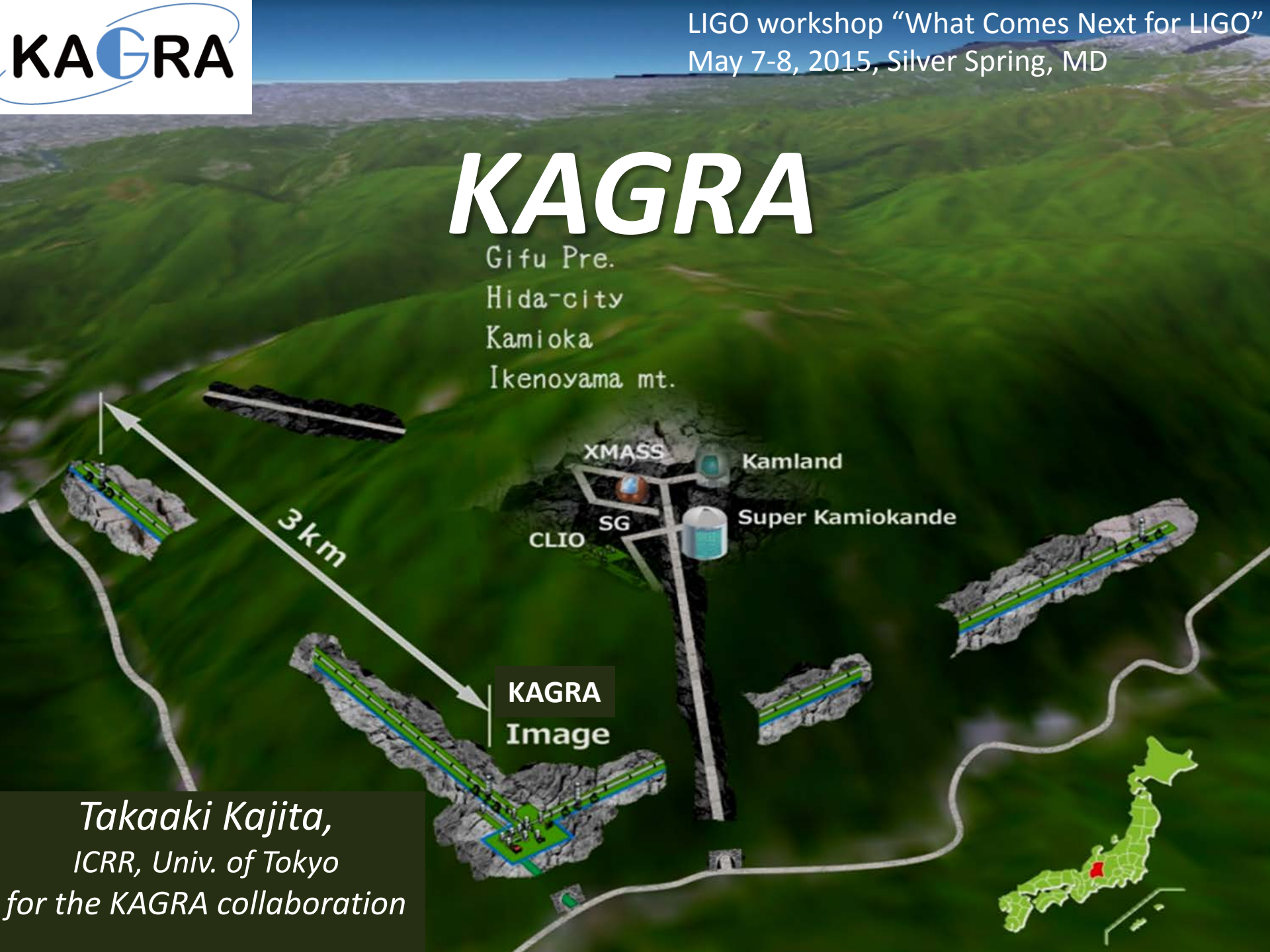
LIGO workshop "What Comes Next for LIGO"
May 7-8, 2015, Silver Spring, MD

# KAGRA



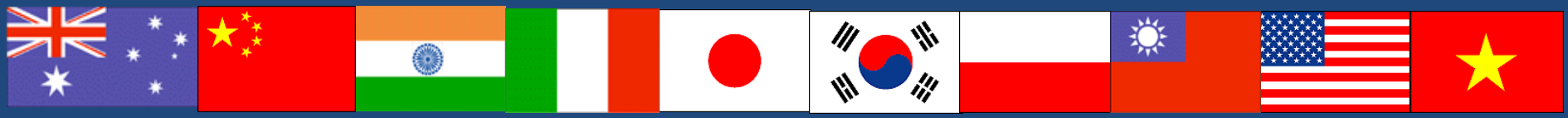

*Takaaki Kajita,*
*ICRR, Univ. of Tokyo*
*for the KAGRA collaboration*

# Outline

- Introduction: Overview of KAGRA
- Status of the KAGRA project
- Plan toward the cryogenic operation (bKAGRA)
- International GW network
- Summary

