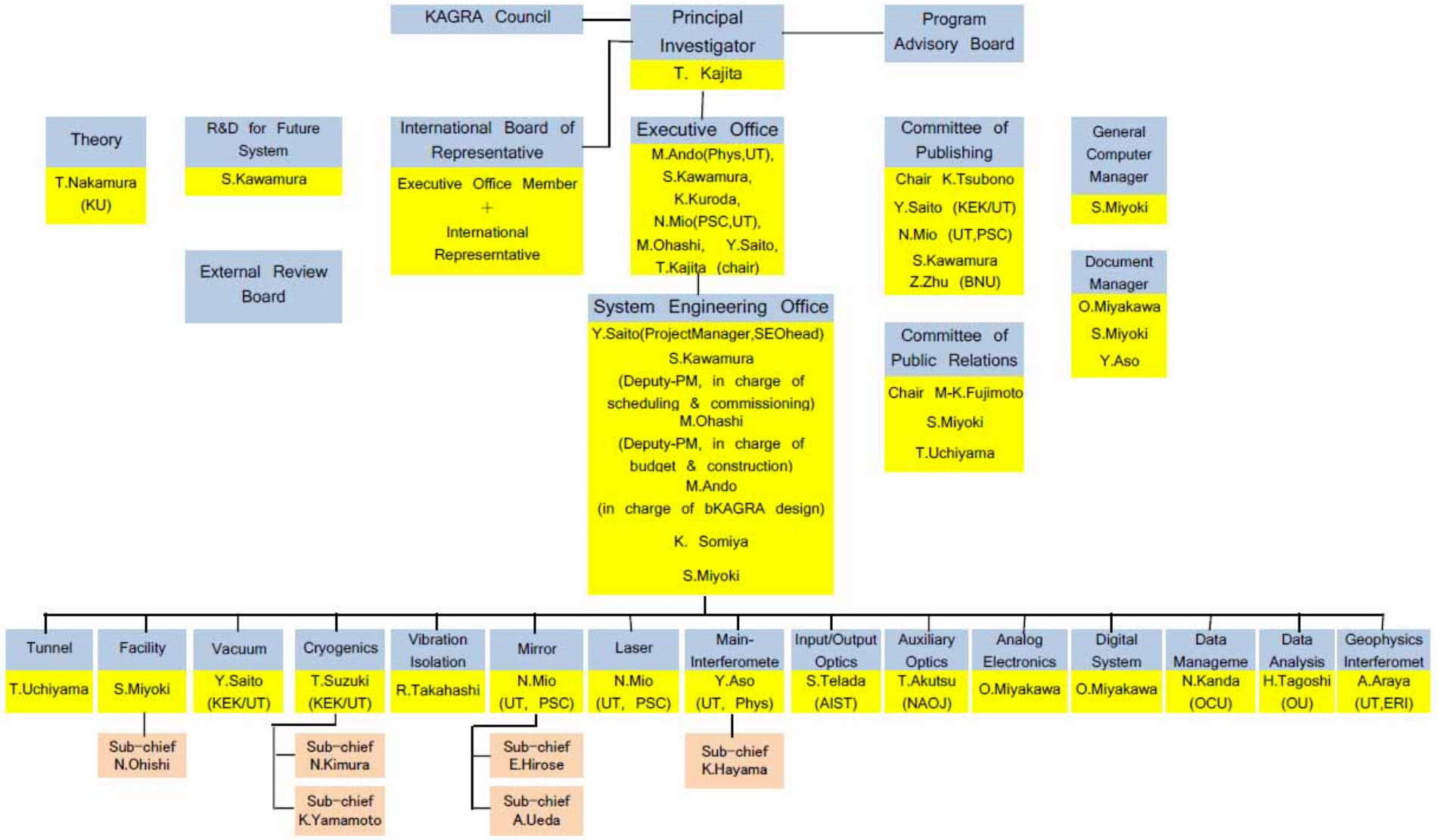
Inspiral range: 167 Mpc
(the same definition as LIGO/Virgo)

Assuming Inspiral rate per galaxy

$$118^{+174}_{-79}\,\mathrm{Myr}^{-1}$$

Expected event rate $9.8^{+14}_{-6.6}\,\mathrm{yr}^{-1}$

Organization of KAGRA



Collaboration

Toyama University

1st Toyama University-KAGRA Workshop
(Jul. 7, 2012 @ Toyama Univ.)

ET

ELiTES (ET-LCGT Telescopes: Exchange of Scientists) meeting (Oct. 3, 2012 @Europa House, Tokyo)

LIGO and Virgo

Memorandum of Understanding
between
KAGRA, LIGO and Virgo Scientific Collaborations

A. Purpose of the agreement:

The purpose of this Memorandum of Understanding (MOU) is to establish a collaborative relationship between the signatories who are seeking to discover gravitational waves and pursue the new field of gravitational wave astronomy. The main scientific motivation is that the maximum return from gravitational wave observations is through simultaneous joint measurements by several instruments.

