Recent News from KAGRA

Masaki Ando
(National Astronomical Observatory of Japan)

Outline

- News in project management
  - Schedule, budget, organization
  - International collaborations

- News in antenna construction
  - Tunnel, Vacuum, Cryo-system
  - Vibration Isolation

KAGRA（かぐら）

LCGT

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

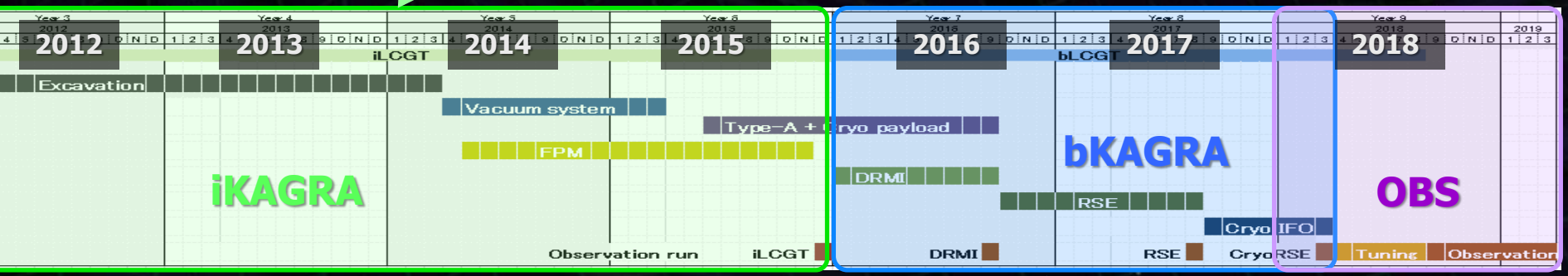
Underground site

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

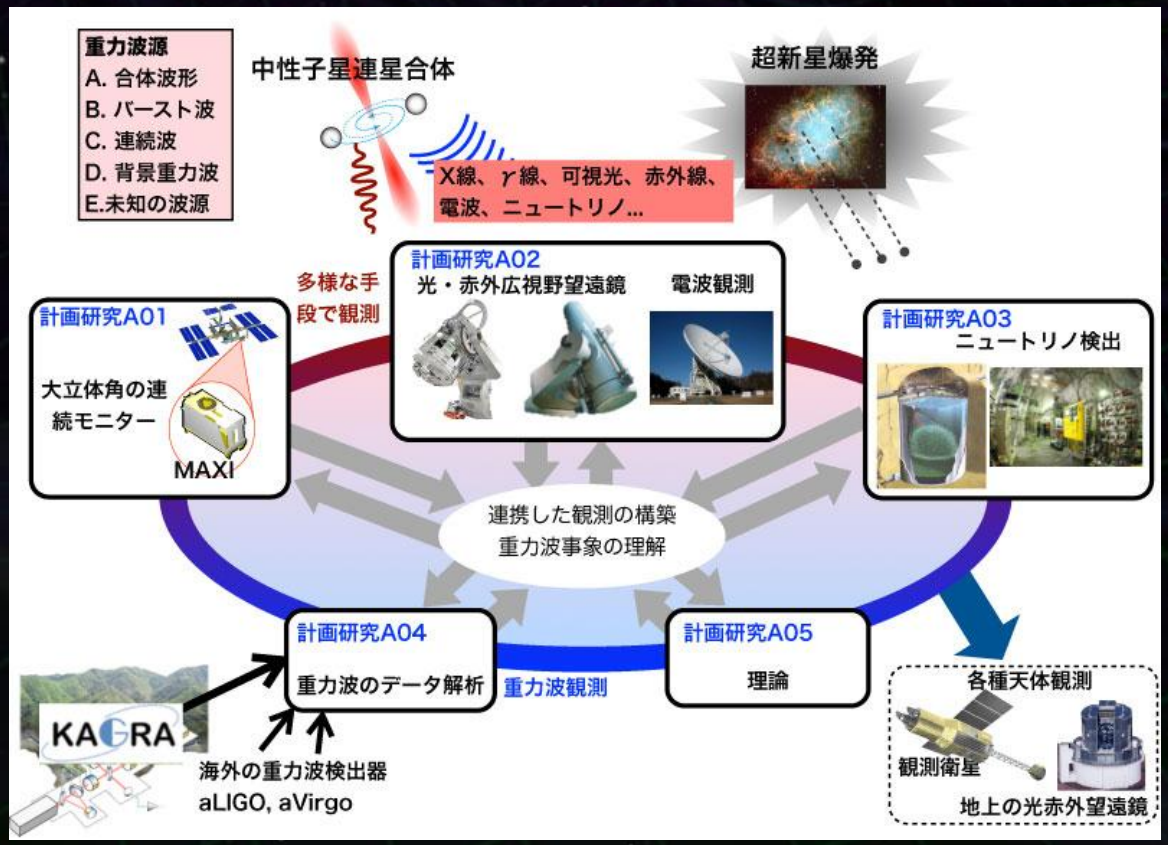
- FY2012 is the last year of
  'Leading-edge Research Infrastructure Program'.
  → We are asking to extend the period.

- 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

iKAGRA

- KAGRA facility
- 3km simple room-temp. interferometer

Upgrade

bKAGRA

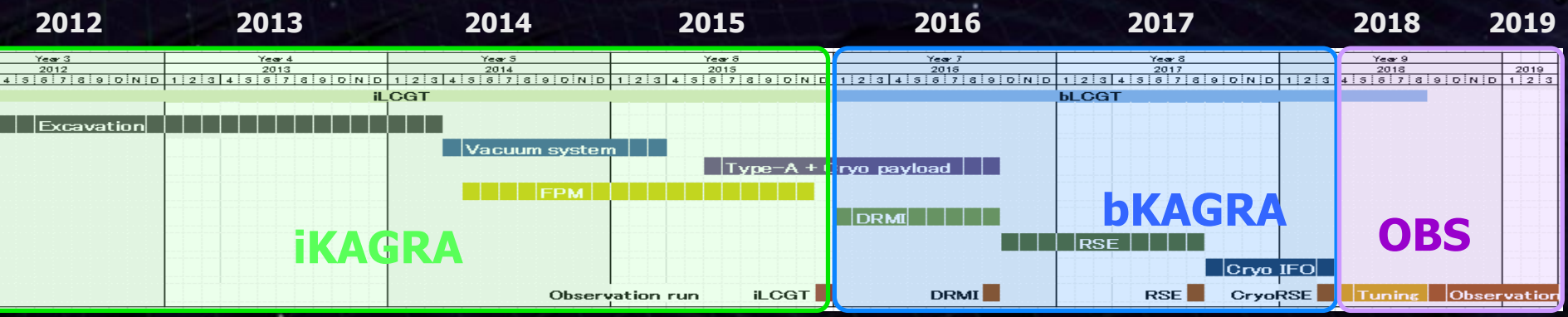
- Cryogenic mirrors
- Full-power RSE configuration