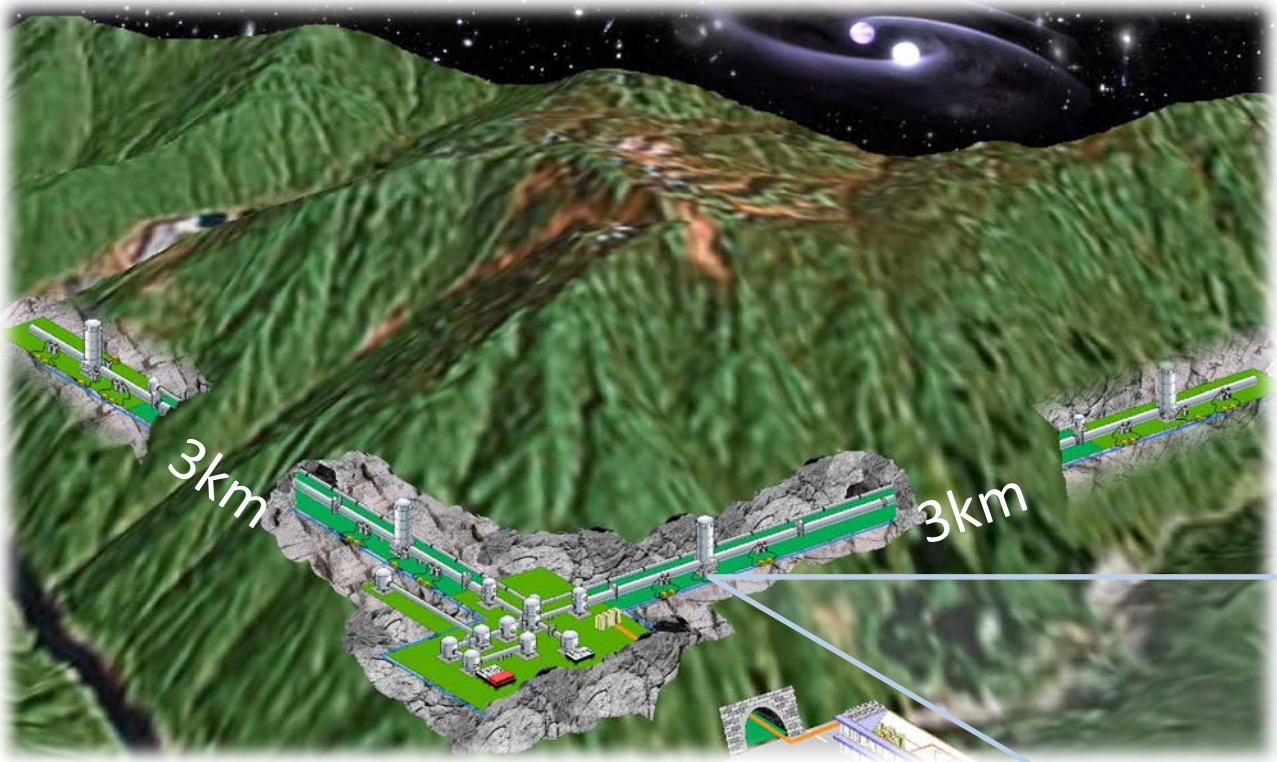
# *Introduction: Overview of KAGRA*

***KAGRA collaboration***



10 countries, ~230 members

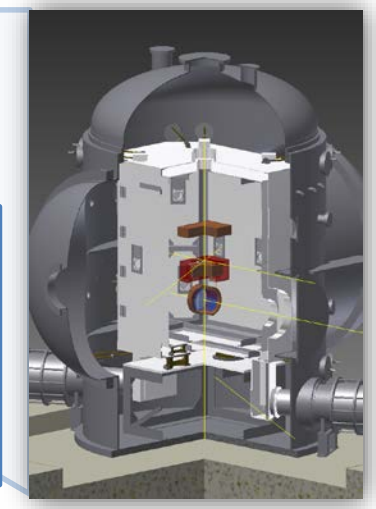
# Key features of KAGRA





The detector will be constructed underground Kamioka.
➔ Small seismic noise (approximately 1/100 of that of the surface).