This MOU provides for joint work between the scientific collaborations of KAGRA, LIGO and Virgo. We enter into this agreement in order to lay the groundwork for decades of world-wide collaboration. When sensitive detectors are in operation, we intend to carry out the search for gravitational waves in a spirit of teamwork.

Details and extensions to this MOU will be provided in Attachments agreed by the parties.

Korean GW group

4th Korea-Japan workshop on KAGRA
(Jun. 18, 2013 @Osaka Univ.)


Outline:
Review of KAGRA
Current status and lessens learned
Summary

Tunnel excavation

Mozumi Entrance

New-Atotsu Entrance

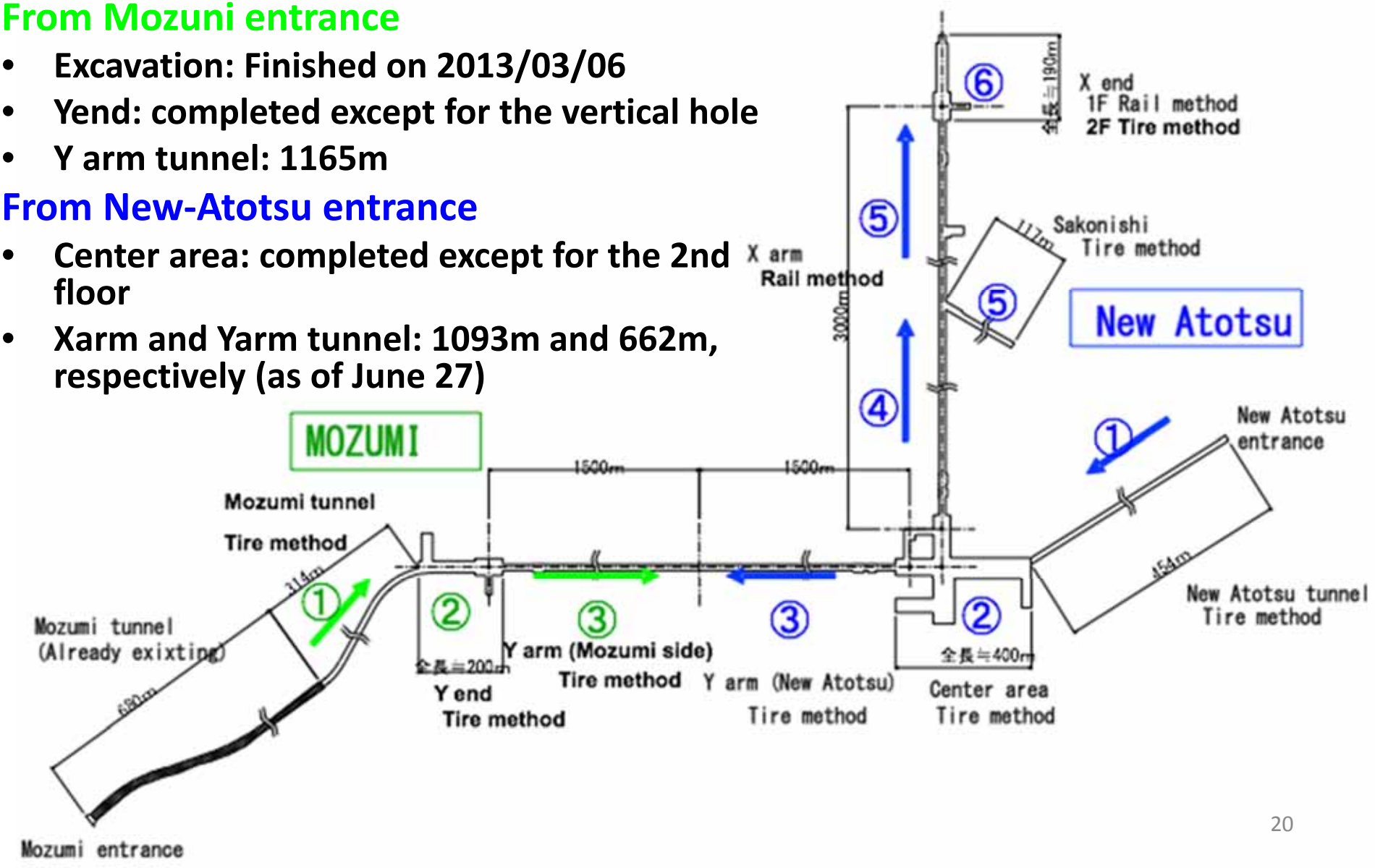
Current status of tunnel excavation

From Mozuni entrance

- Excavation: Finished on 2013/03/06
- Yend: completed except for the vertical hole
- Y arm tunnel: 1165m