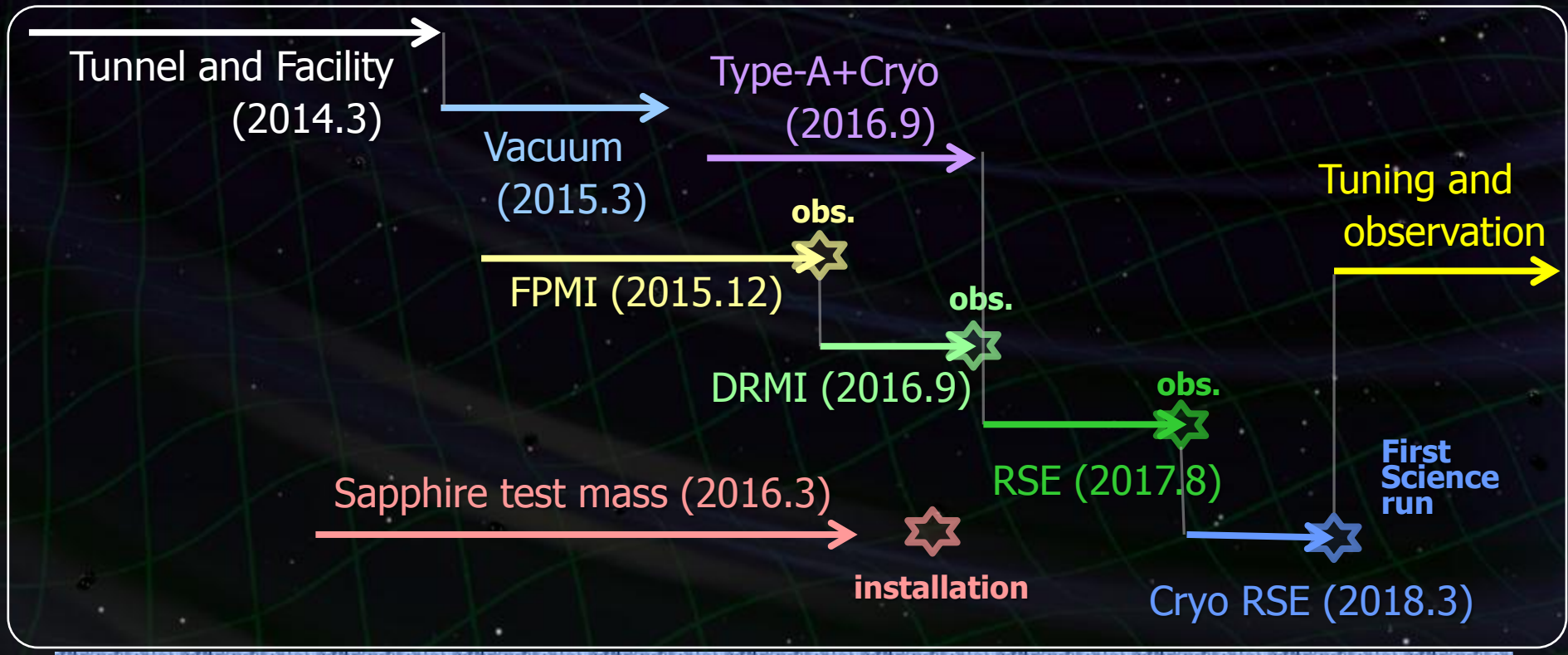
Purpose

Preparation of infrastructure

GW detection and astronomy

Major Milestones of KAGRA





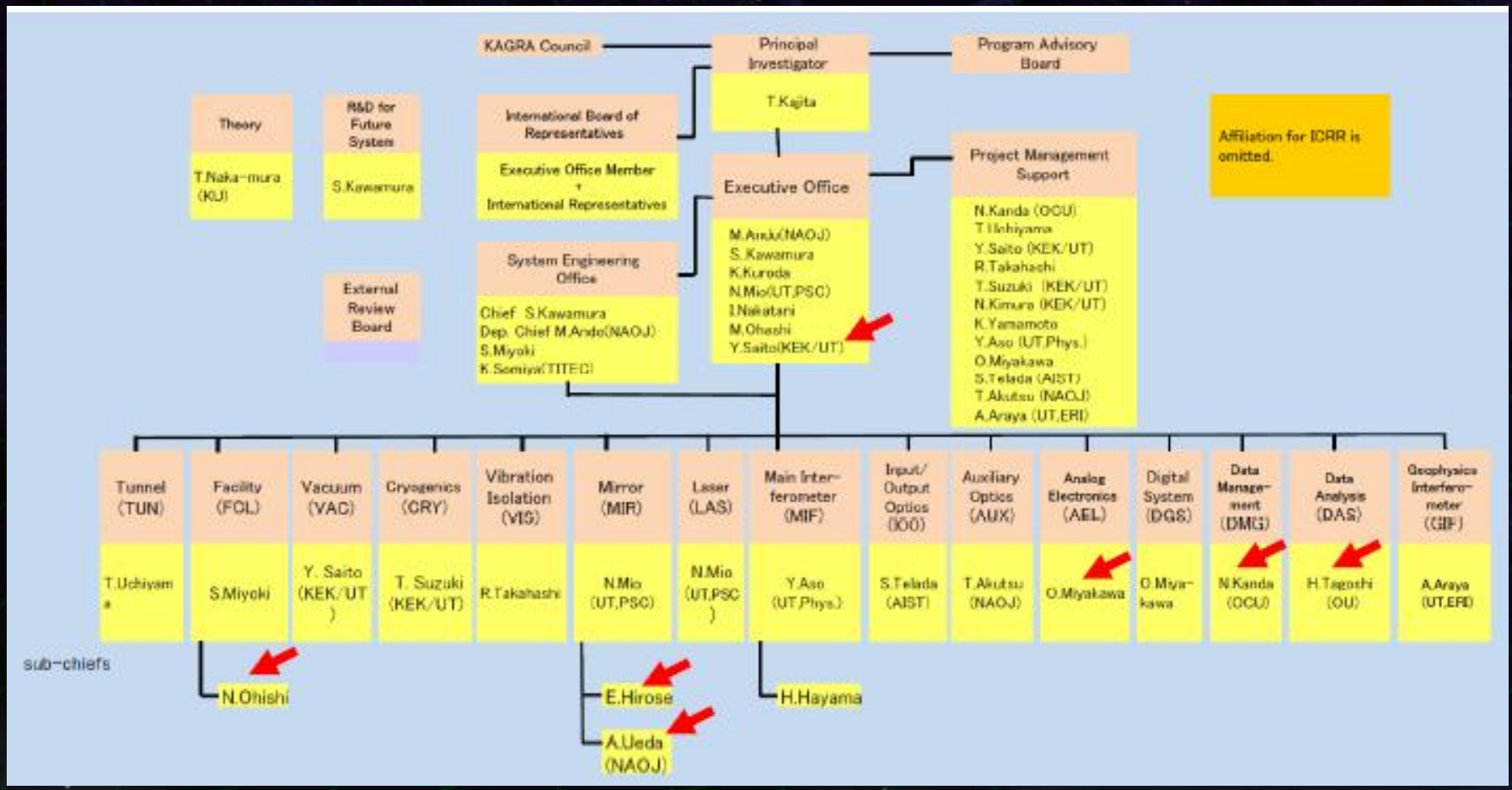
iKAGRA Scope

- 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.

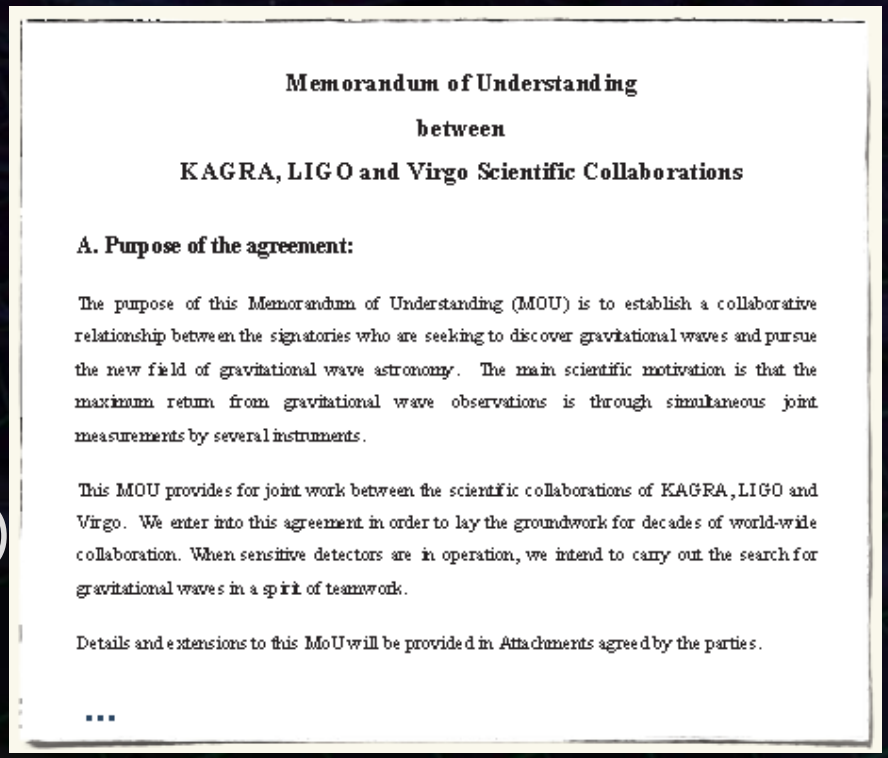
Organization Updated

- 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



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.

...