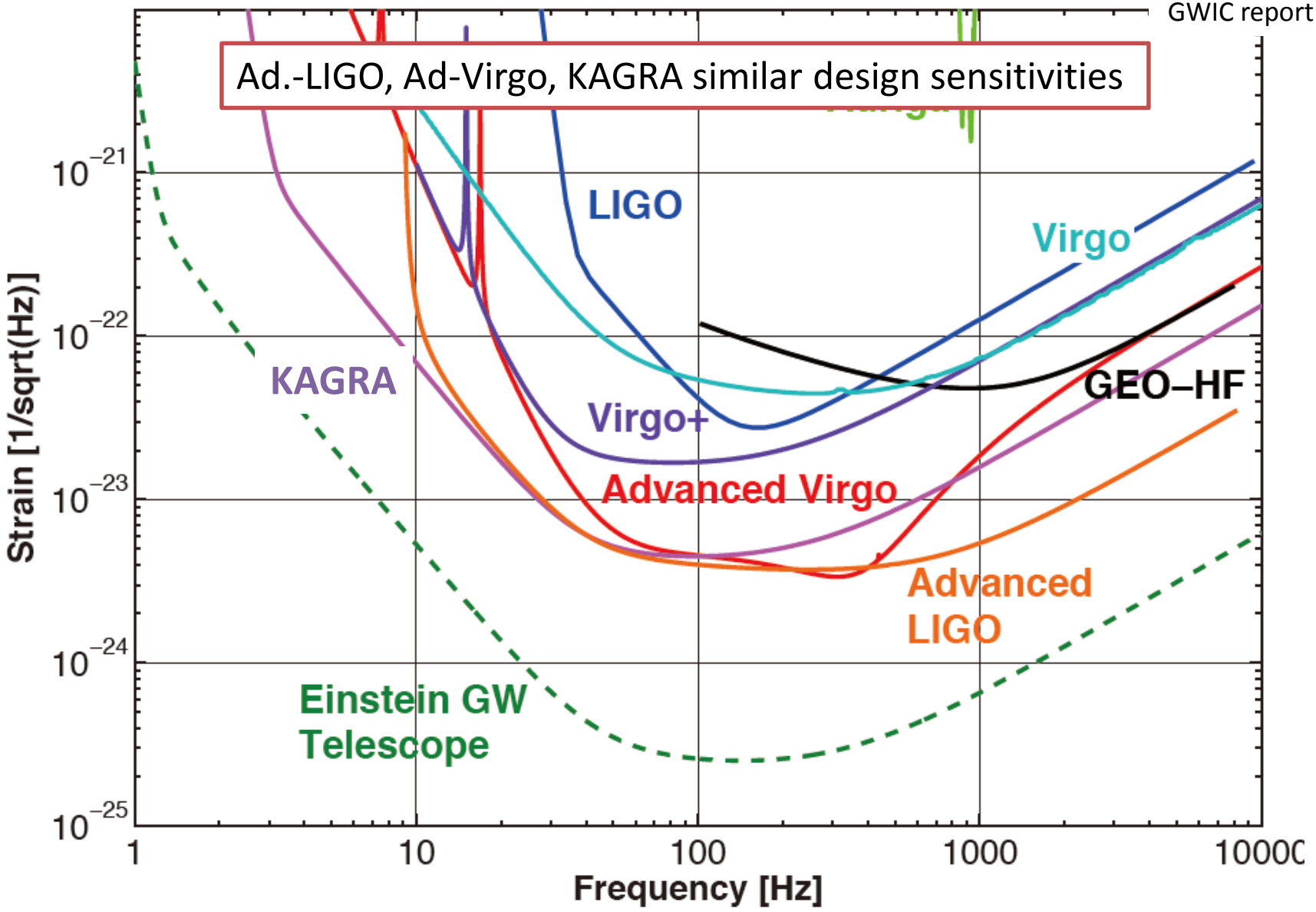
Cryogenic mirrors will be used to reduce the thermal noise (in the 2nd phase).



➔ Very high sensitivity.