From New-Atotsu entrance

- Center area: completed except for the 2nd floor
- Xarm and Yarm tunnel: 1093m and 662m, respectively (as of June 27)

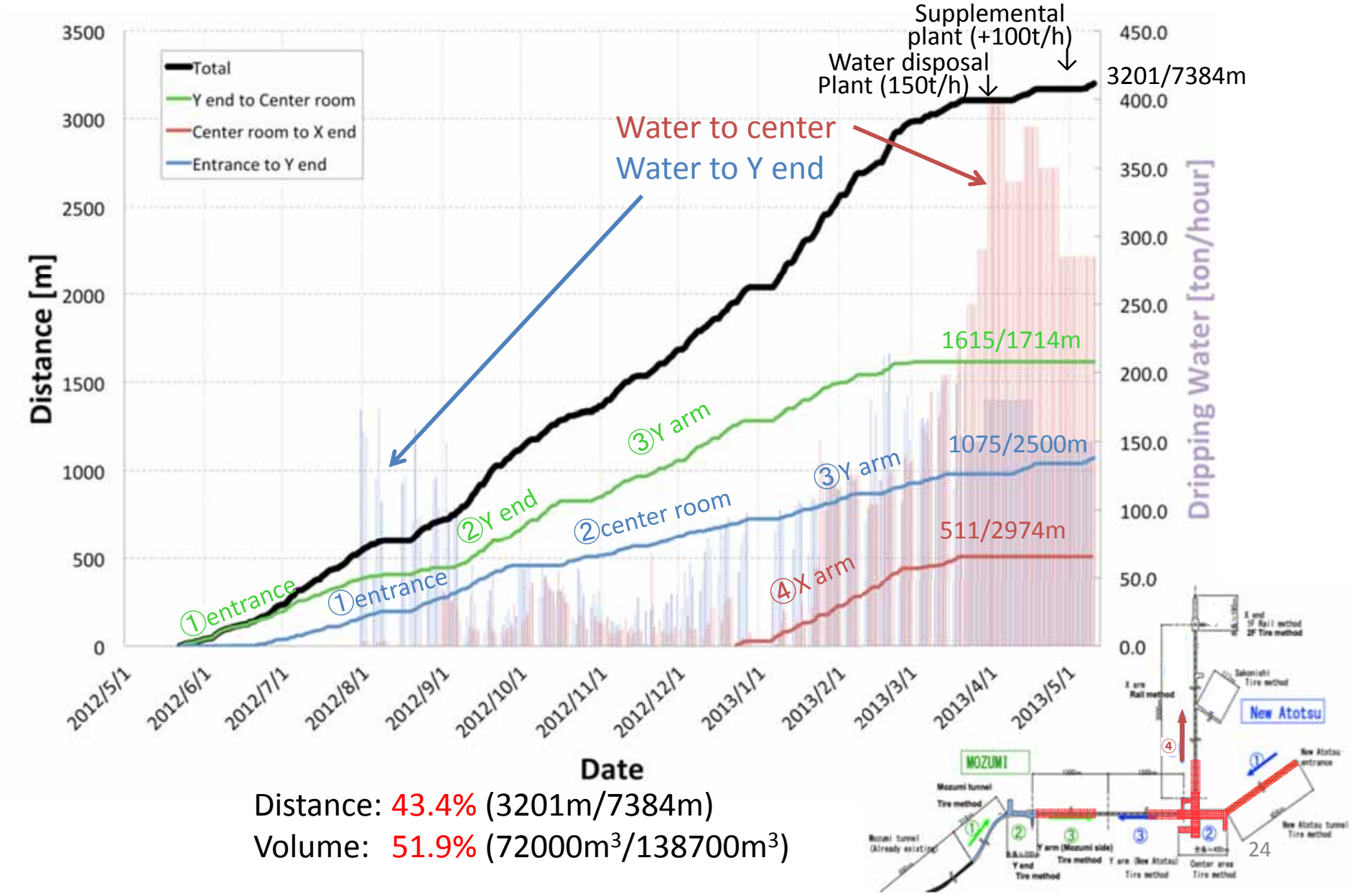


Blasting (Movie)

Dripping water (Movie)

Dripping water (Movie)