EliTES

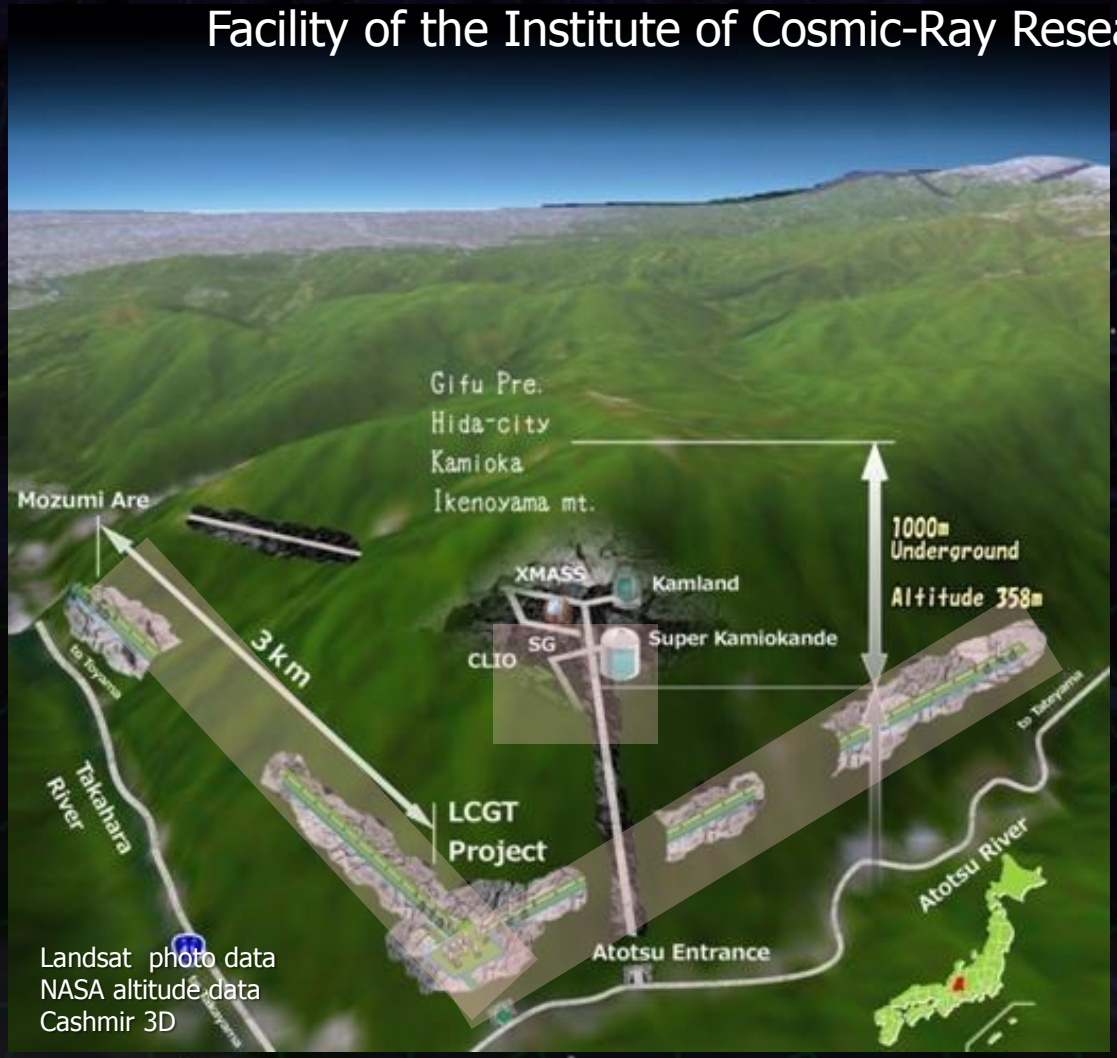
- ET-KAGRA collaboration program
  mainly on underground site and cryogenics.
- First general meeting on Oct. 3rd and 4th at Tokyo.

