

Recent News from KAGRA



Masaki Ando
(National Astronomical
Observatory of Japan)

- News in project management
 - Schedule, budget, organization
 - International collaborations
- News in antenna construction
 - Tunnel, Vacuum, Cryo-system
 - Vibration Isolation

KAGRA (かぐら)

Large-scale Cryogenic Gravitational-wave Telescope
2nd generation GW detector in Japan



Large-scale Detector

Baseline length: 3km

High-power Interferometer

Cryogenic interferometer

Mirror temperature: 20K

Underground site

Kamioka mine,

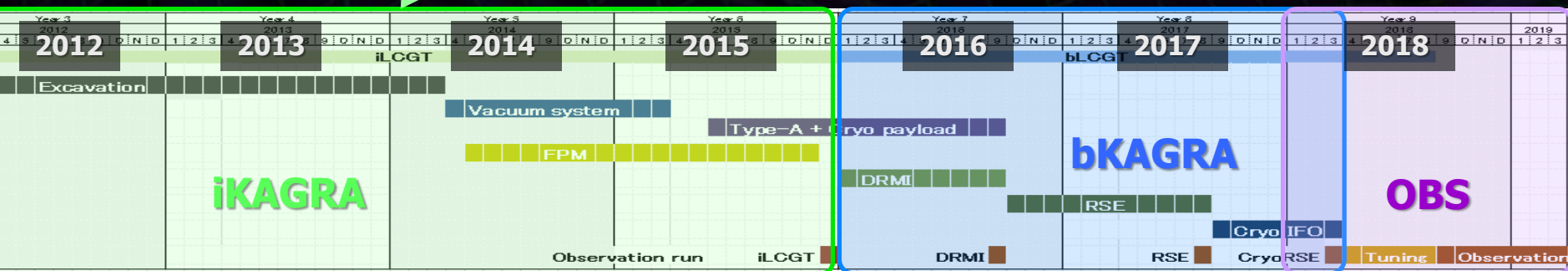
1000m underground

KAGRA Schedule

- **iKAGRA** (2010.10 – 2015.12)

3-km FPM interferometer

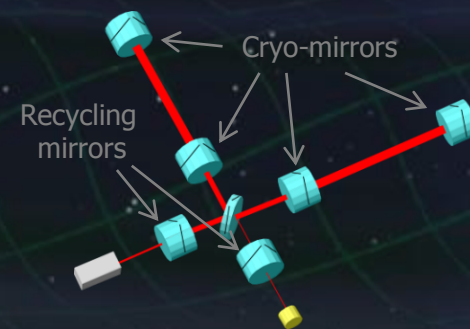
- Baseline 3km room temp.
- Operation of total system with simplified IFO and VIS.



- **bKAGRA** (2016.1 – 2018.3)

Operation with full config.

- Final IFO+VIS configuration
- Cryogenic operation.

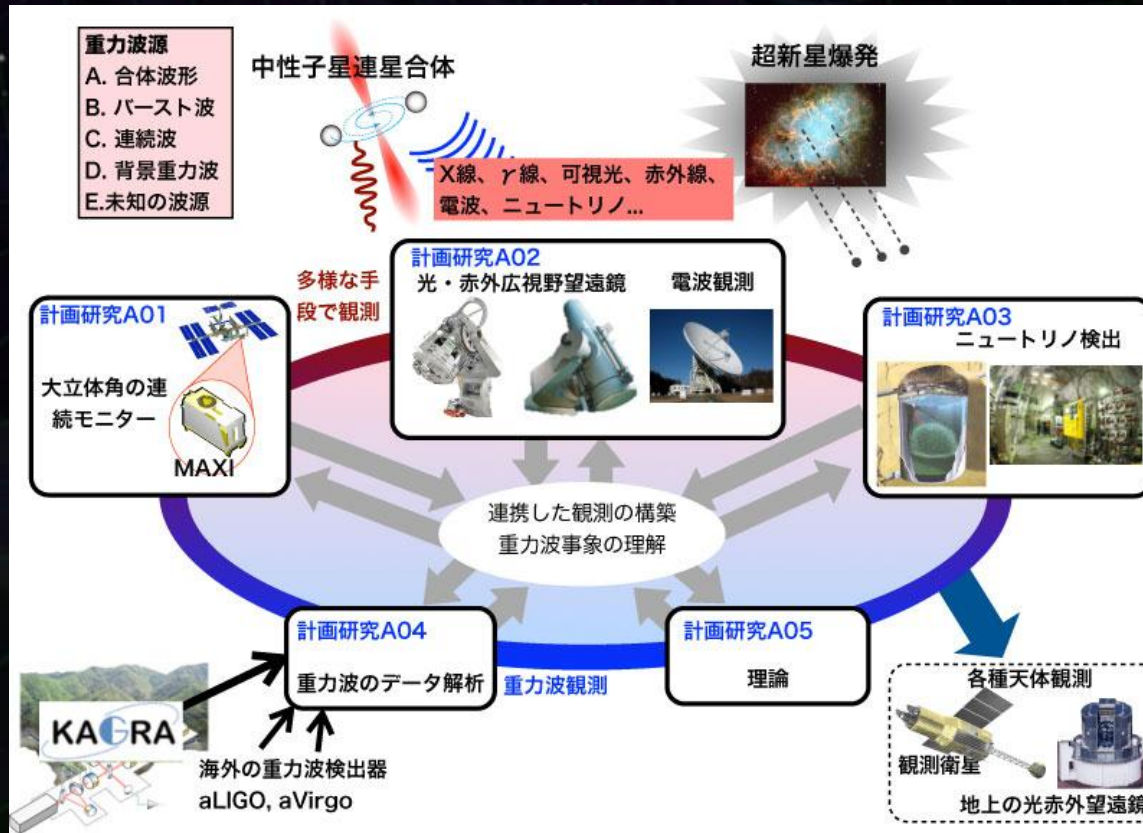


Budget Status

- FY2012 is the last year of
`Leading-edge Research Infrastructure Program'.
→ We are asking to extend the period.
- Budget for bKAGRA has been submitted from MEXT to Ministry of Finance. (4 year budget starting in FY 2013)
- The Grants-in-Aid for Scientific Research
 - `Scientific Research on Priority Areas' for the multi-messenger astronomy. → Approved and started.
 - `Specially Promoted Research' for bKAGRA construction (postdocs, engineers, travels and various studies.)
Failed in this year → New proposal submitted (Nov 2012).

Multi-messenger Astronomy

- Based on the approved Grants-in-Aid for Scientific Research: 'Scientific Research on Priority Areas' → 4.5-yr project.
- GW theory, GW data analysis, EM transients, and Neutrino. (KAGRA and other GW experiment are not included.)



Schedule and Budget

FY2010 FY2011 FY2012 FY2013 FY2014 FY2015 FY2016 FY2017

Budget

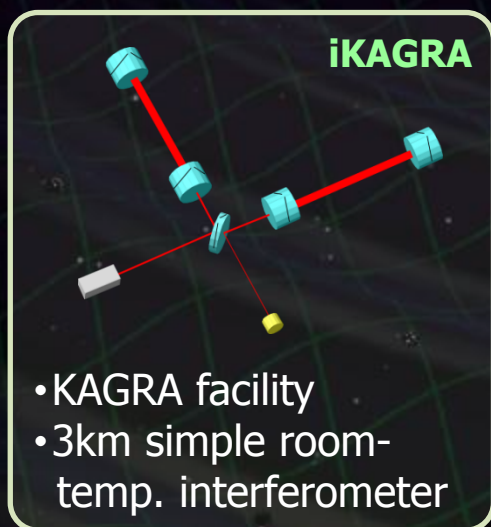
'Leading-edge Research Infrastructure' program (~98M\$) for iKAGRA

'Specially Promoted Research' program (~5M\$) for detector upgrade

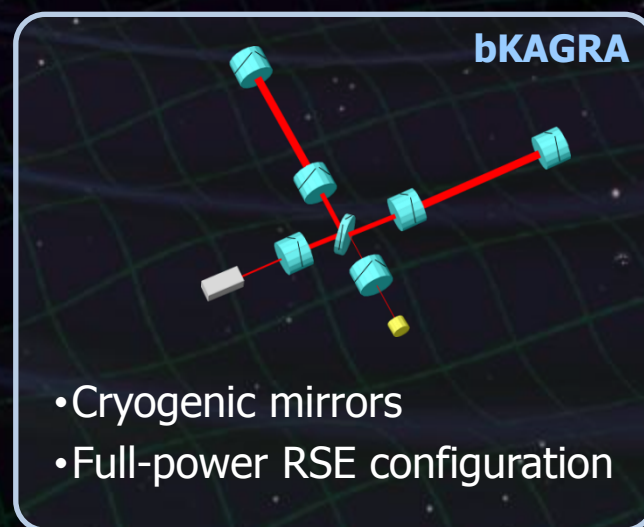
Budget from MEXT (~33M\$) for excavation