Dripping water

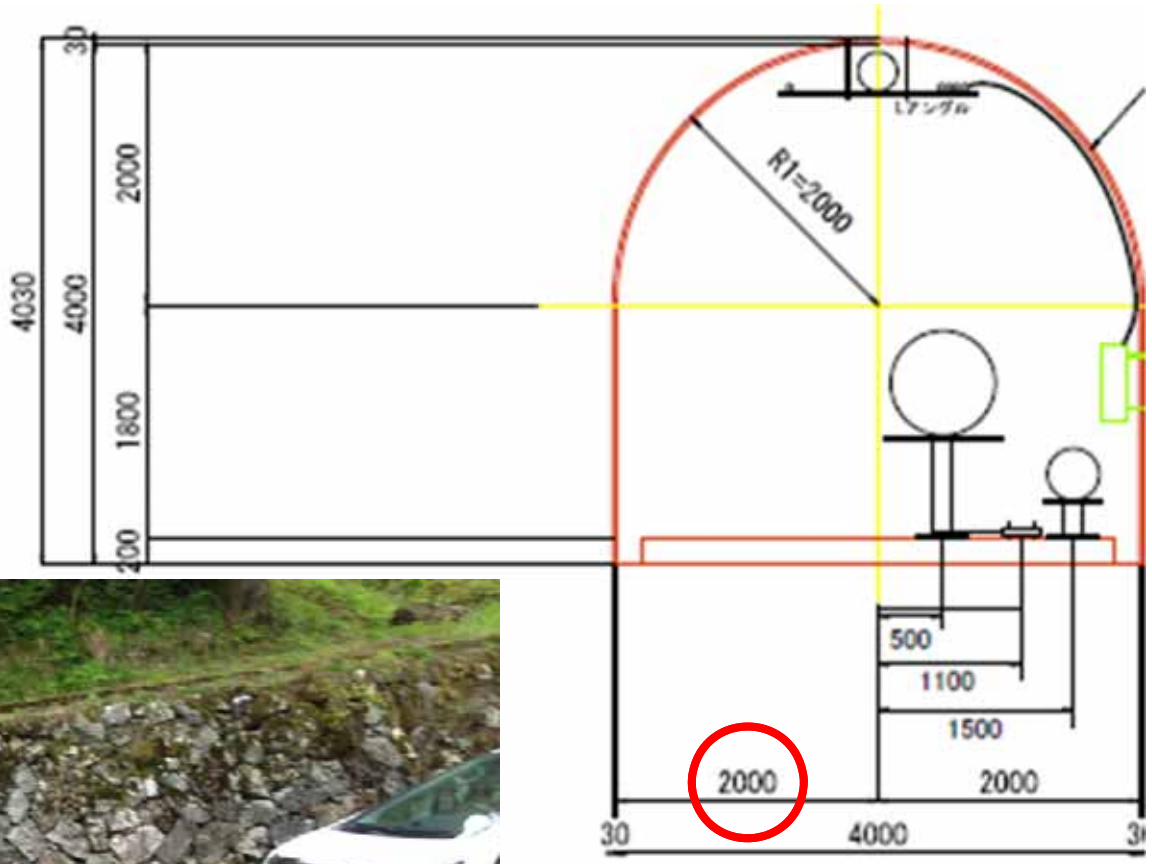


Distance: 43.4% (3201m/7384m)

Volume: 51.9% (72000m^3/138700m^3)

Transportation inside arms

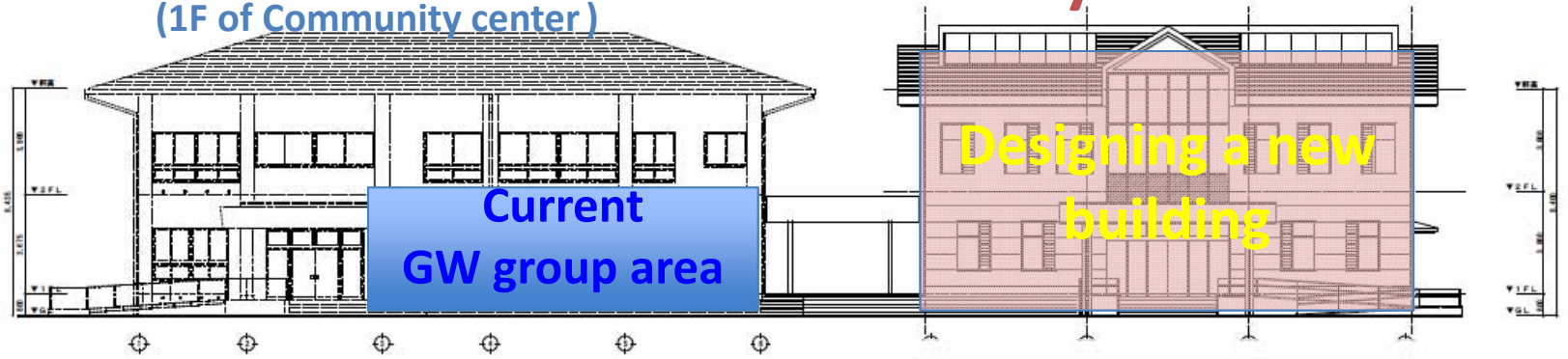
- Electric car
- 6hous charge, 70km drive
- Max 60km/h
- Max 12 ° slope
- ~8000USD