Construction Status

KAGRA Site

Underground site at Kamioka, Gifu prefecture

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



Neutrino
- Super Kamiokande, Kamland

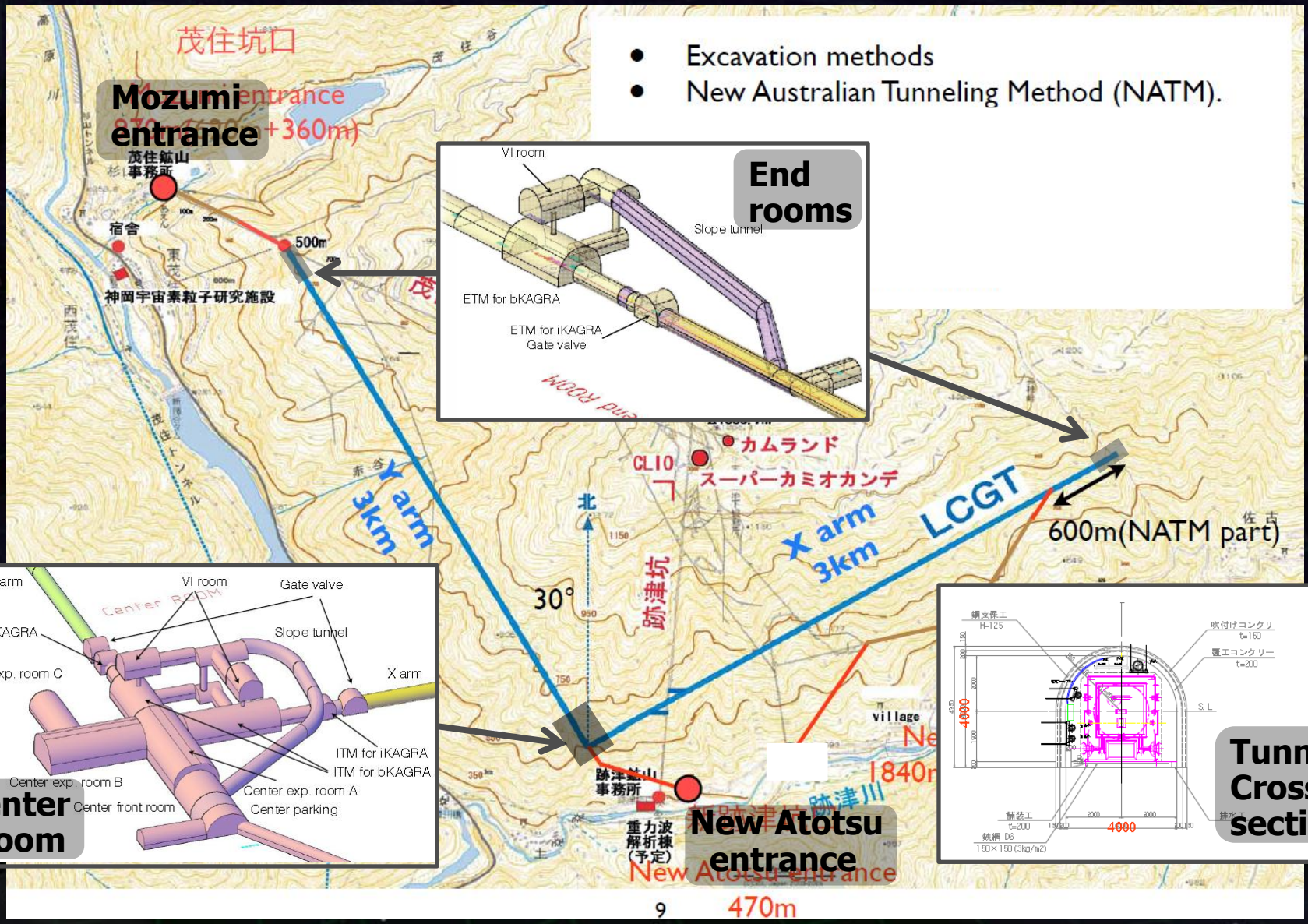
Dark matter
- XMASS

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



KAGRA Site

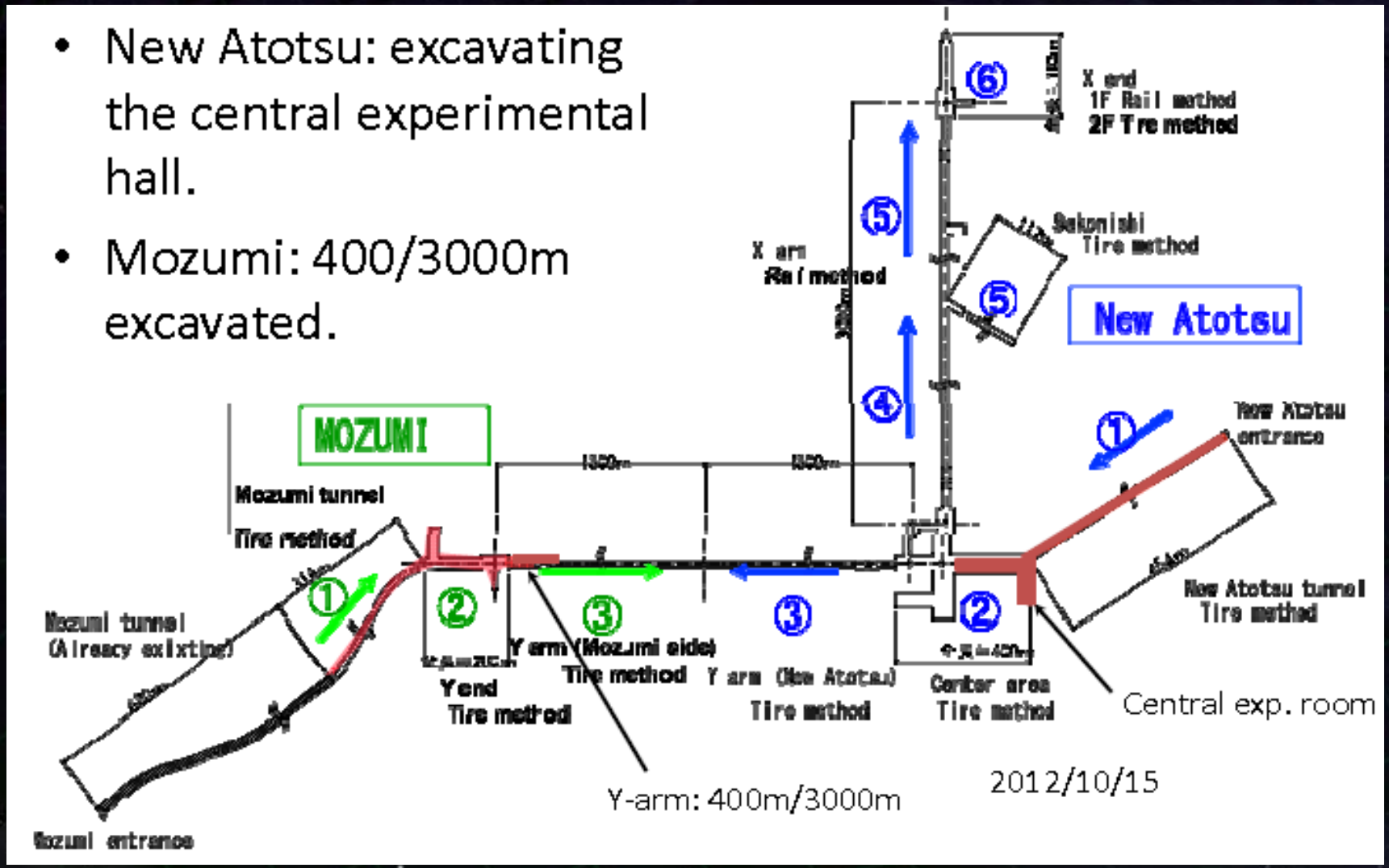
- Construction companies were decided, final design were almost fixed, construction was started.

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 (140㎡) 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, Φ800mm ducts for 3km x 2 arms.
  → 70% of 478 ducts have been delivered.

Press to form a duct

Bellows for each duct

Presentation
By Y.Saito (KEK)

Transportation to Kamioka

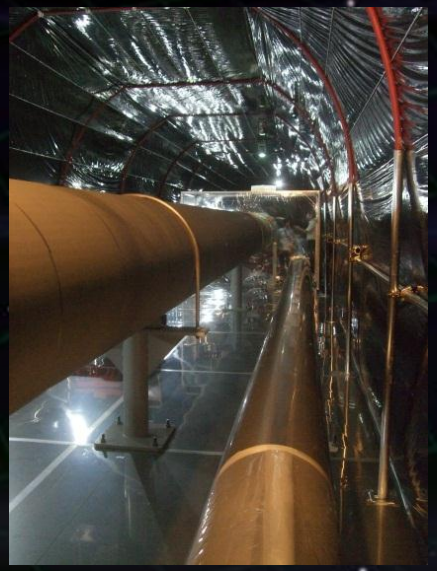
Baking at MIRAPRO Co.
Noda/MESCO, Kamioka

Test at MIRAPRO Co. Noda

Installation Test Facility

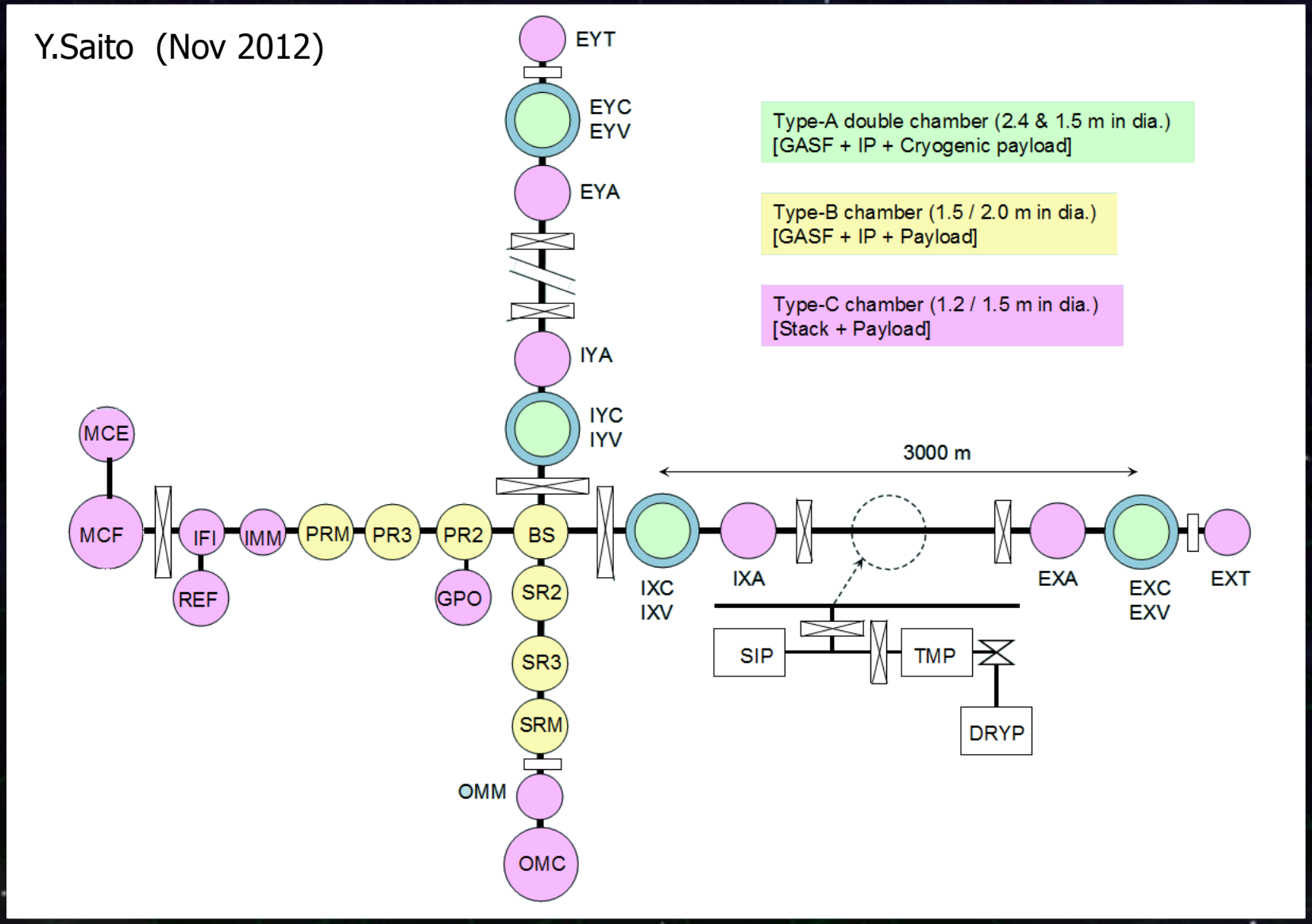
KAGRA tunnel simulator for installation test

(MIRAPRO, Noda factory)