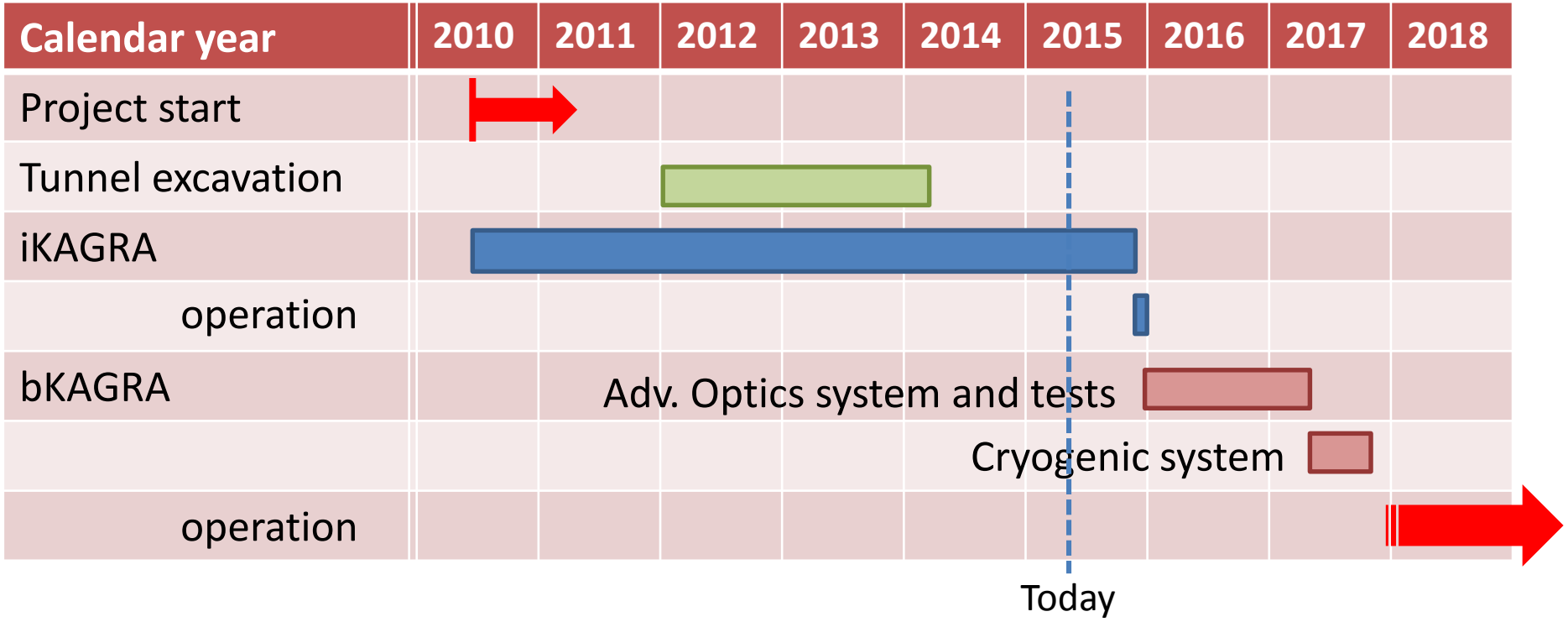
# Sensitivities

GWIC report (2010)



# *Status of the KAGRA Project*

# Time line
## (Construction and Observation)

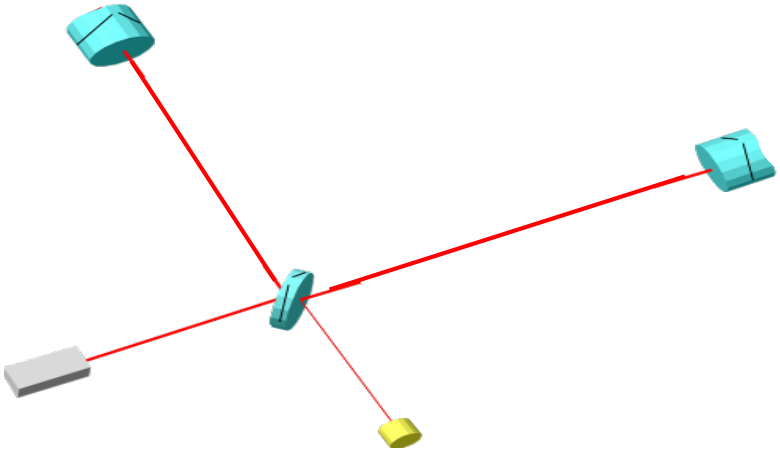


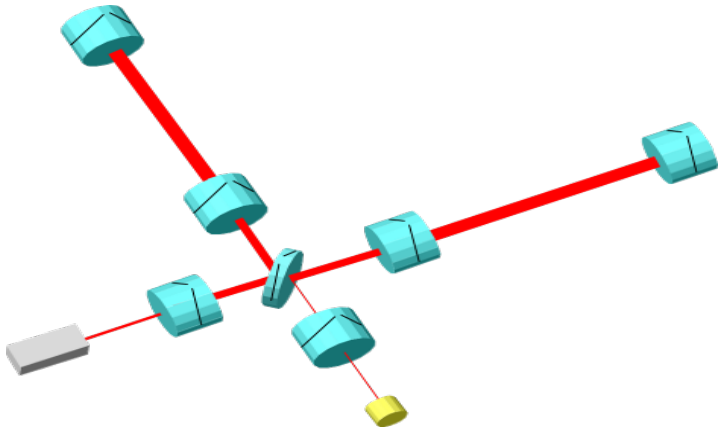

The construction/operation plan is in 2 stages:

- ✓At the end of 2015, non-cryogenic operation (iKAGRA).
- ✓Starting operation with cryogenic system in JFY 2017 (bKAGRA).
- ✓(High sensitivity operation in ?)