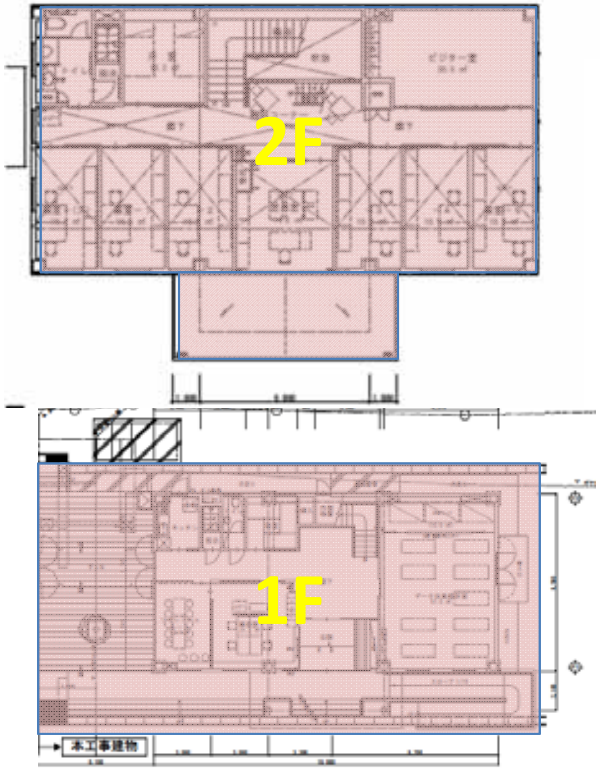
New building at Kamioka

Last year: ~150m^2

(1F of Community center)



This year: 338m^2

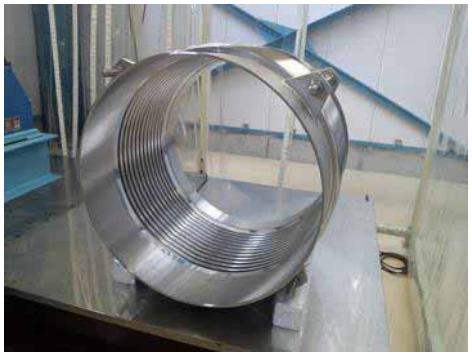


Beam tubes

12m, Φ800mm beam tubes for 3km x 2 arms:

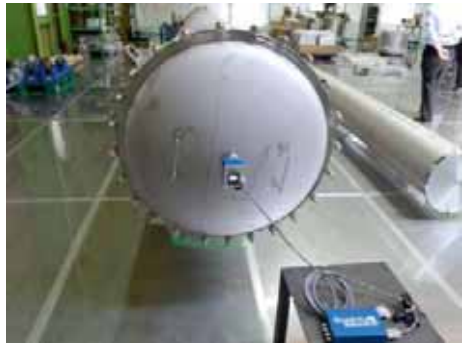
Delivered in 2012

Press to form a beam tube



Bellows for each beam tube

Baking at MIRAPRO Co.
Noda/MESCO, Kamioka



Test at MIRAPRO Co. Noda

Transportation to Kamioka

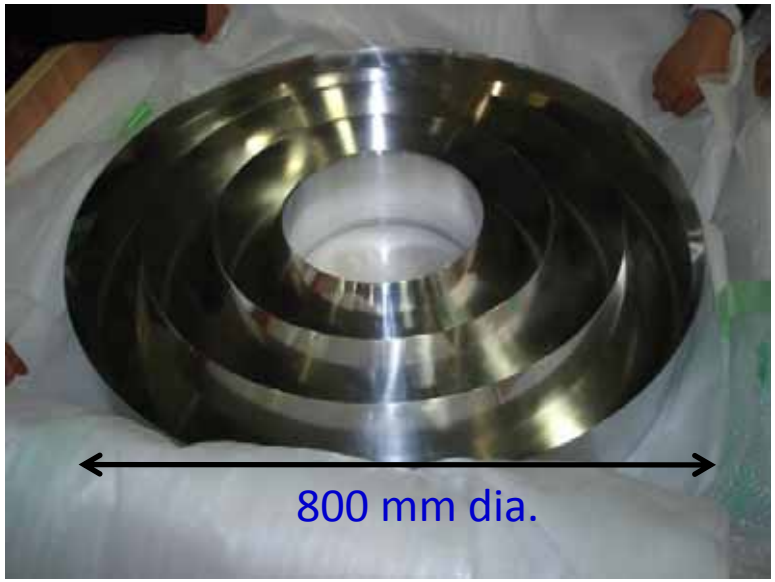
Cryostat construction and test

Construction and cooling tests were finished!