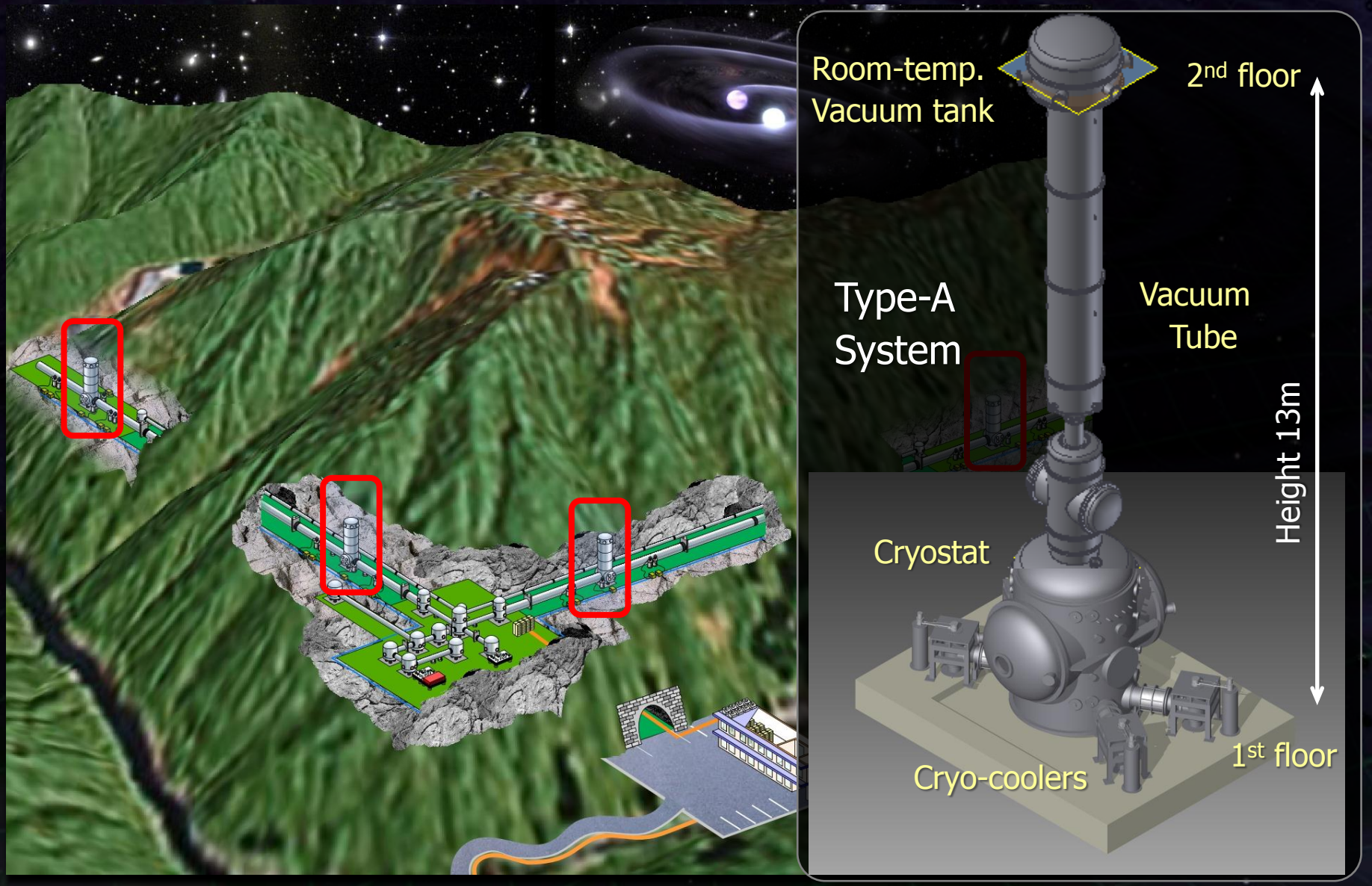


June 28, 2012, Photo by Kamiizumi and Iwasaki (ICRR)