Budget from MEXT (~20M\$) for detector upgrade

KAGRA configuration



Upgrade



Purpose

Preparation of infrastructure

GW detection and astronomy

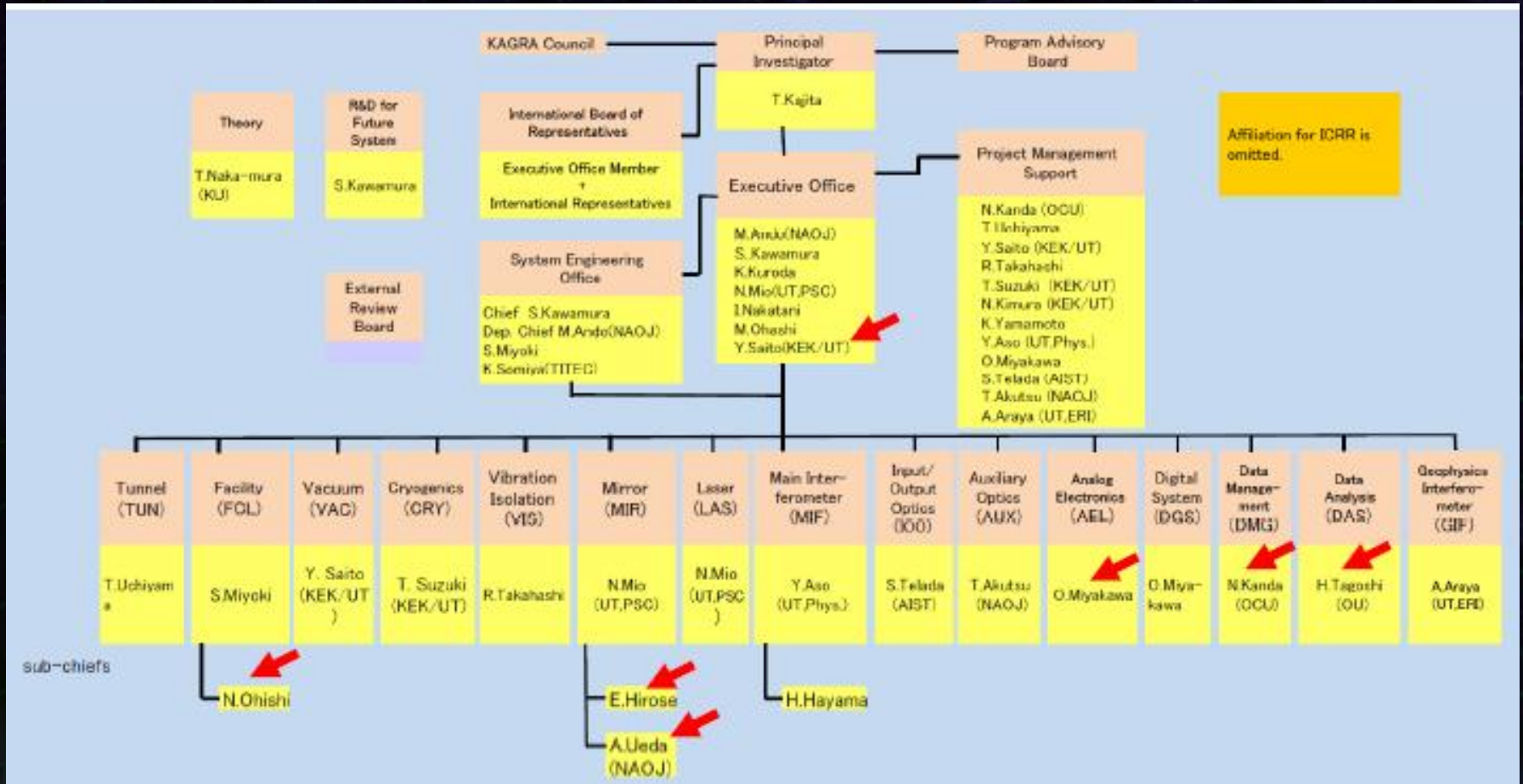
- Discussions on iKAGRA scope
 - External Review (April 17- 20, 2012)
 - * Recommend to consider about **enhancing** the scope.
 - * Better isolation, Silica fiber, Higher power.
 - Program Advisory Board (Aug 17 - 18, 2012)
 - * Recommend to consider about **de-scoping** iKAGRA.
 - * Schedule, financial, and man-power constraint.
 - **MEXT recommendation** : start obs. in 2017.



- We decided not to change iKAGRA scope.
- Observation start is first run with cryogenic interferometer.

Organization Updated

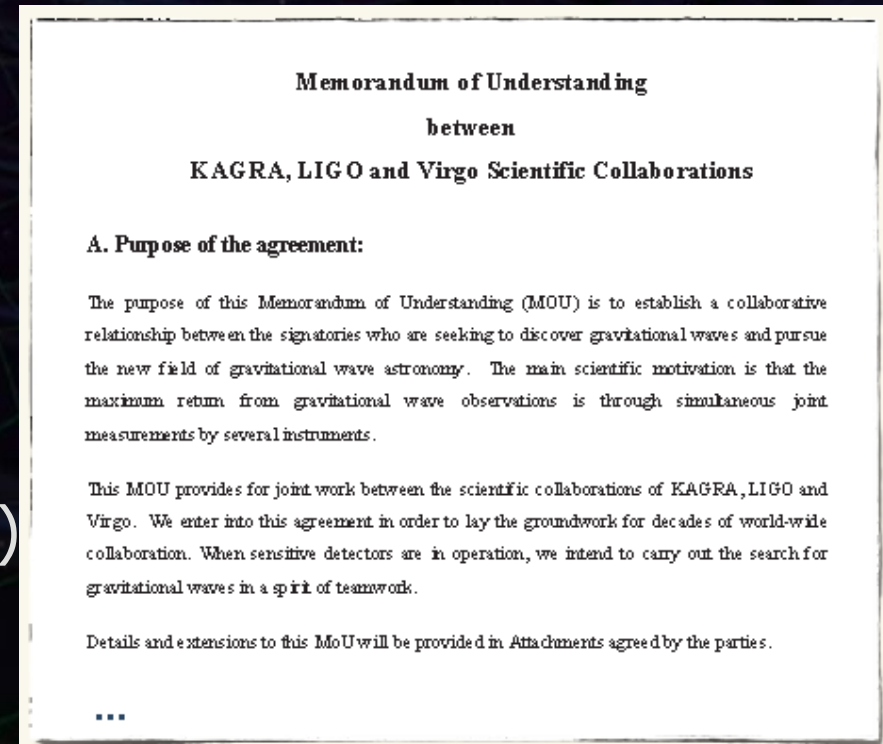
- Data analysis subgroup was divided into two subgroups
 → Data Analysis (DAS) and Data Management (DMG)



MoU with LSC and VIRGO



- Draft finished, waiting for sign
 - MoU General part.
 - Attachment A (LSC-KAGRA)
Technical collaboration
Information sharing
 - Attachment B (K-L-V)
Data sharing.
 - Attachment C (VIRGO-KAGRA)
Technical collaboration
Information sharing



- ET-KAGRA collaboration program mainly on underground site and cryogenics.
- First general meeting on Oct. 3rd and 4th at Tokyo.



Construction Status

Underground site at Kamioka, Gifu prefecture

Facility of the Institute of Cosmic-Ray Research (ICRR), Univ. of Tokyo.



Neutrino

Super Kamiokande, Kamland

Dark matter

XMASS

Gravitational wave

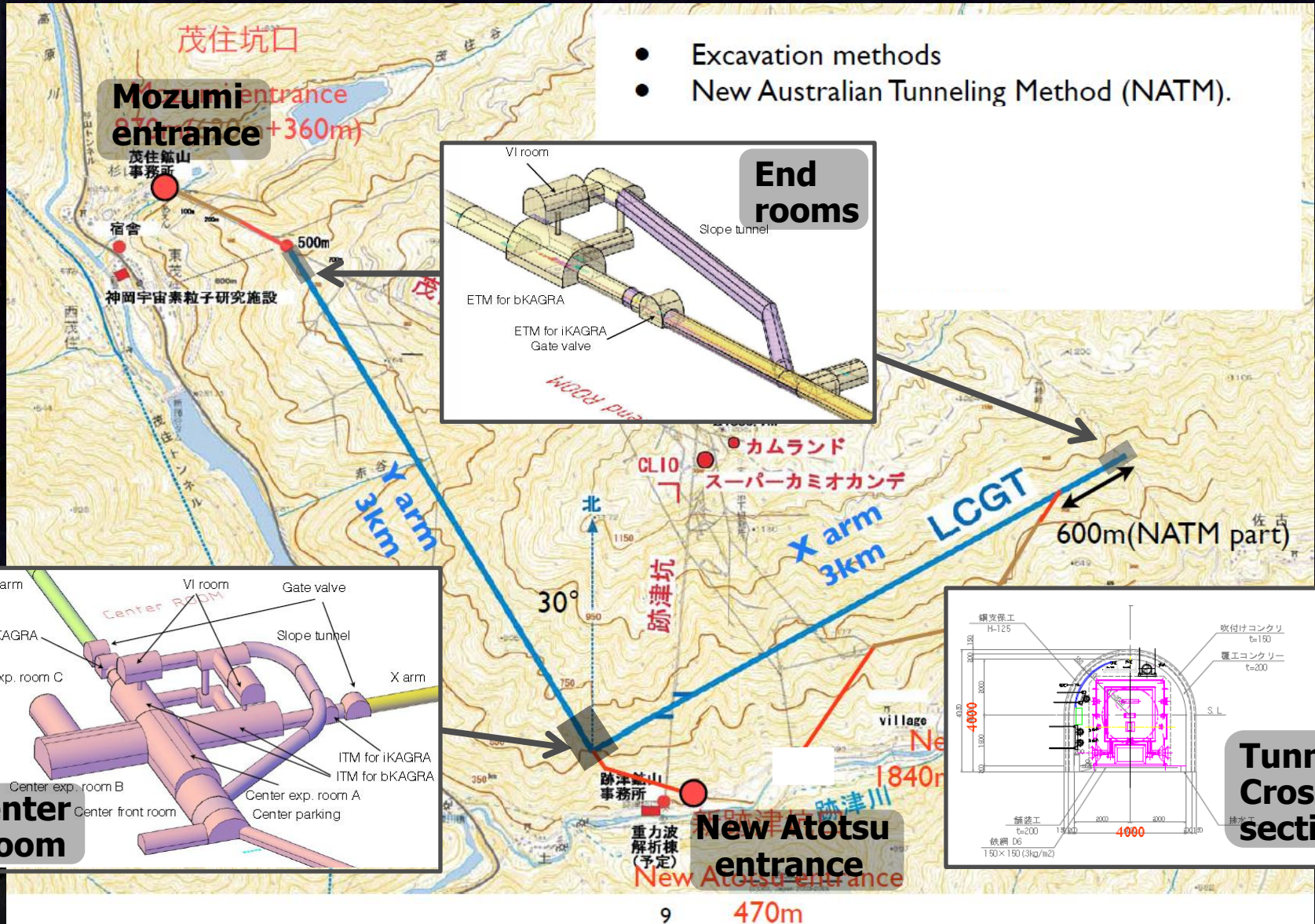
CLIO, **KAGRA**

Geophysics

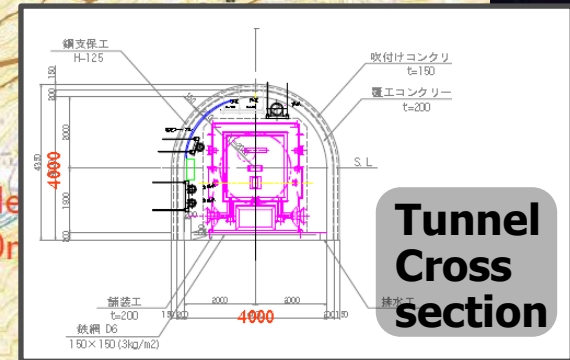
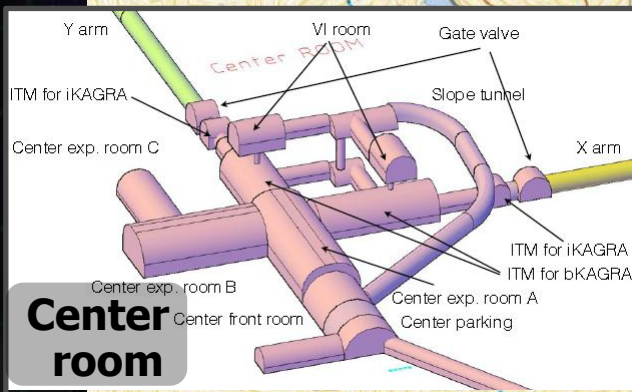
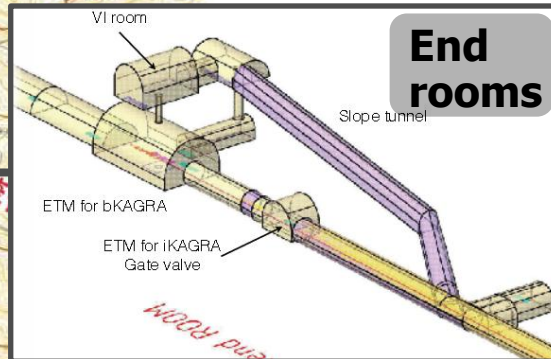
Strain meter