See talk by Nobuhiro Kimura on Tuesday (C3)

Baffle

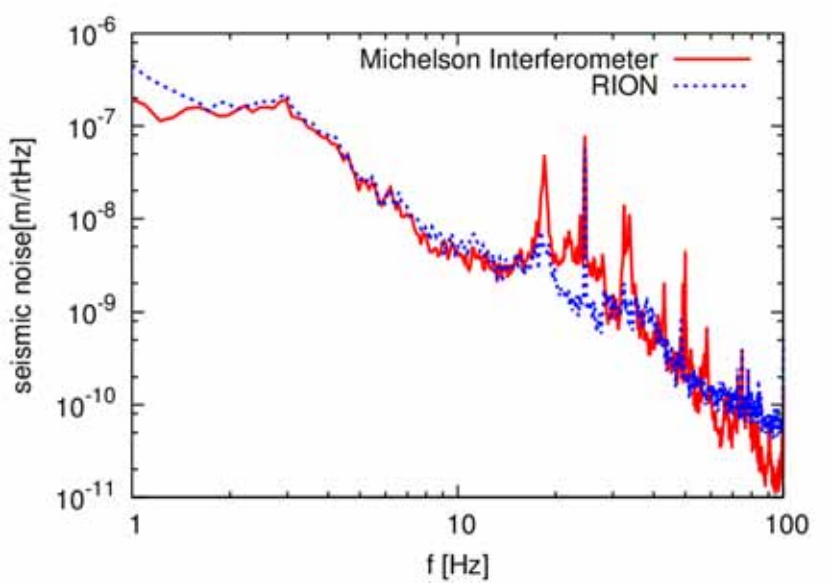
A prototype of the narrow-angle baffle

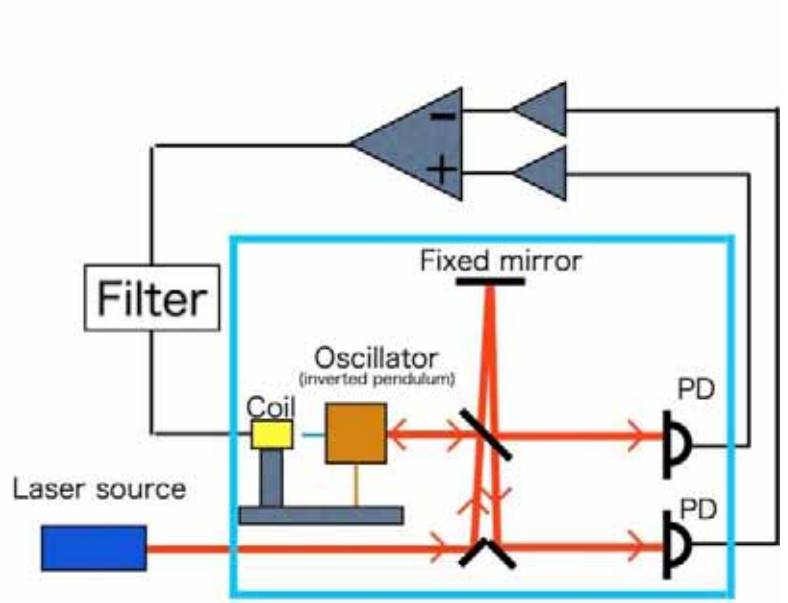


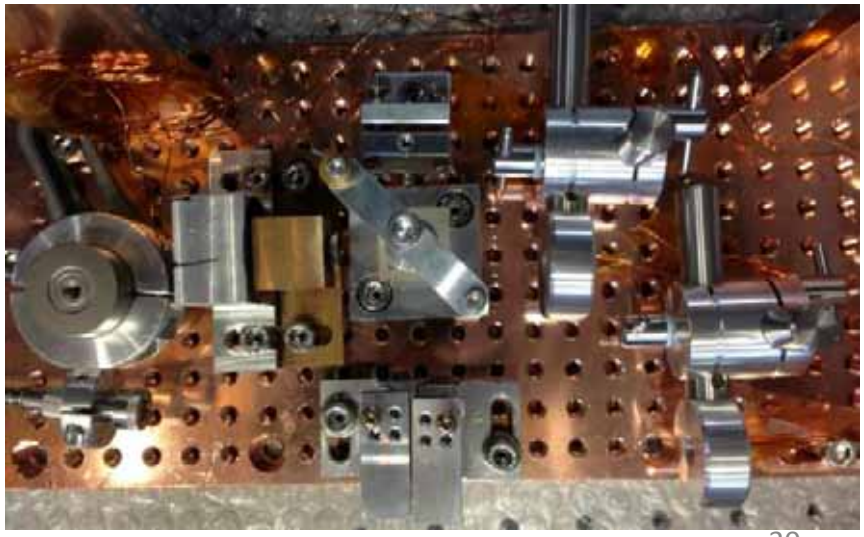
See poster by Tomotada Akutsu (C3)

Vibration caused by cryocooler

Vibration inside the cryostat with the cryocooler on has been measured.