Vacuum System Design



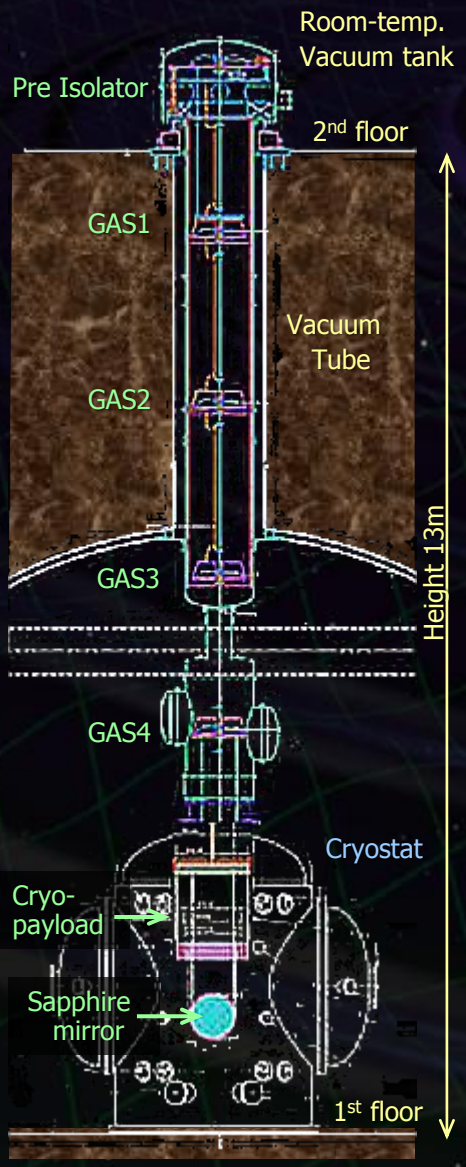
Cryogenic Isolator

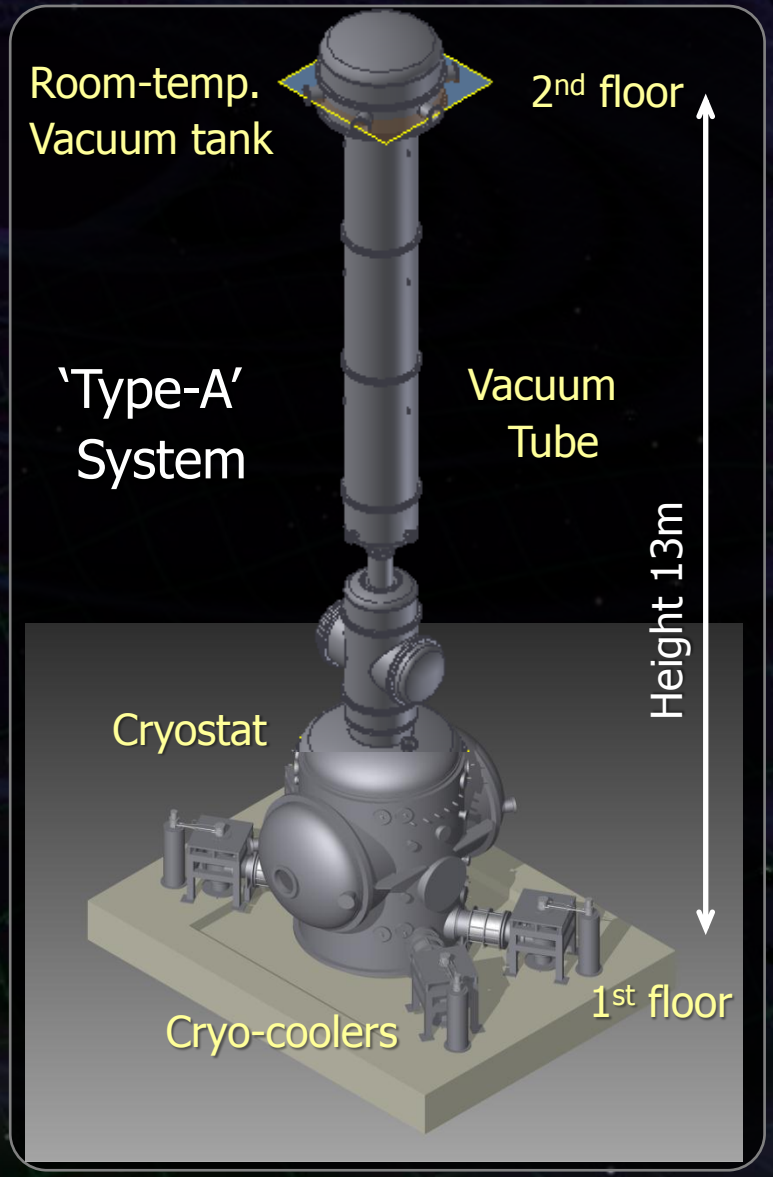


Cryogenic Mirror Isolator

Room-temp.
Filter chain

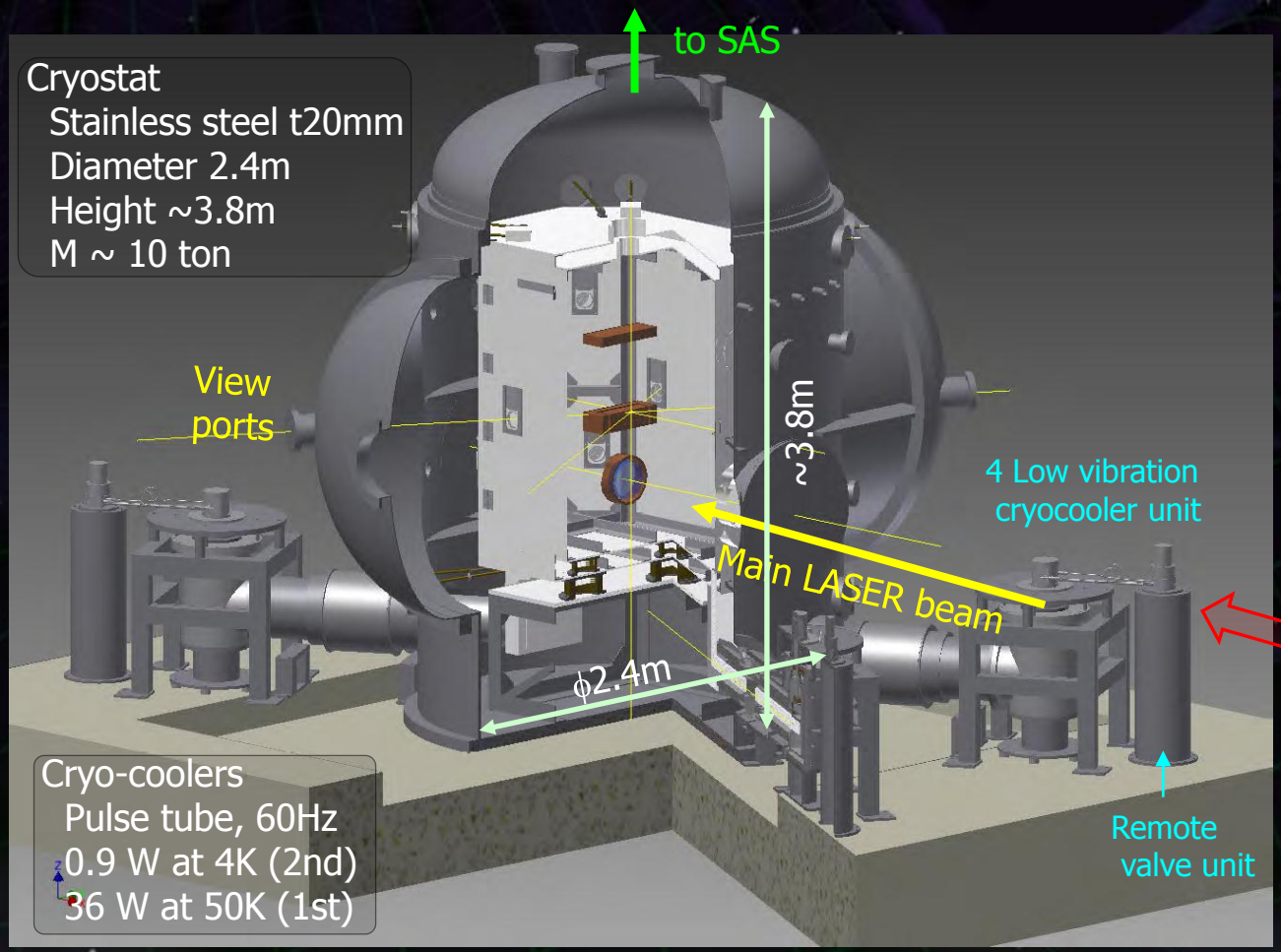
Cryogenic
Payload

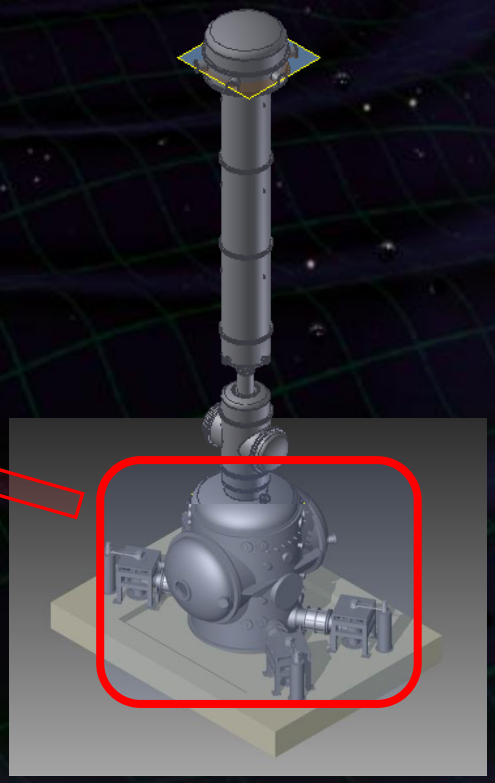




Cryostat Design

- 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

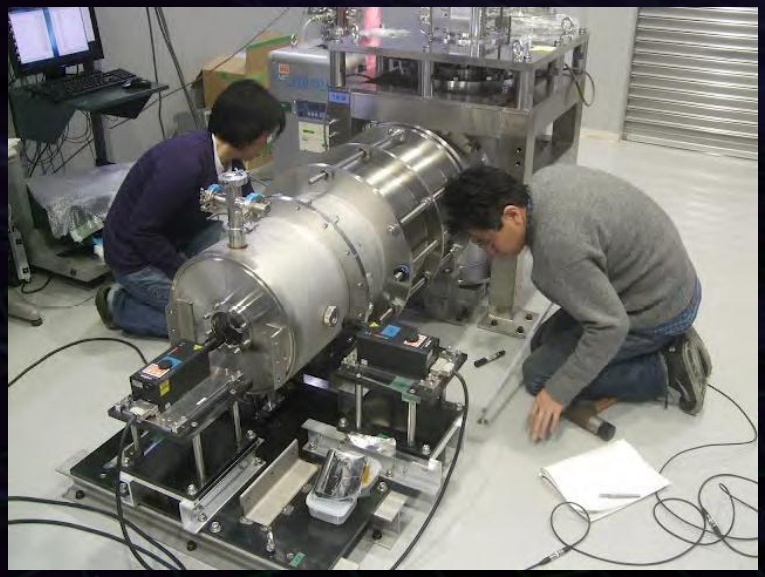
Radiation shield

Toshiba Keihin Factory (Oct 31, 2012)

Cryo-cooler Construction

Cryo-cooler units at ICRR (Kashiwa)

Vibration measurement

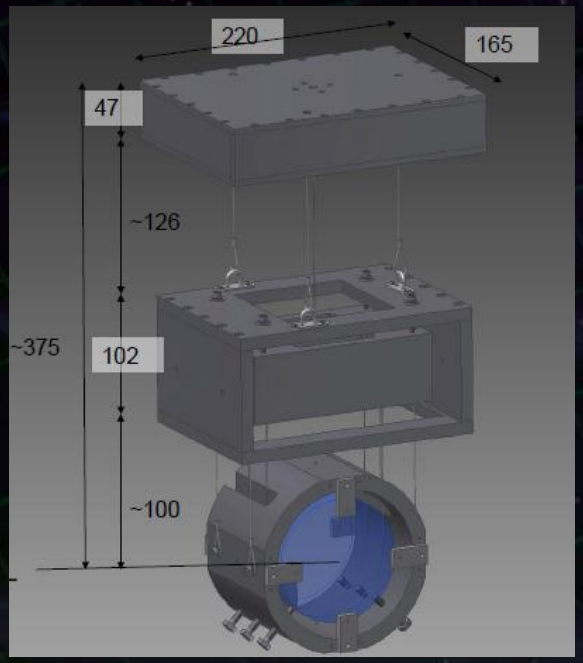


Storage at ICRR (Akeno)

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. - : ½-scale dummy payload.