- 220km away from Tokyo
- 1000m underground from the top of the mountain. (Near Super Kamiokande)
- 360m altitude
- Hard rock of Hida gneiss (5 [km/sec] sound speed)

Tunnel Design



- Excavation methods
- New Australian Tunneling Method (NATM).



- Construction companies were decided, final design were almost fixed, construction was started.

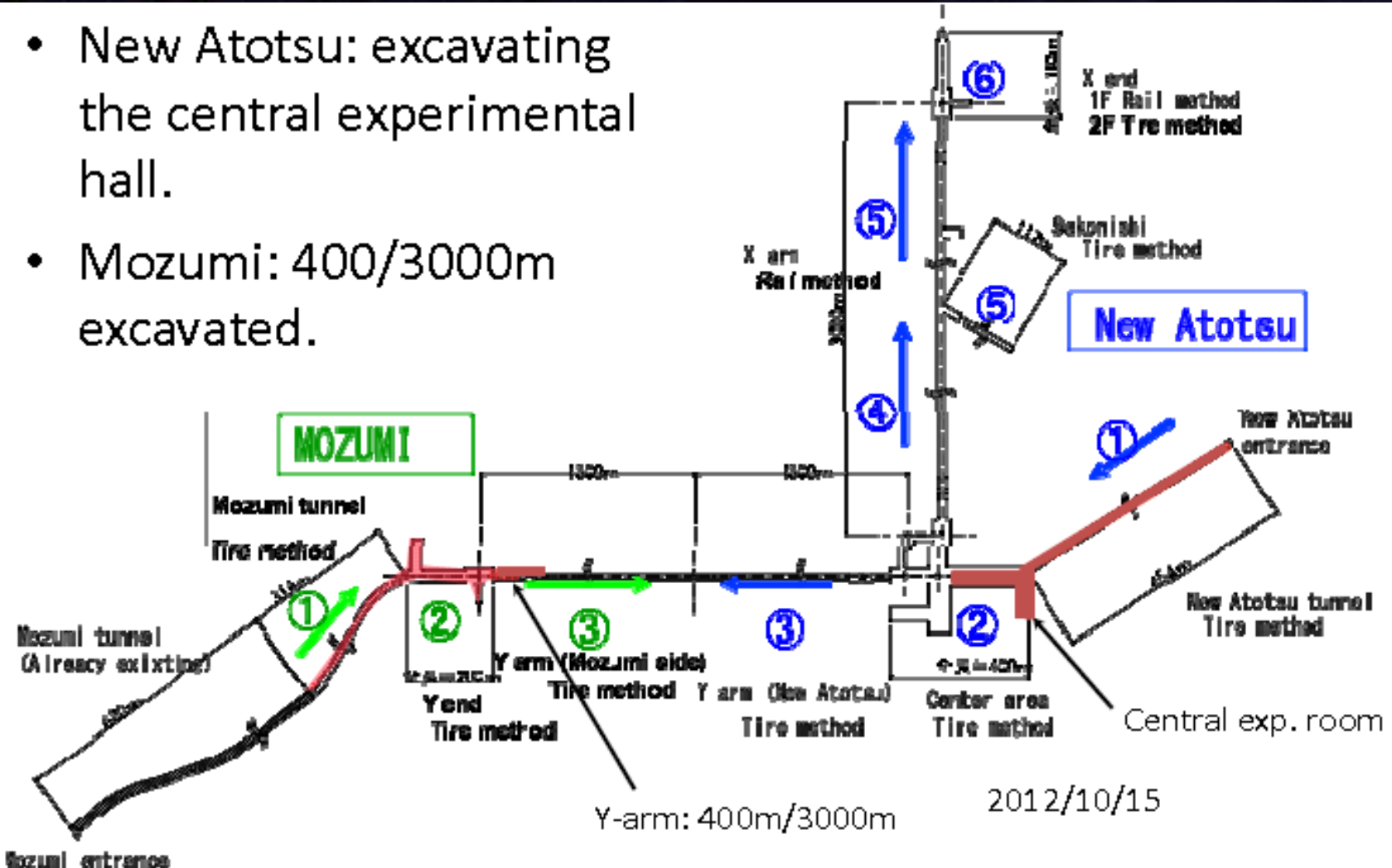


Field development for the 'New Atotsu' entrance, and for office building of the companies. (Photo by T.Uchiyama, [April 2012](#))

Excavation Status

- The tunnel will be completed by March 2014

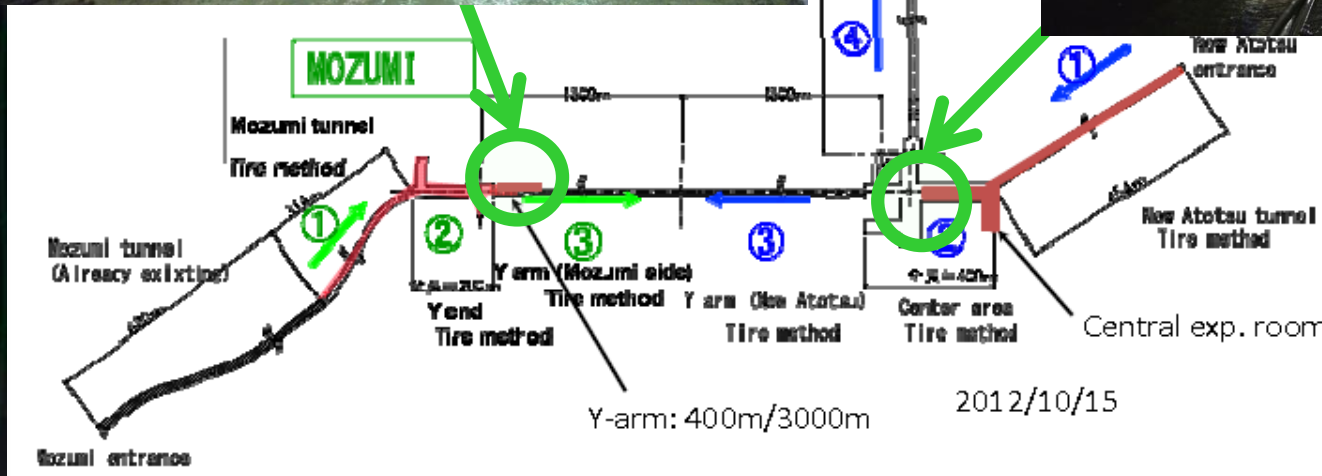
- New Atotsu: excavating the central experimental hall.
- Mozumi: 400/3000m excavated.



Excavation Status

- Mozumi entrance
 - Y-end room almost completed
 - Y-arm tunnel 400m/3000m

- New Atotsu entrance
 - Center Hall excavation



Surface Facility at Kamioka

Rent and remodel a public building (140m²) for free.

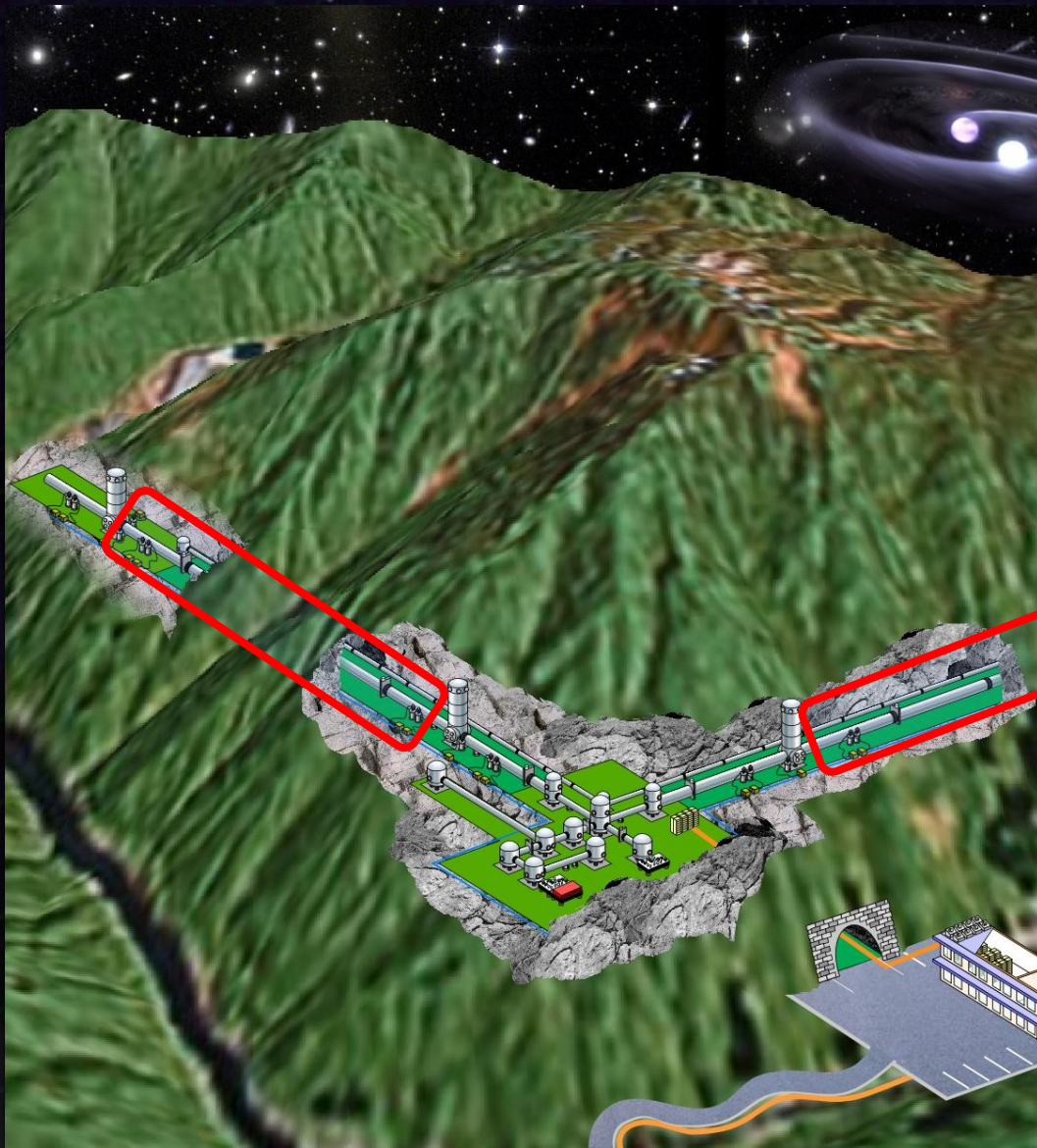
→ On-site office and laboratory for GW group.