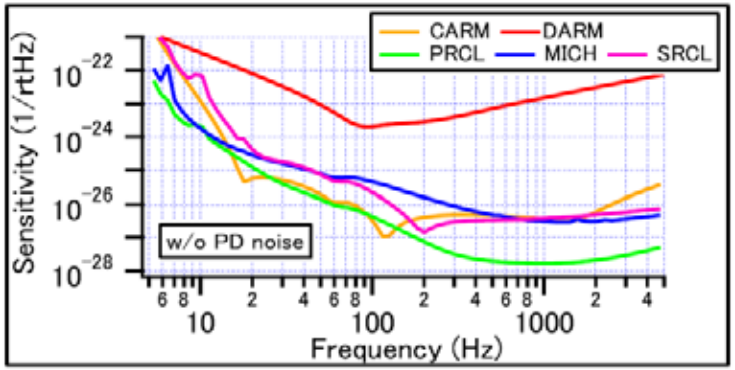






See poster by Dan Chen (C3)

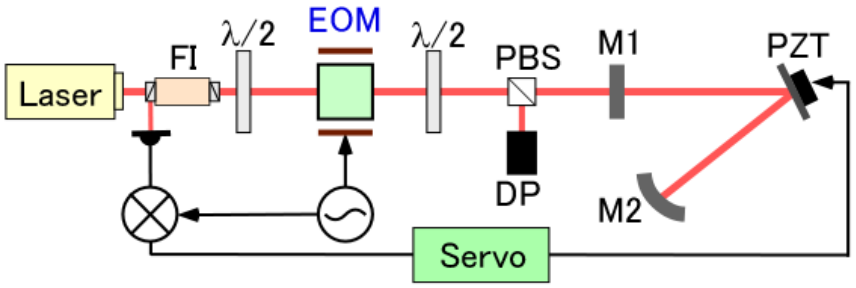
DRSE control noise and a solution



Detuning of the SR cavity causes phase rotation of the control PM SBs.

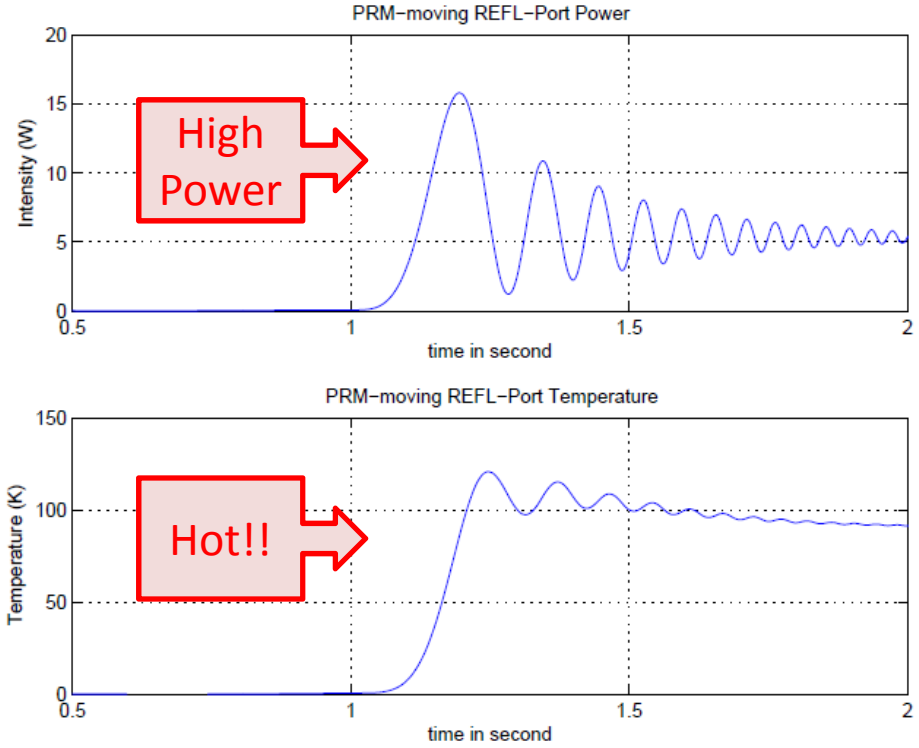
The phase rotation produces an offset and increases detector noise.

In KAGRA, we add AM SBs to cancel the offset at the signal extraction port.