# iKAGRA and bKAGRA

*iKAGRA ( ~ 2015)* → *bKAGRA*

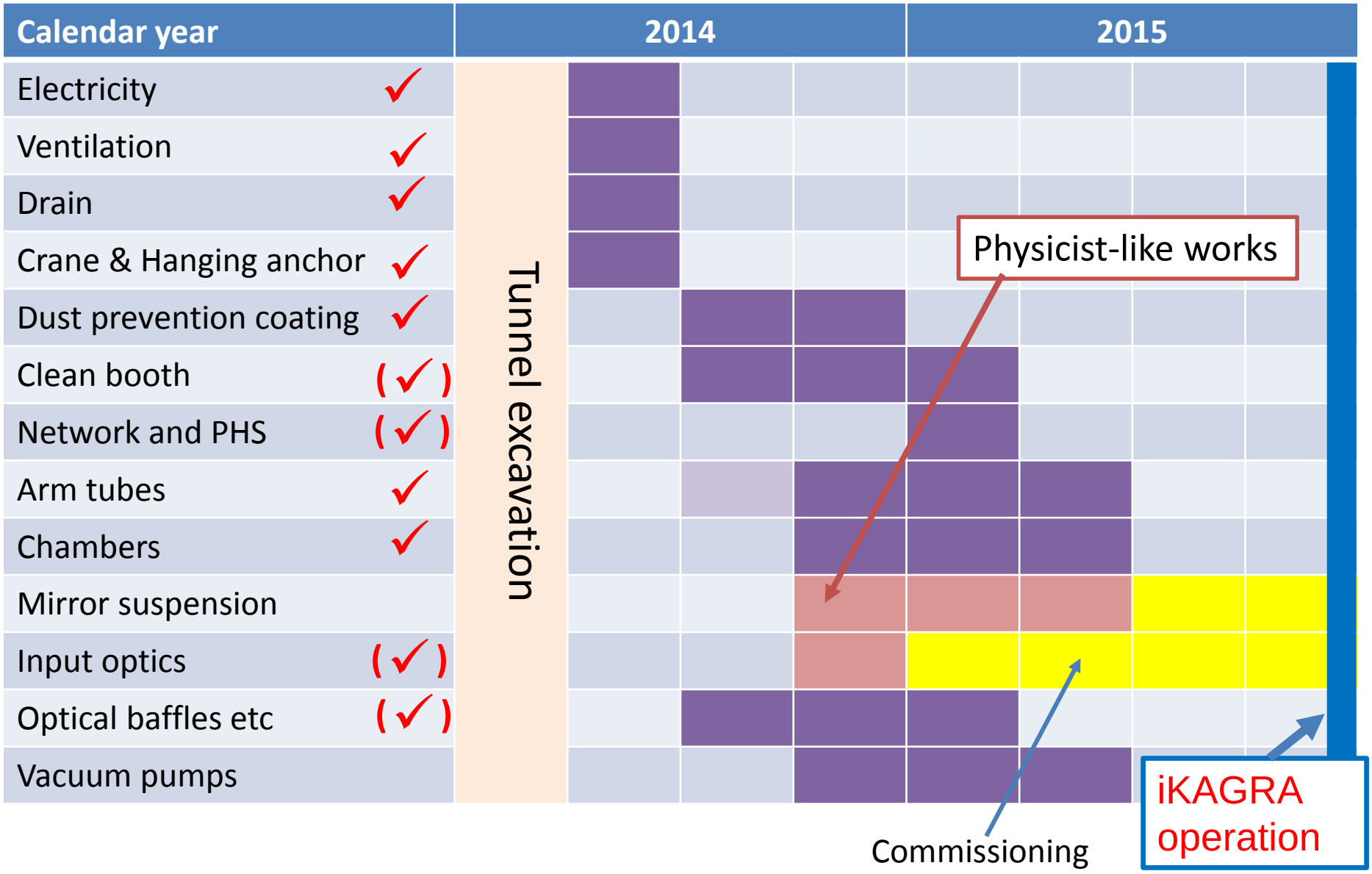




- Simple Michelson interferometer with: room temperature operation and 2W class laser.
- However, full end-to-end (relatively short) observation, in order to experience the operation and to understand the potential problems as soon as possible.

- Full bKAGRA with; power and signal recycling, cryogenic sapphire mirrors, and ~180W laser.

# iKAGRA on-site schedule (2014-2015) (planed in 2014)



# Status (some delay…)

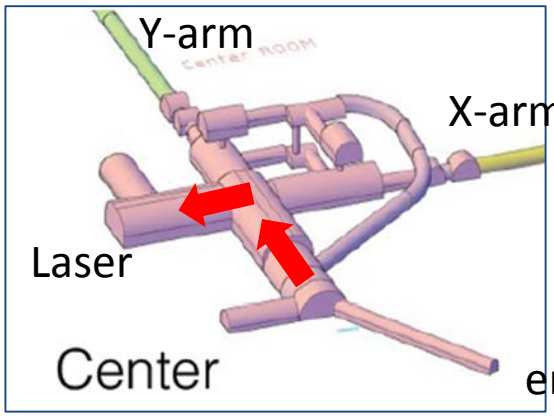
- The underground water has been (much) more than expected, in particular during spring (due to melting snow).
- It has been impossible to install the in-vacuum devises.
- Additional civil-engineering work to minimize the effect of the water during this winter-spring.
- Rescheduling of the installation and commissioning works…