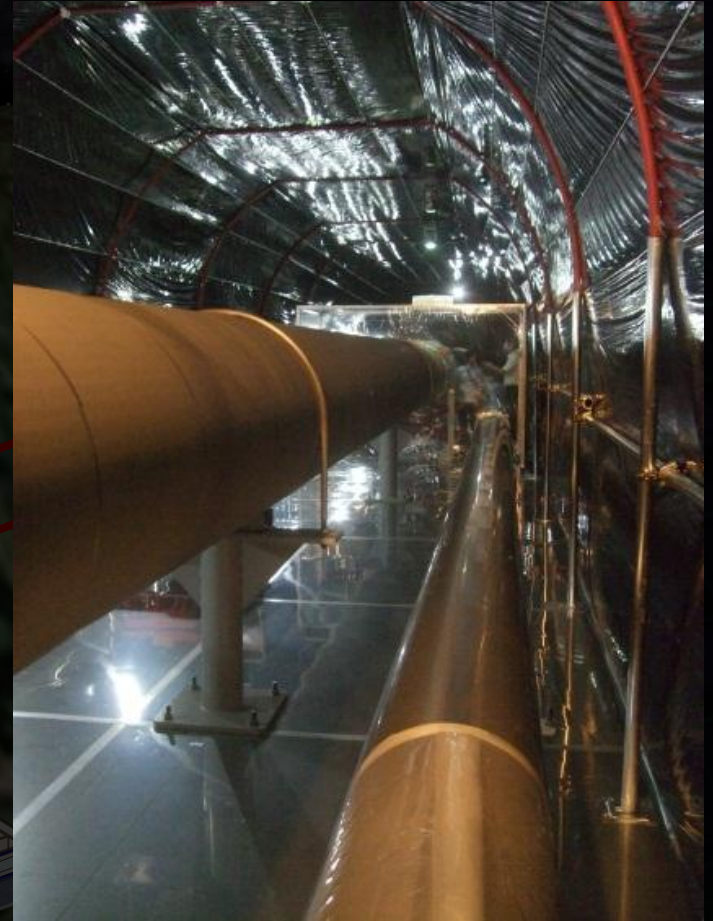
Aug. 29, 2012
Announcement for local people
→ Open as office in Nov.



Vacuum System



Installation test facility



KAGRA Vacuum duct



- 12m, $\Phi 800$ mm ducts for 3km x 2 arms.
→ 70% of 478 ducts have been delivered.



Press to form a duct



Bellows for each duct



Baking at MIRAPRO Co.
Noda/MESCO, Kamioka



Test at MIRAPRO Co. Noda

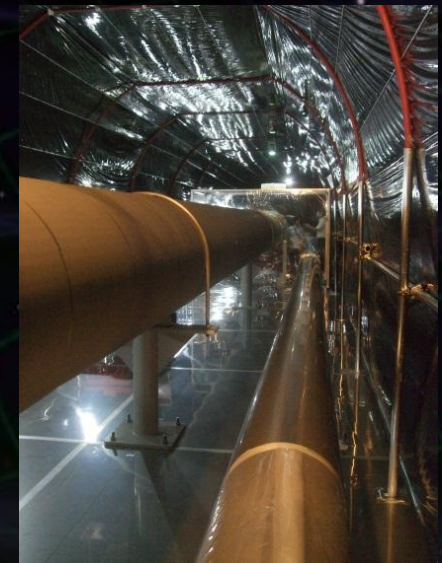


Transportation to Kamioka

Presentation
By Y.Saito (KEK)

Installation Test Facility

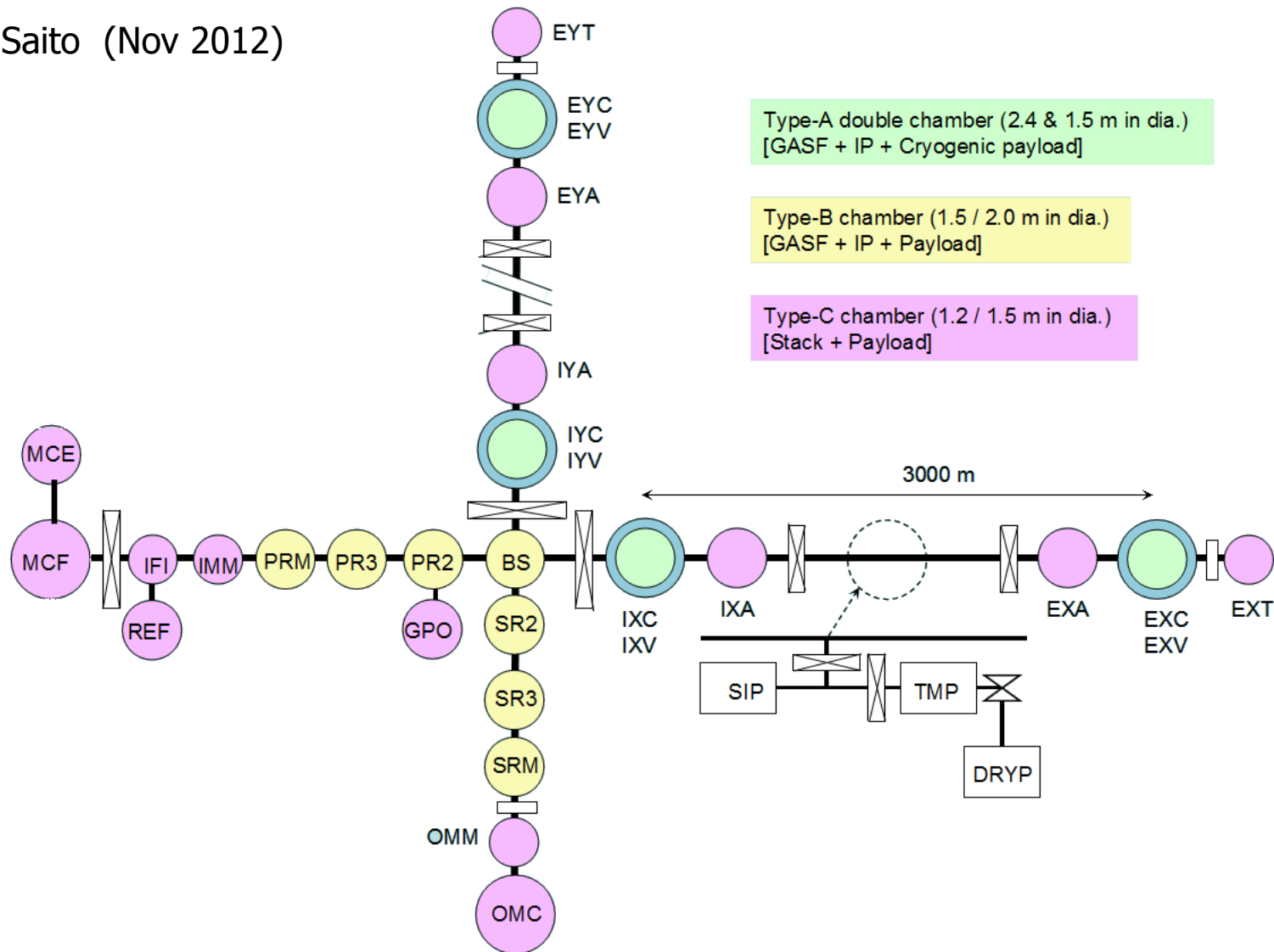
KAGRA tunnel simulator for installation test
(MIRAPRO, Noda factory)