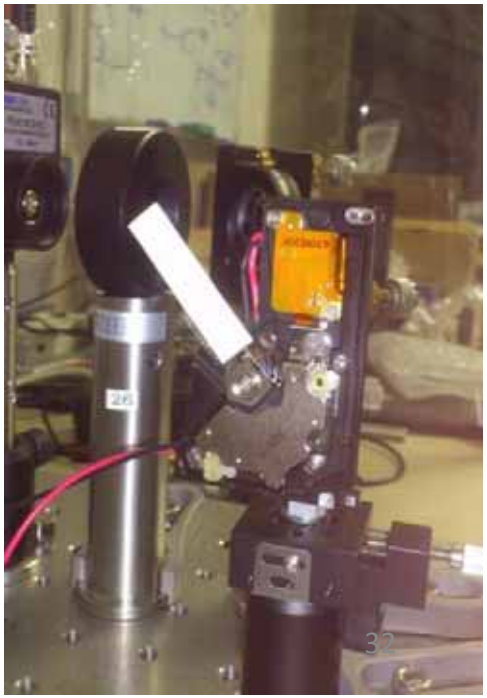
See poster by Nana Saito (C3)

Beam shutter for KAGRA



High power beam on PD at unlock

High-speed shutter is necessary

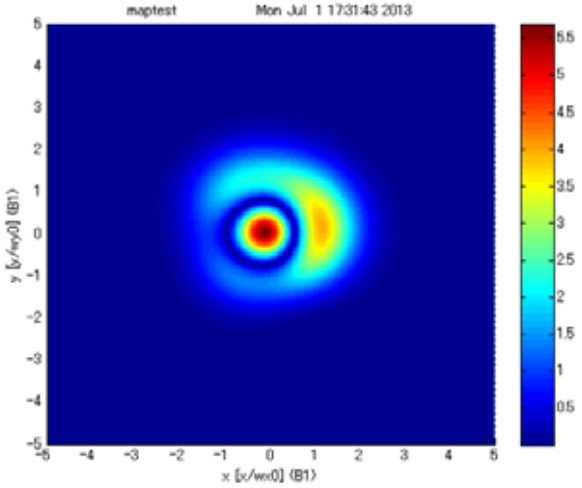


- E2E simulation to estimate the power at unlock
- Trade-off between shutter speed and noise
- Prototype experiment

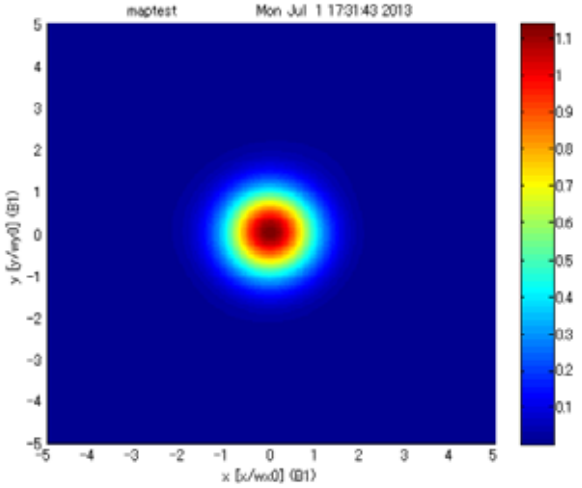
See poster by Shinichiro Ueda (C3)

Output mode-cleaner for KAGRA

FINESSE simulation results

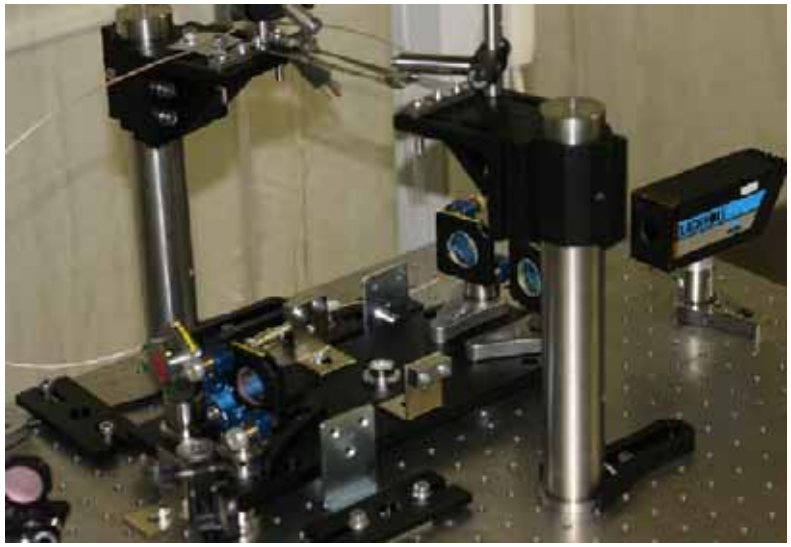


before OMC



after OMC (L=87cm)

- FINESSE simulation for KAGRA OMC using a calculated mirror map
- Prototype experiment for LSC/ASC



See poster by Ayaka Kumeta (C3)

Summary

- **KAGRA has cryogenic and underground GW detector (2.5-generation).**
- **We plan to build KAGRA in two steps: iKAGRA and bKAGRA.**
- **We will start installing iKAGRA in 2014.**
- **We plan to start observation with bKAGRA at the end of 2017.**