# Status

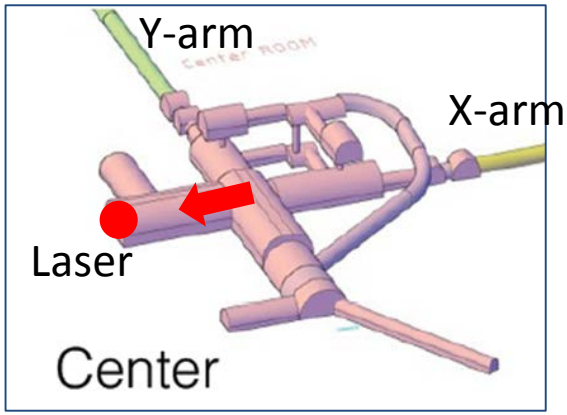
- ✓ Connection and the leak tests of 3km X 3km beam tubes have been finished.

# Status

- ✓ All the vacuum tanks located (slightly old photo).
- ✓ Clean booth construction (planed for JFY 2014) finished.




# Status

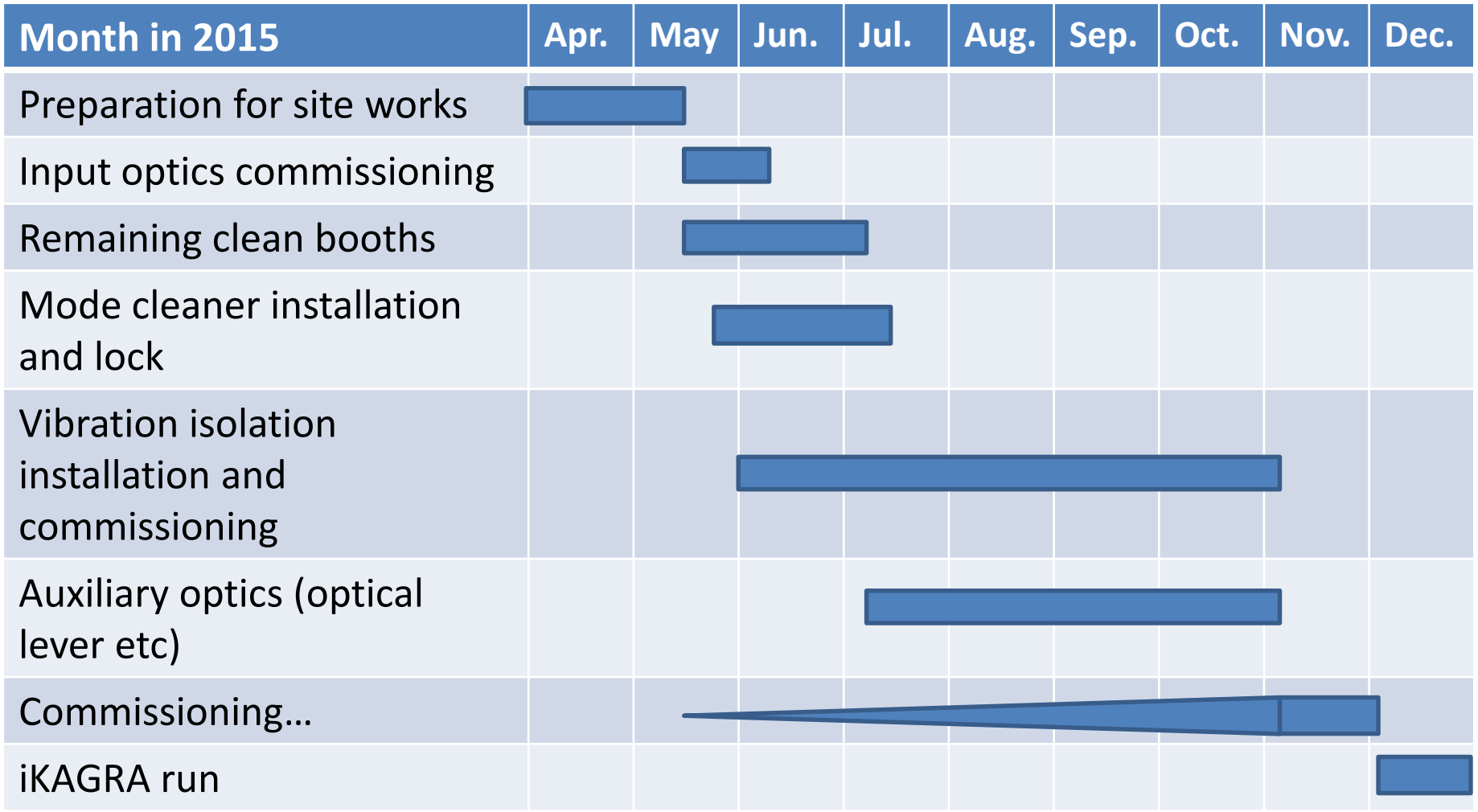



Laser room

- ✓ Preparation of the iKAGRA laser (since Nov. 2014). (ISO class 1 achieved and has been kept).