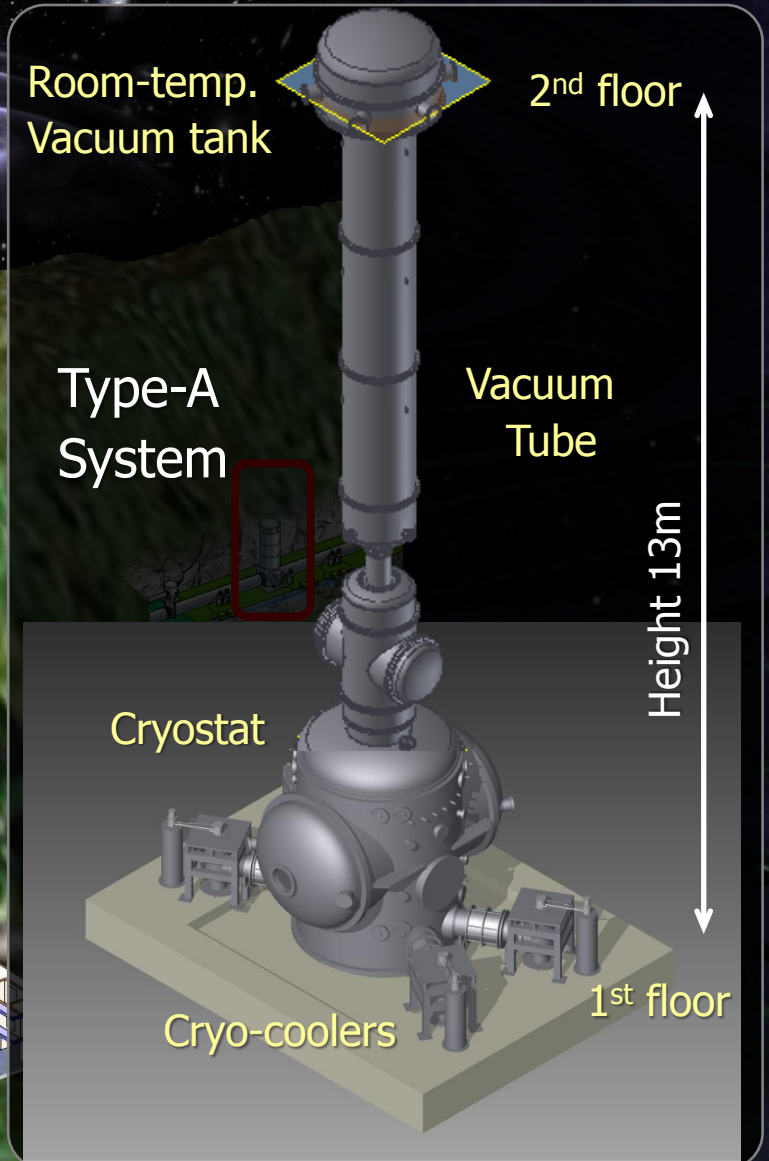
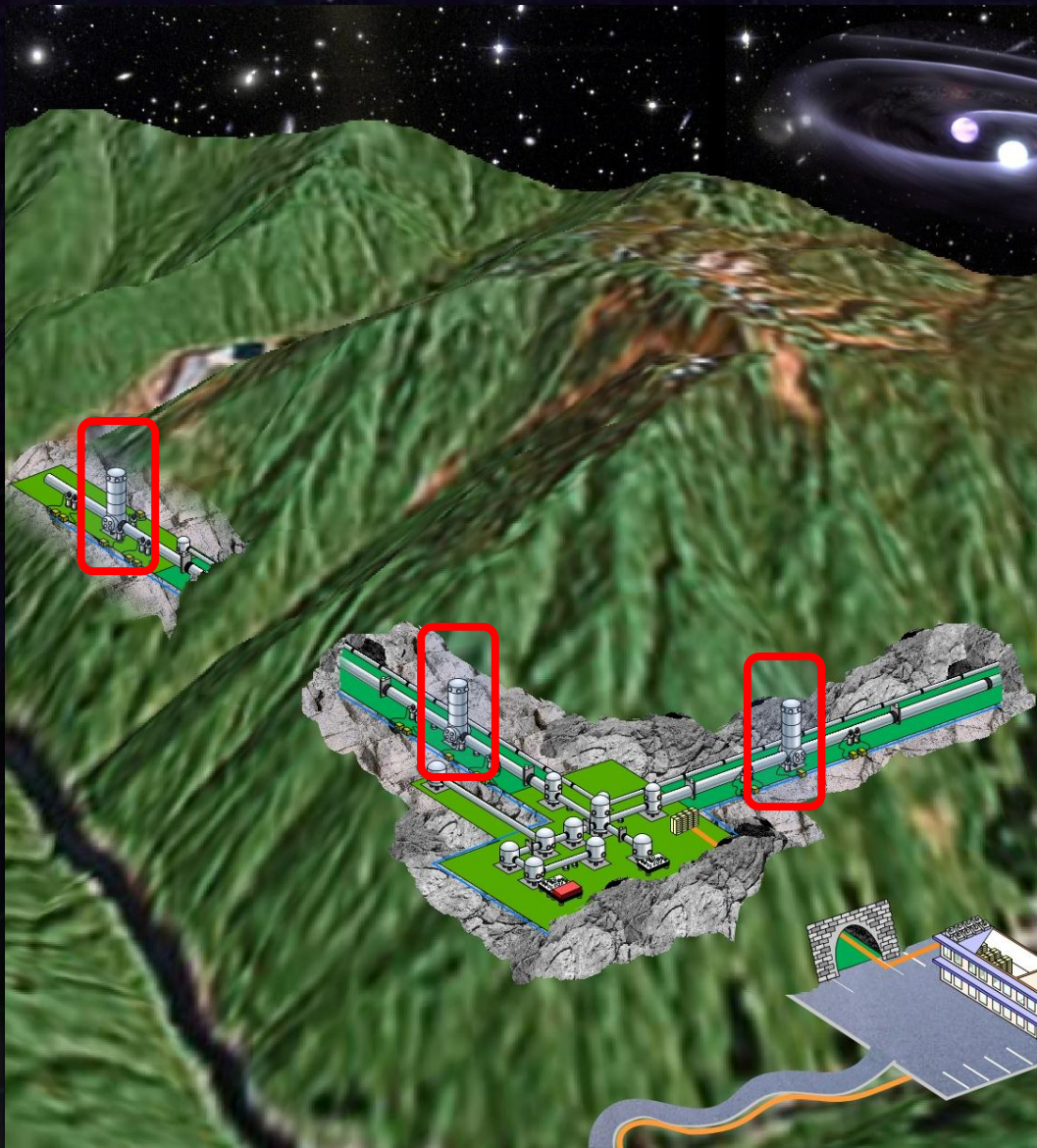
June 28, 2012, Photo by Kamiizumi and Iwasaki (ICRR)

Vacuum System Design

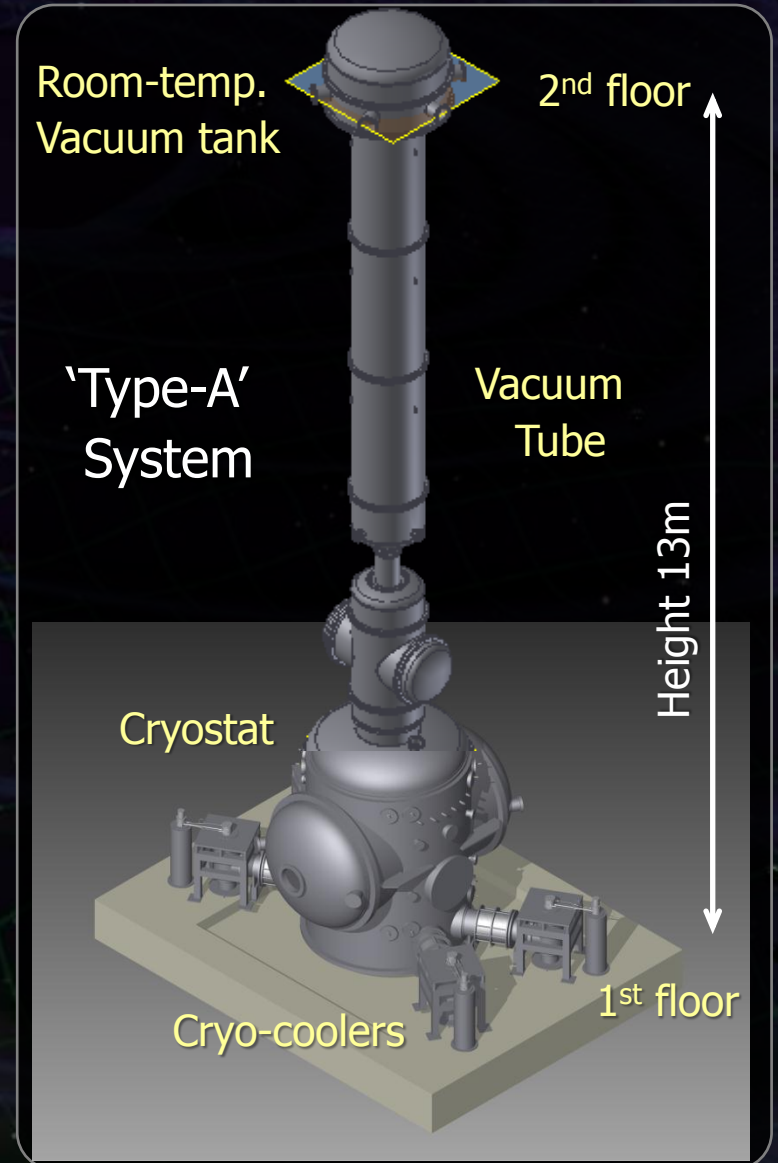
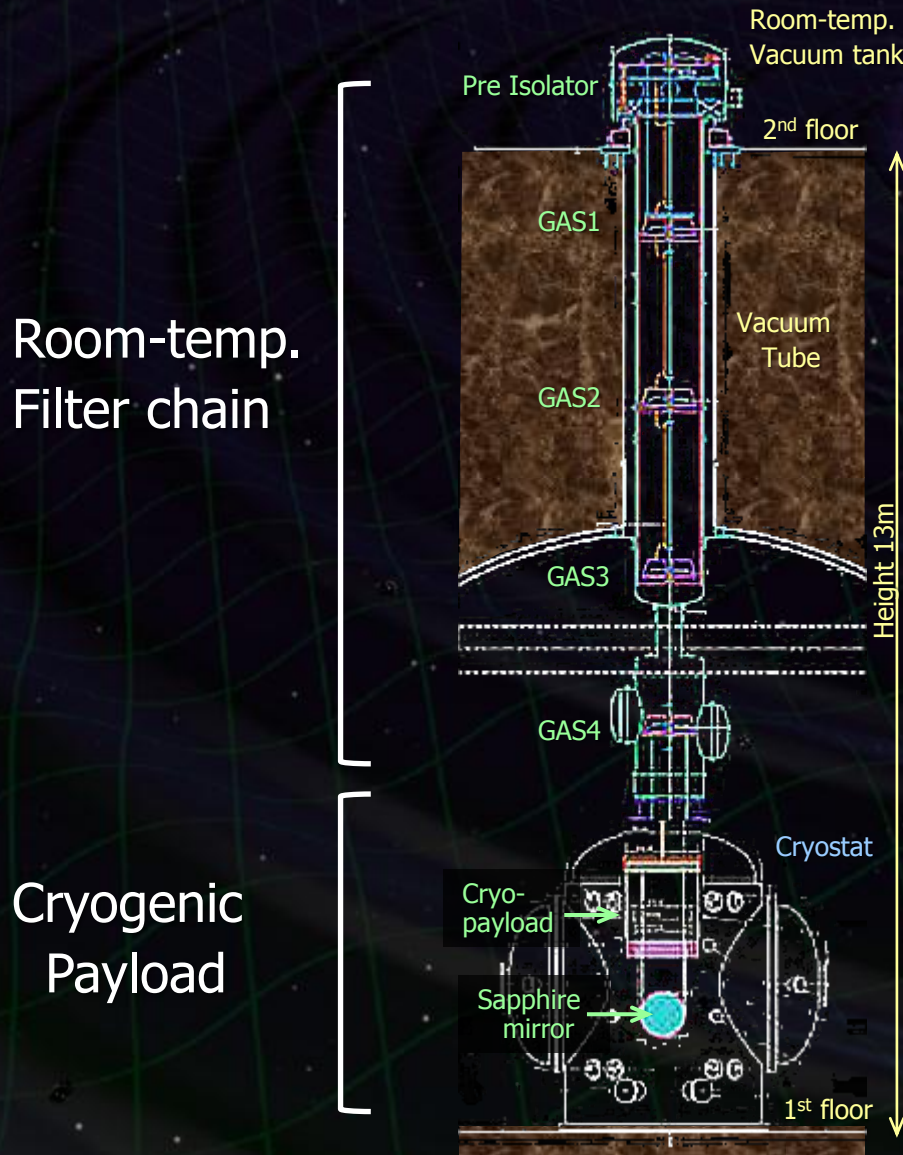
Y.Saito (Nov 2012)