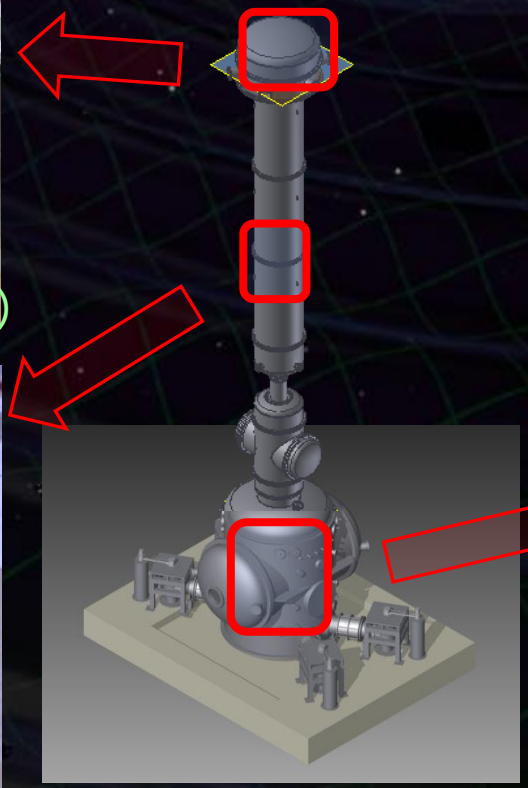


Sapphire Mirror Isolator

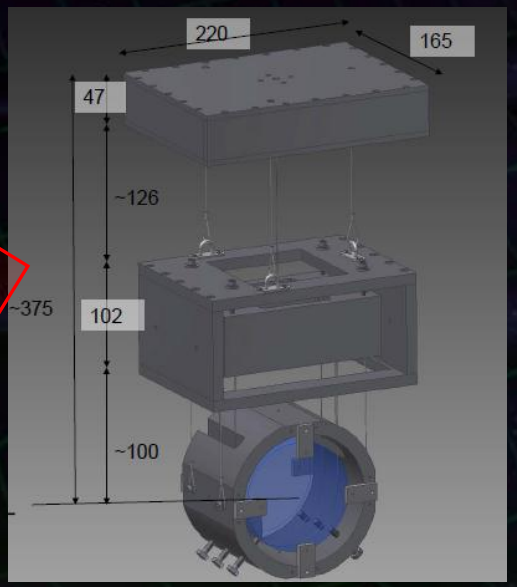
Pre Isolator prototype at Lucca(Pisa)

GAS filter prototype

'Type-A' system



Cryogenic payload
½-scale prototype



Isolator Prototypes

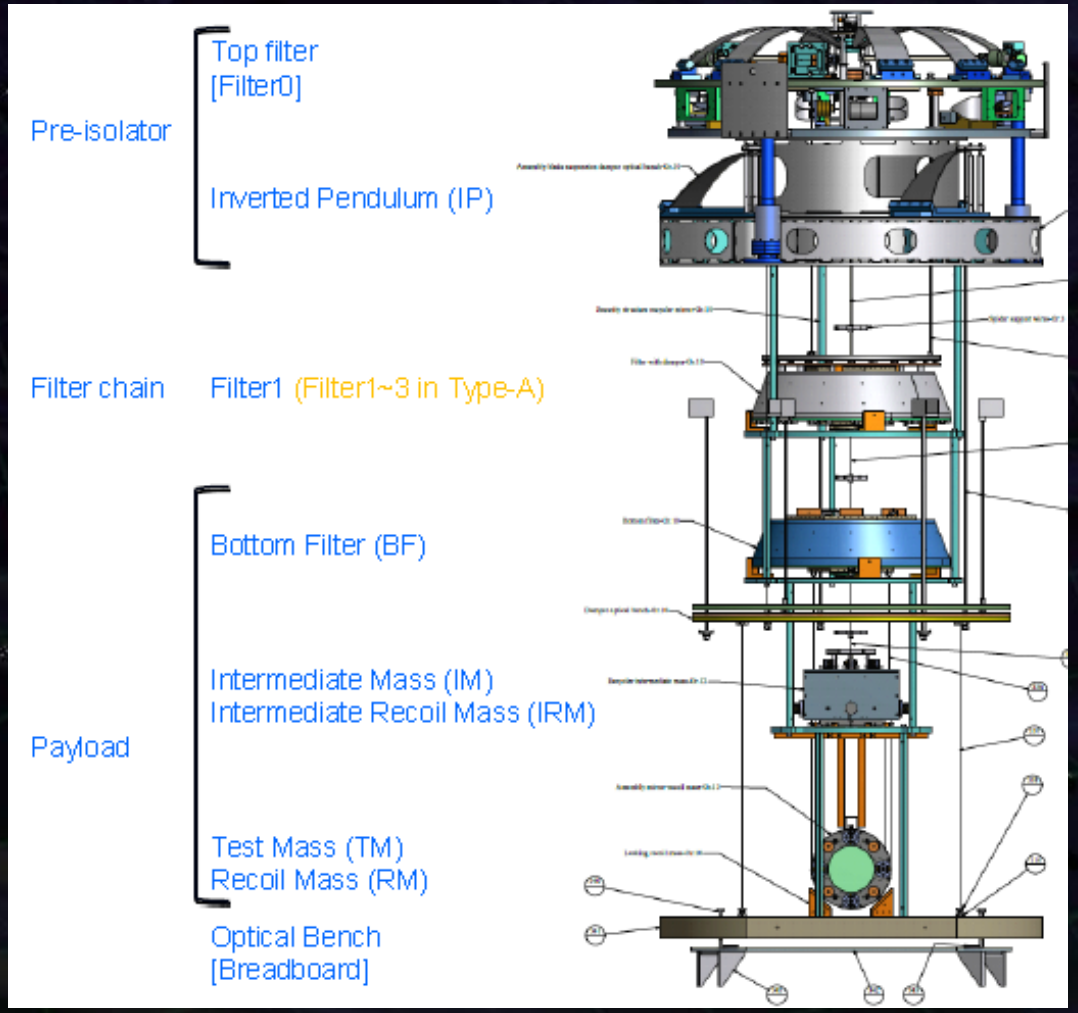
Pre-Isolator Prototype test (Kashiwa)

Vibration Isolation Design

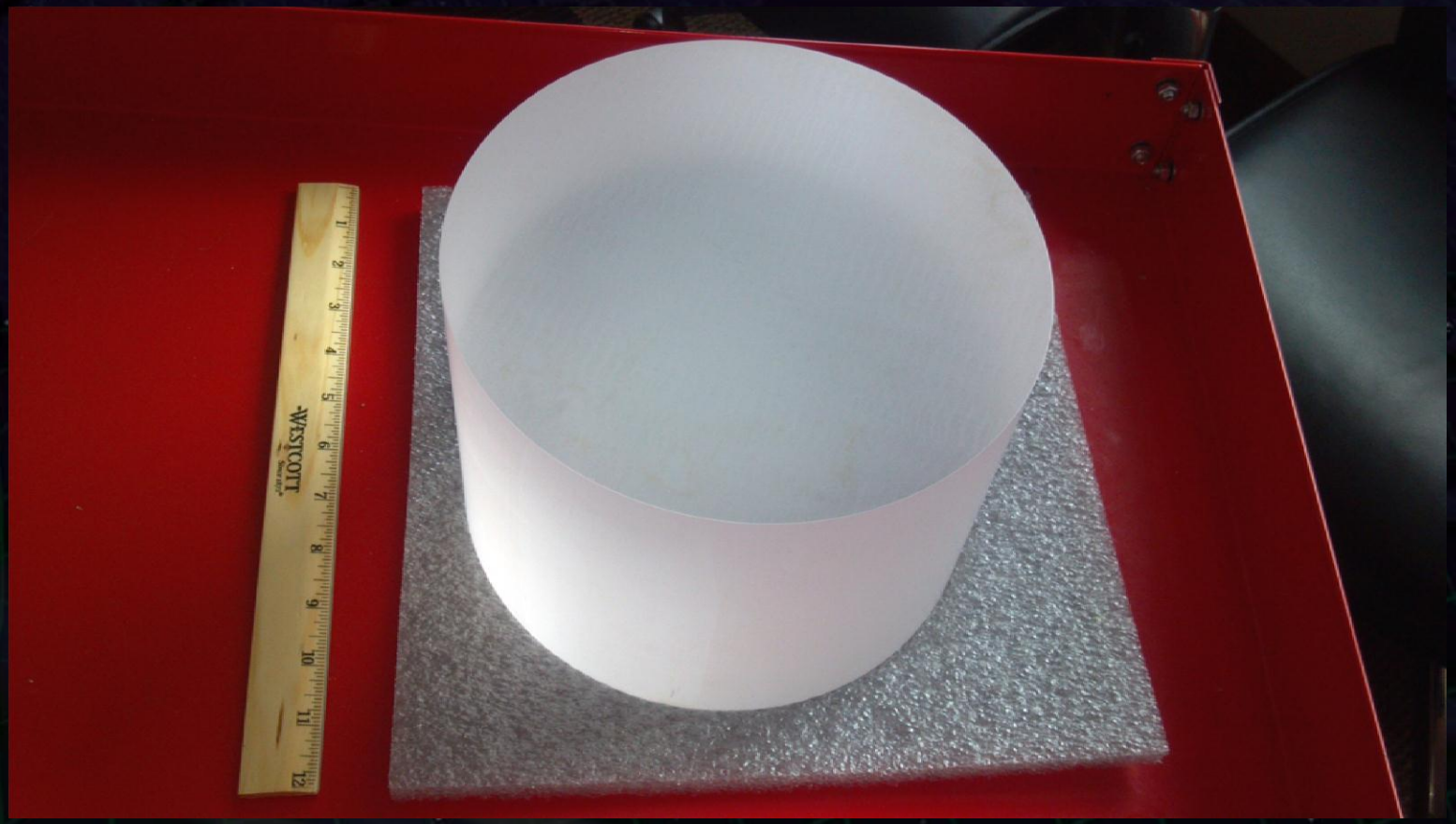
'Type-B' SAS

- 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)