# Updated iKAGRA on-site schedule (2015)

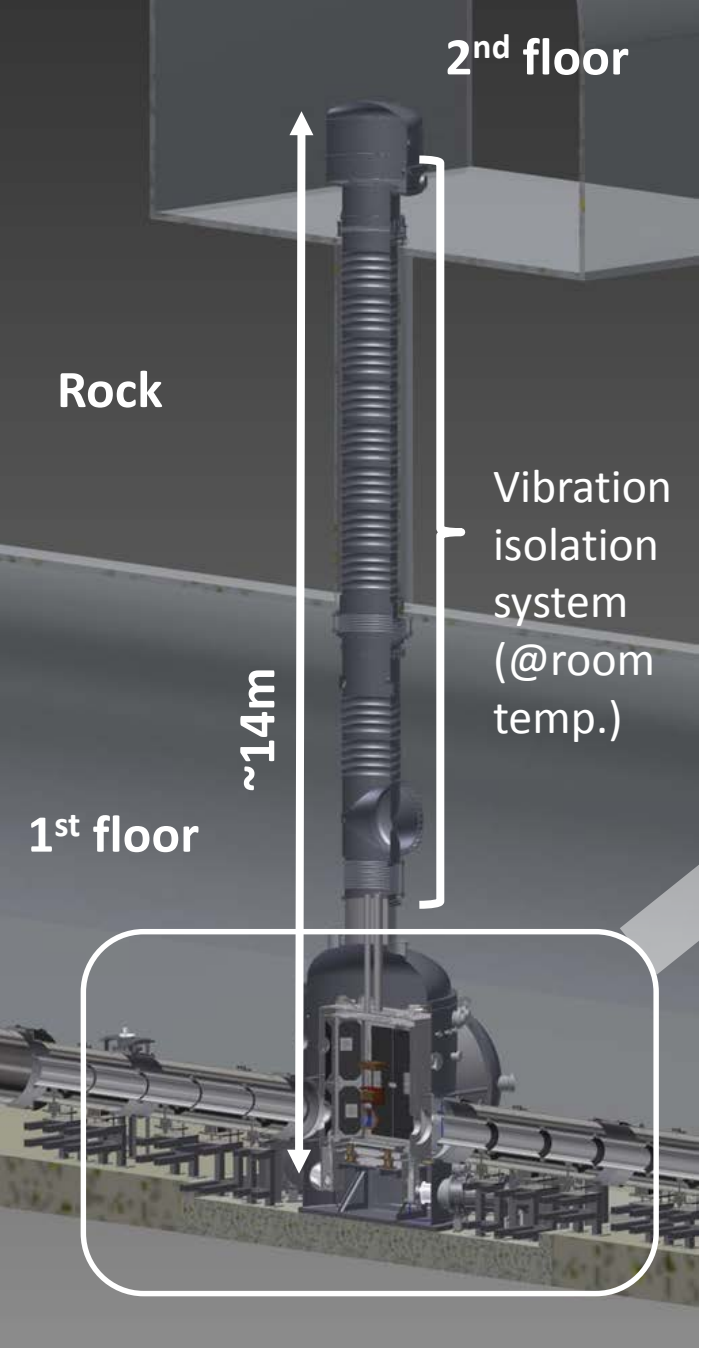
Rescheduled taking the water problem into account…