Cryogenic Isolator

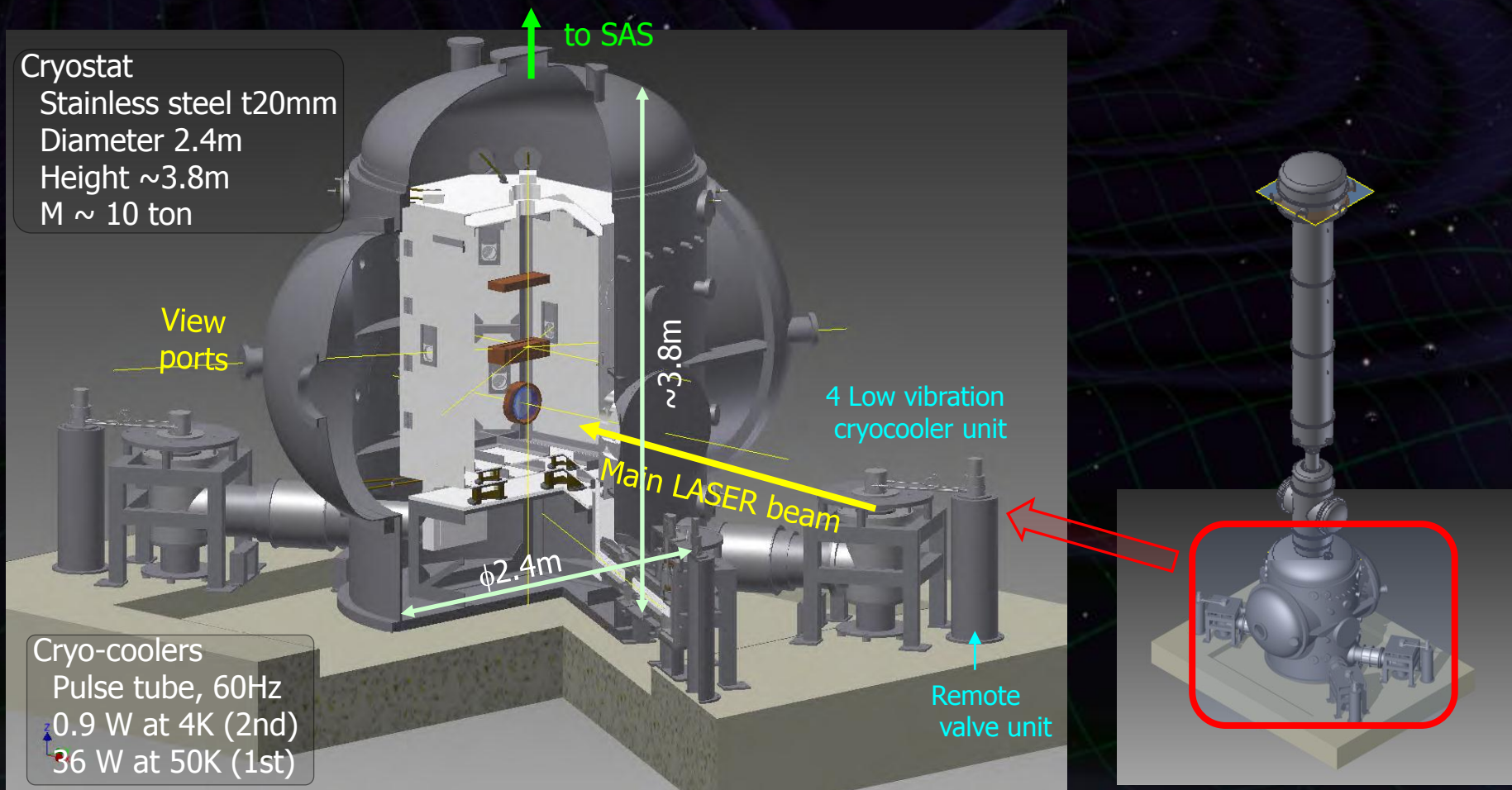


Cryogenic Mirror Isolator



Cryostat Design

- 4 Cryostats and 9 cryo-coolers in FY2012.



Cryostat Construction

Cryostat #1 in preparation for installation of radiation shield.



Cryostat #2 in leak test.

3rd and 4th cryostats under construction



Radiation shield



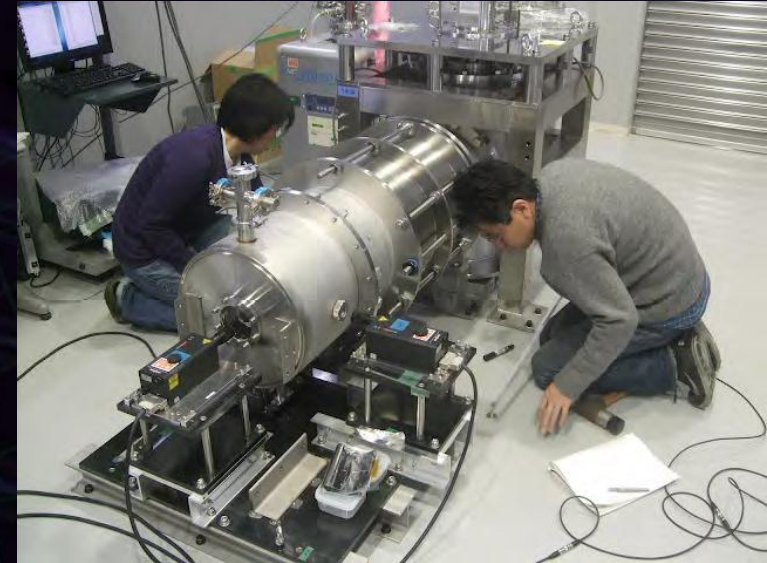
Toshiba Keihin Factory (Oct 31, 2012)

Cryo-cooler Construction

Cryo-cooler units at ICRR (Kashiwa)



Vibration measurement



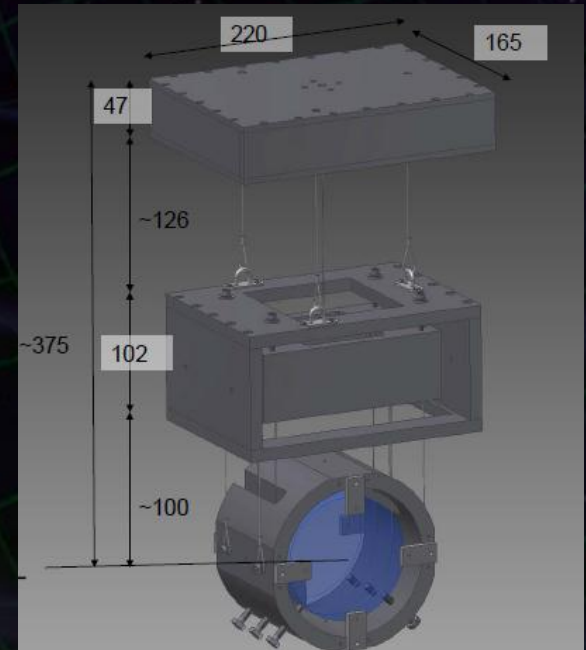
Storage at
ICRR (Akeno)



T.Suzuki at
External Review
(April 2012)

Cooling Test Plan

- Cryostat #1: 12 Nov. - : Dummy sphere cooling
- Cryostat #2: 22 Nov. - : DLC coated sphere
- Cryostat #3: 7 Jan. - : Vibration measurement
(Roma accelerometer, Interferometer)
- Cryostat #4: 21 Jan. - : 1/2-scale dummy payload.