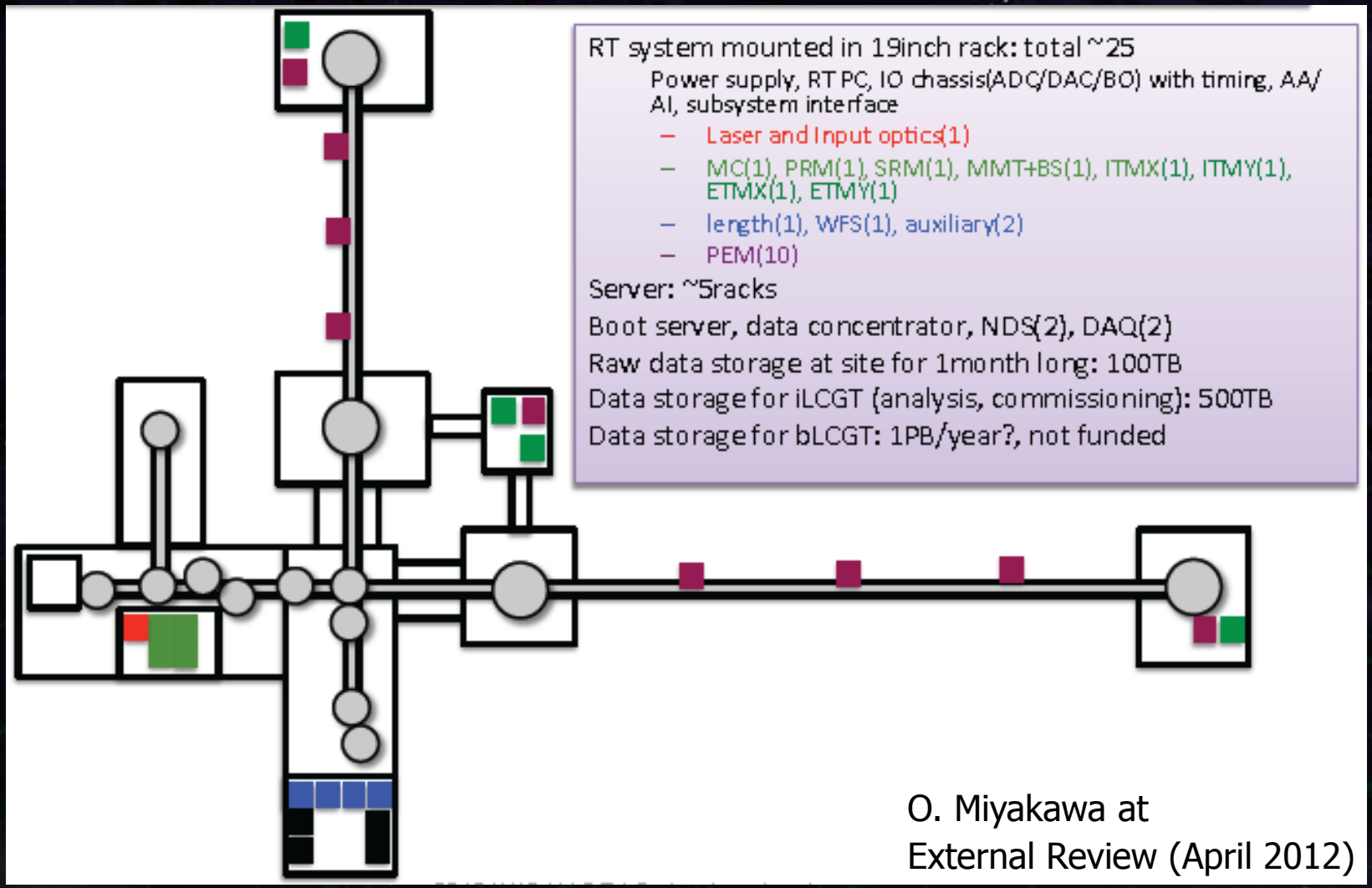
Sapphire Mirror



2 Sapphire substrates were delivered
(Φ220mm, t 150mm, c-axis)

Digital Control System

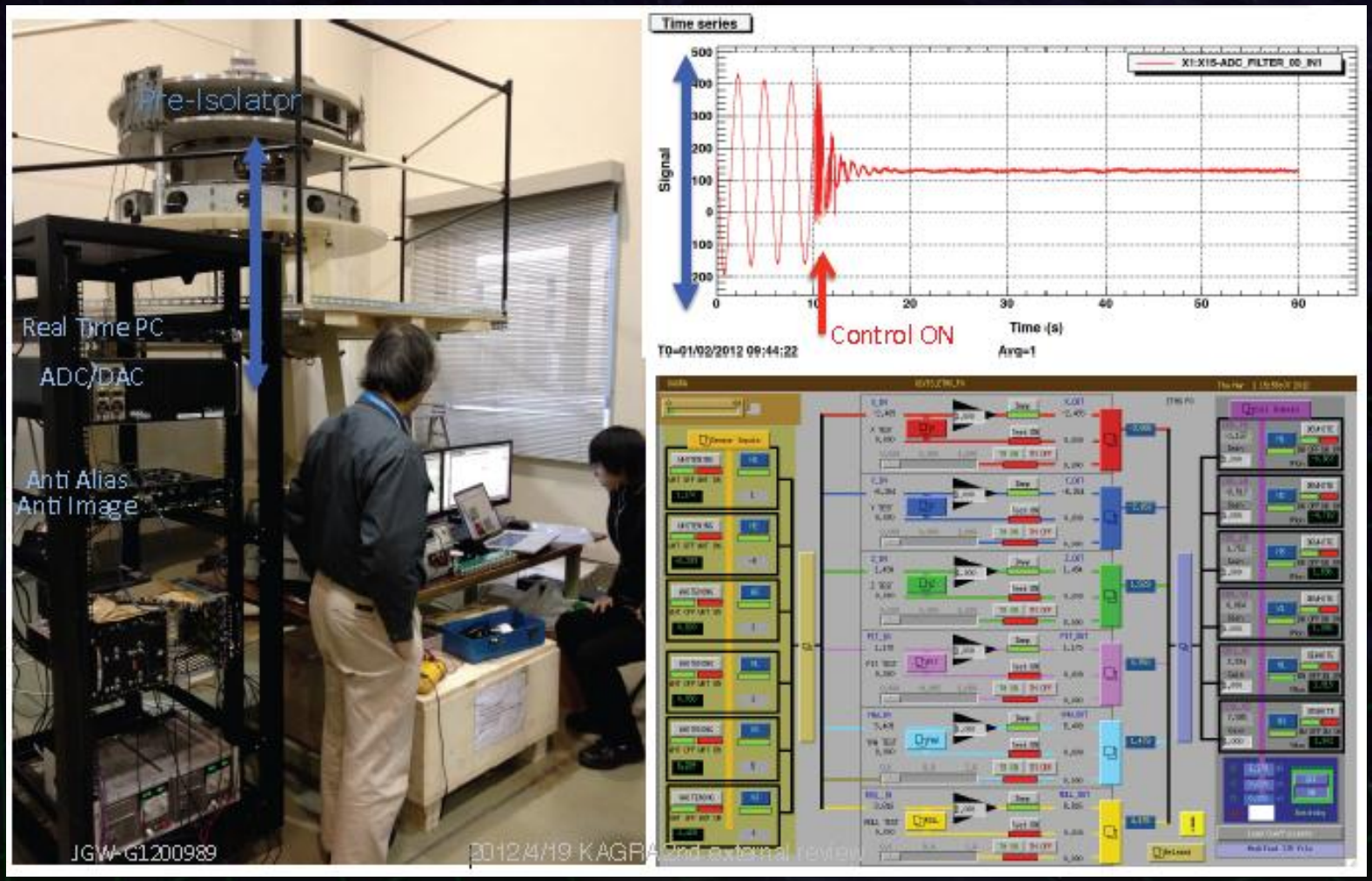
- Digital control based on LIGO system.



O. Miyakawa at
External Review (April 2012)

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