Sapphire Mirror Isolator

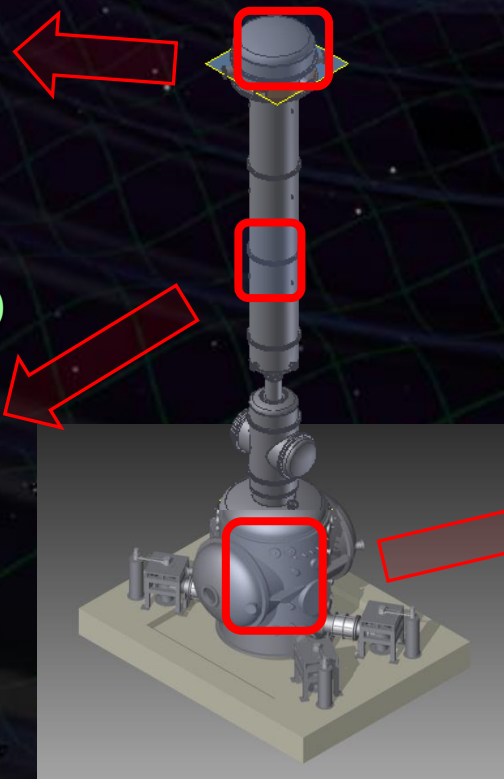


Pre Isolator prototype at Lucca(Pisa)

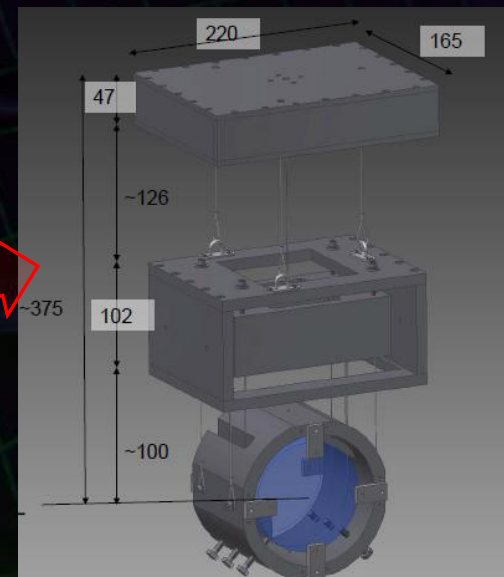


GAS filter prototype

'Type-A' system



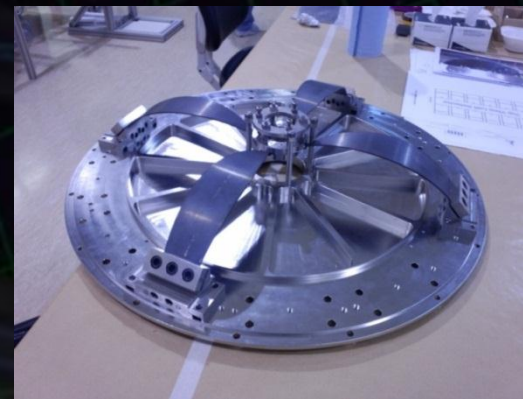
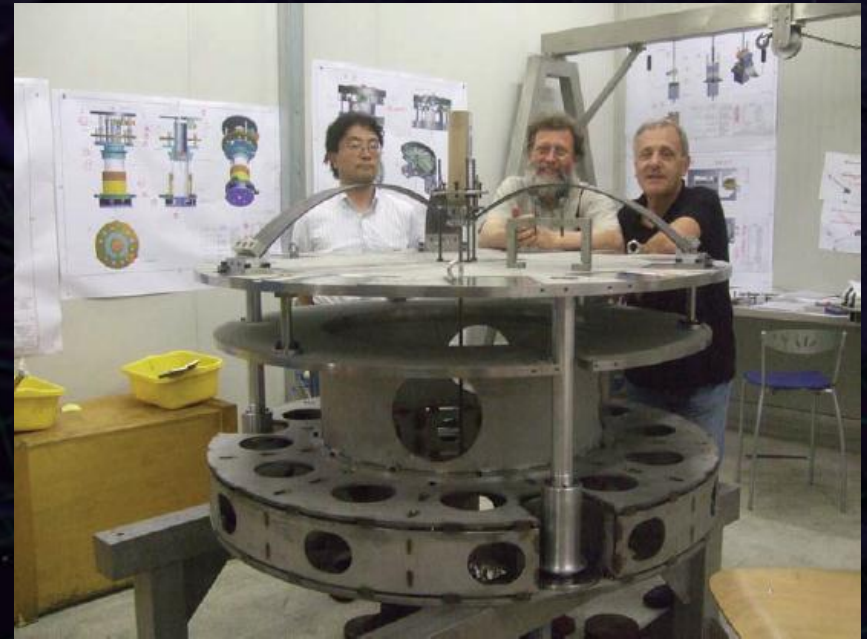
Cryogenic payload
1/2-scale prototype



Isolator Prototypes



Pre-Isolator Prototype test (Kashiwa)

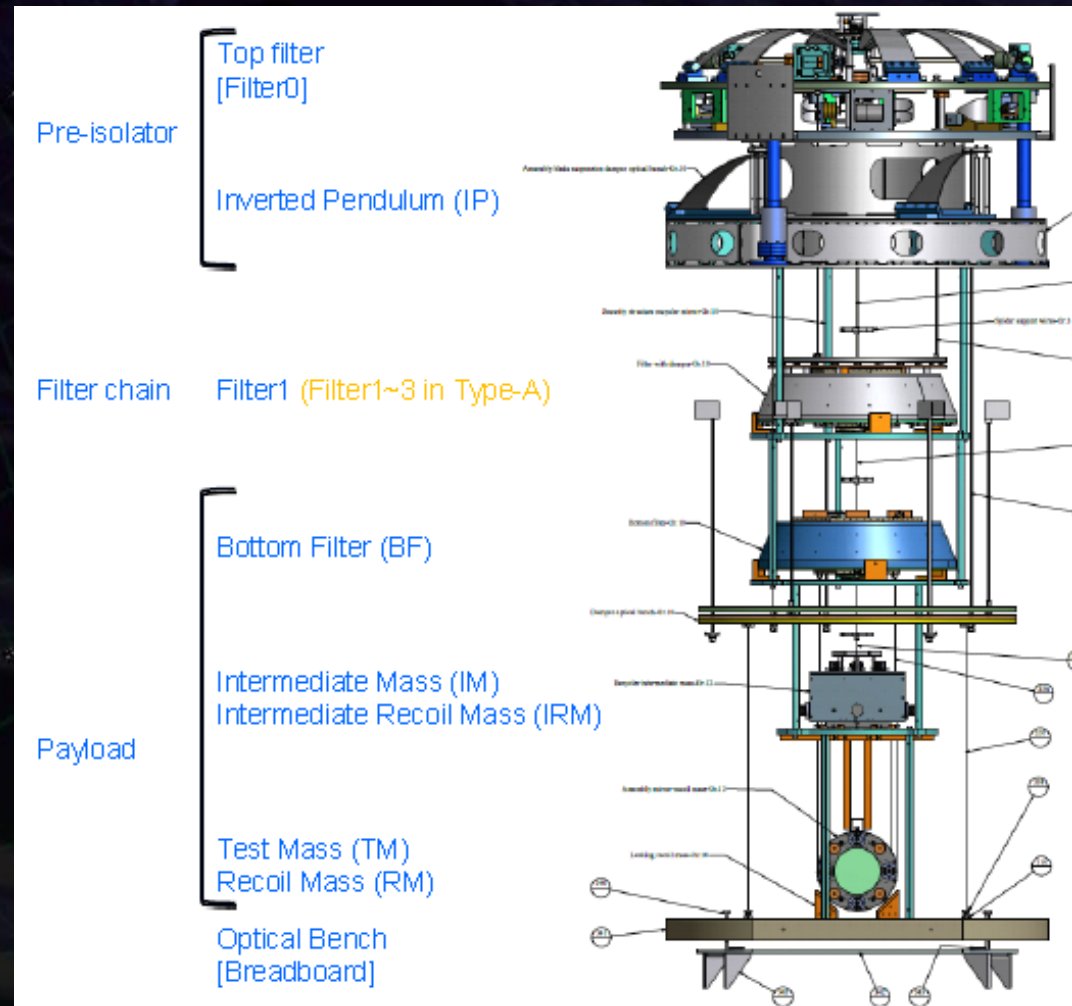


Vibration Isolation Design

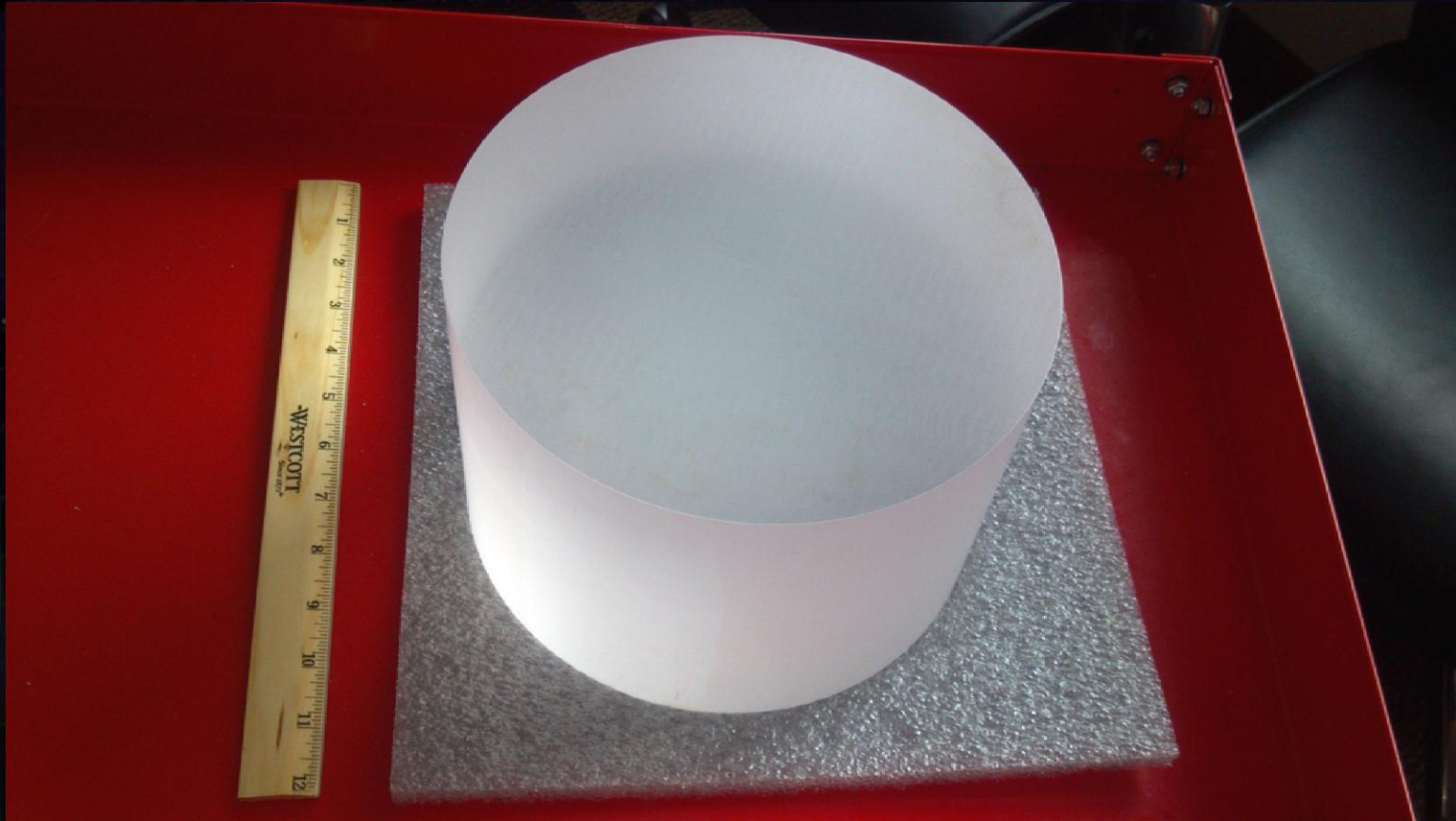
'Type-B' SAS

- Multi-stage, low-freq. isolator for silica room-temp. optics (BS, PRC, and SEC).
- Full system test at TAMA300 facility from next April.

R. Takahashi at External Review (April 2012)



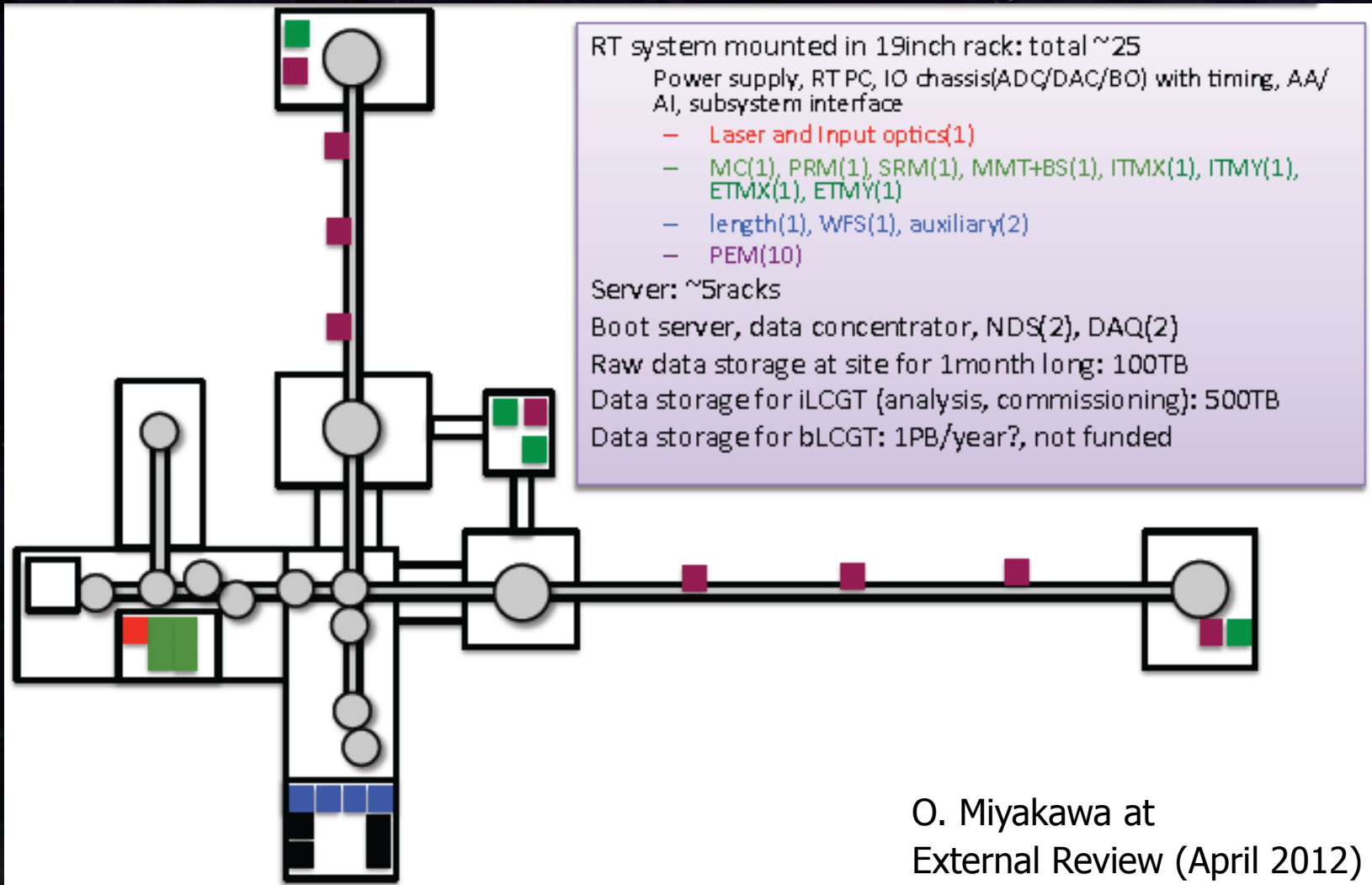
Sapphire Mirror



2 Sapphire substrates were delivered
($\Phi 220\text{mm}$, t 150mm, c-axis)

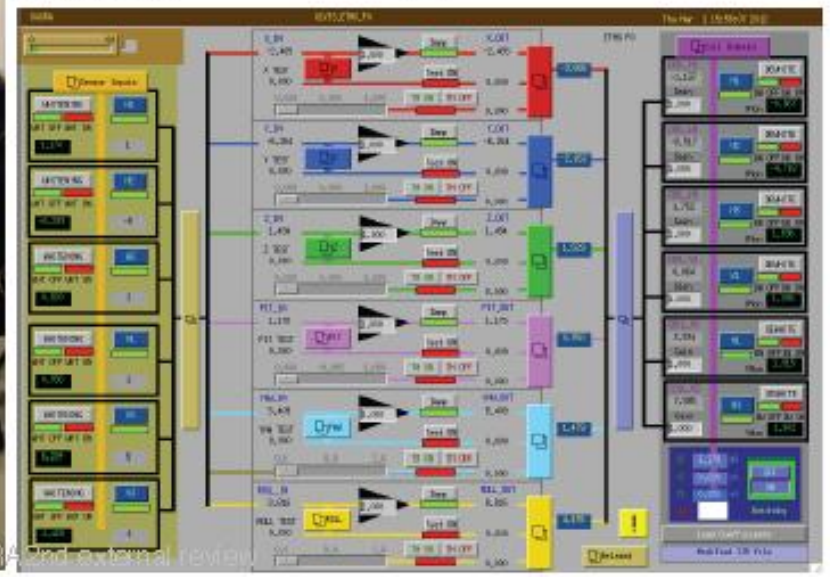
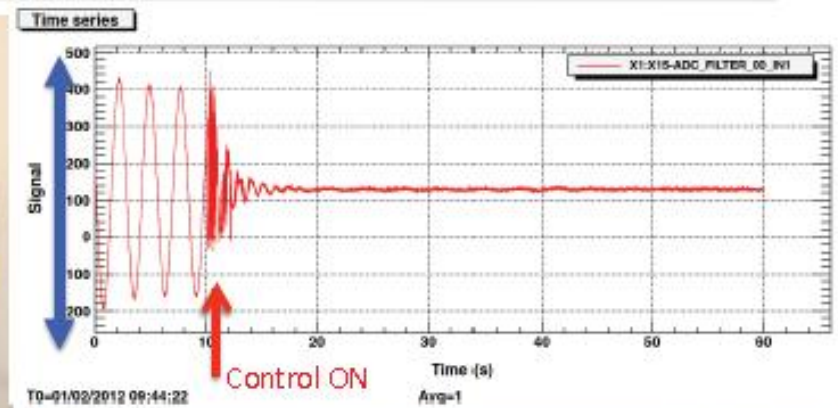
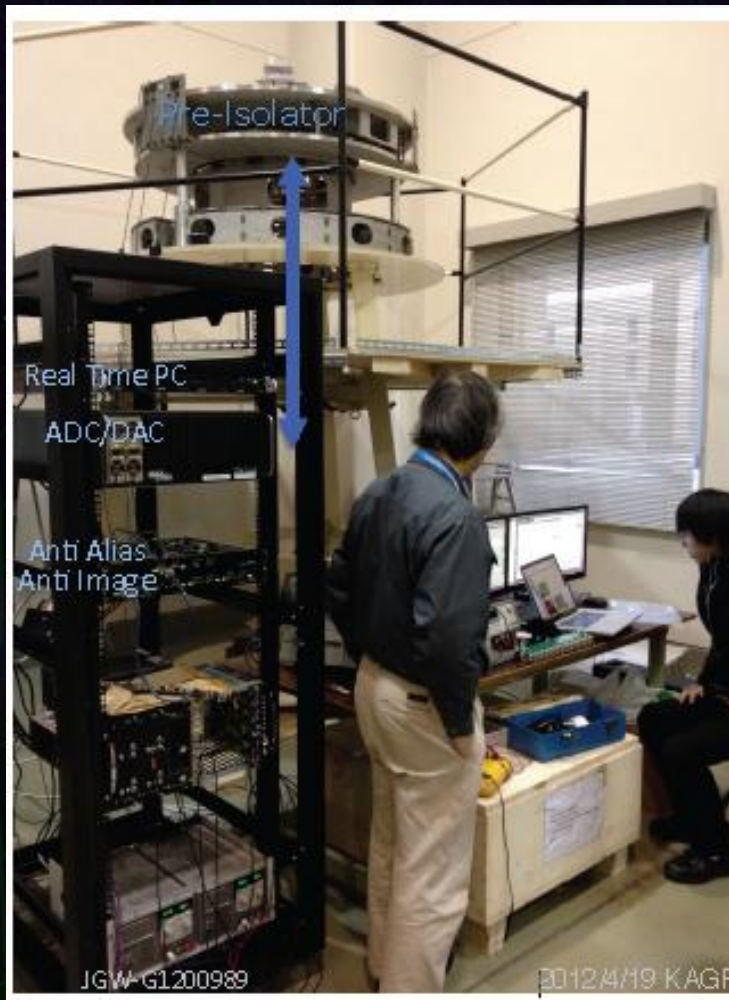
Digital Control System

- Digital control based on LIGO system.



Digital Control Test

- Damping of SAS pre-isolator (at ICRR Kashiwa).



O. Miyakawa at External Review (April 2012)

Summary

Summary

- A lot of progress in KAGRA!
 - Tunnel construction in progress.
 - Vacuum, Cryo system, etc. are becoming real.
 - Sorry for skipping important subsystems:
FCL, MIF, IOO, AOS, MIR, LAS, DAS, AEL, GIF.
 - However, the budget, manpower and schedule are still very tight.
- We appreciate supports from LIGO.
 - Digital system and components
 - DCC access and many information
 - Human exchange
 - Reviews

End