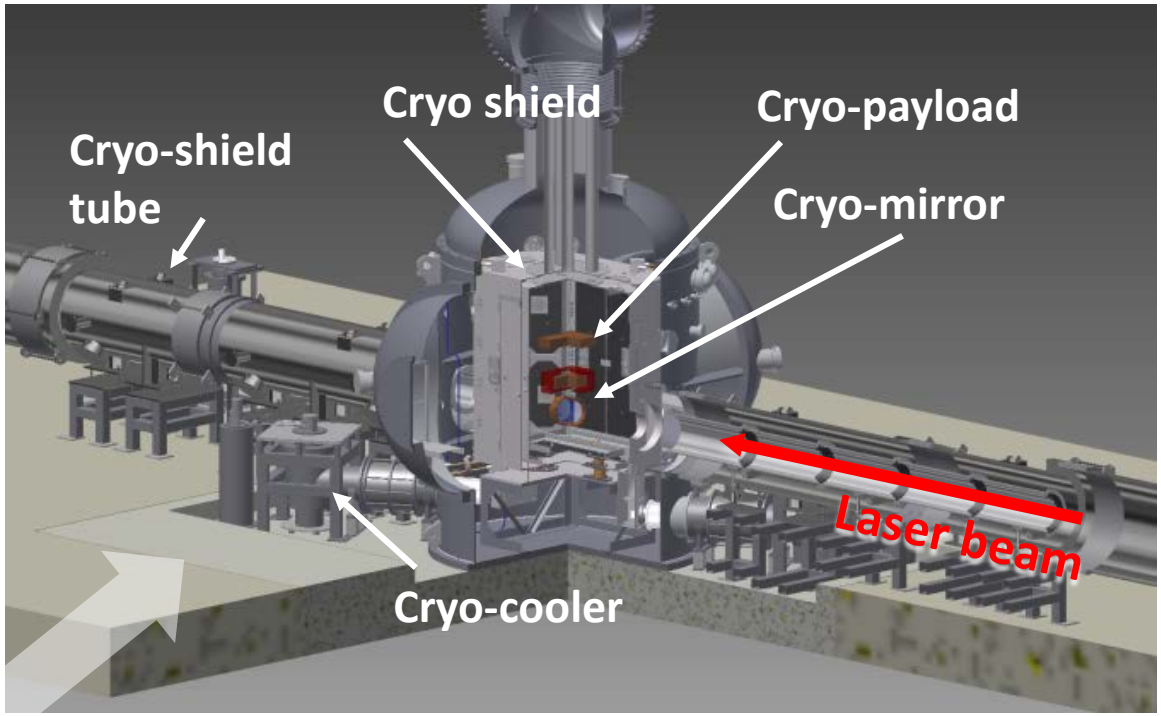


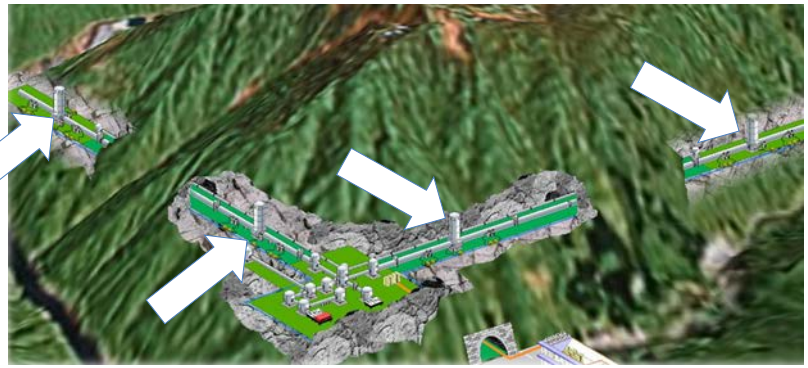

Still hope to have the iKAGRA operation in Dec. 2015…

# *Plan toward the cryogenic operation (bKAGRA)*

# Cryogenic mirrors and cryostat

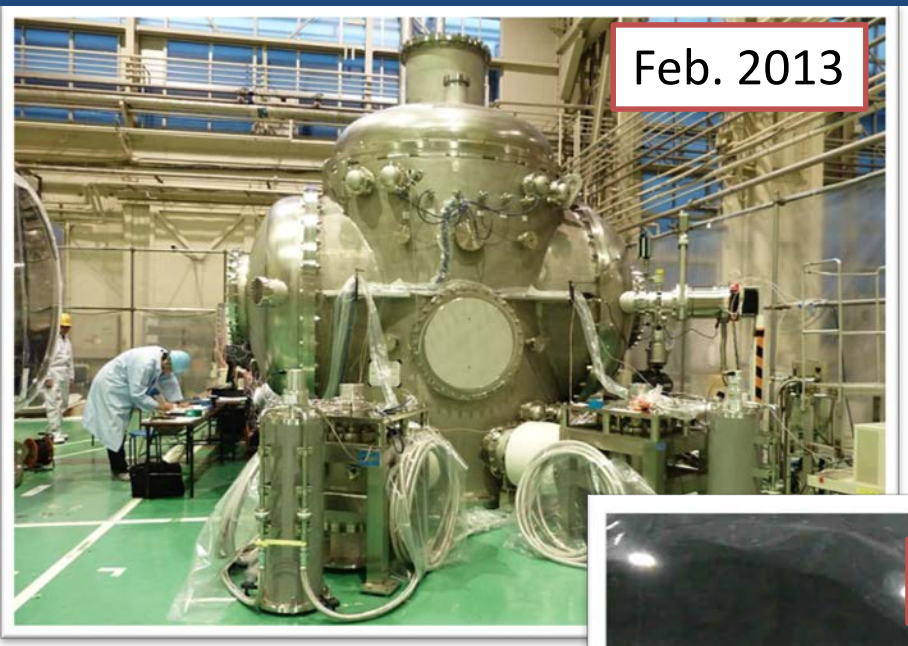


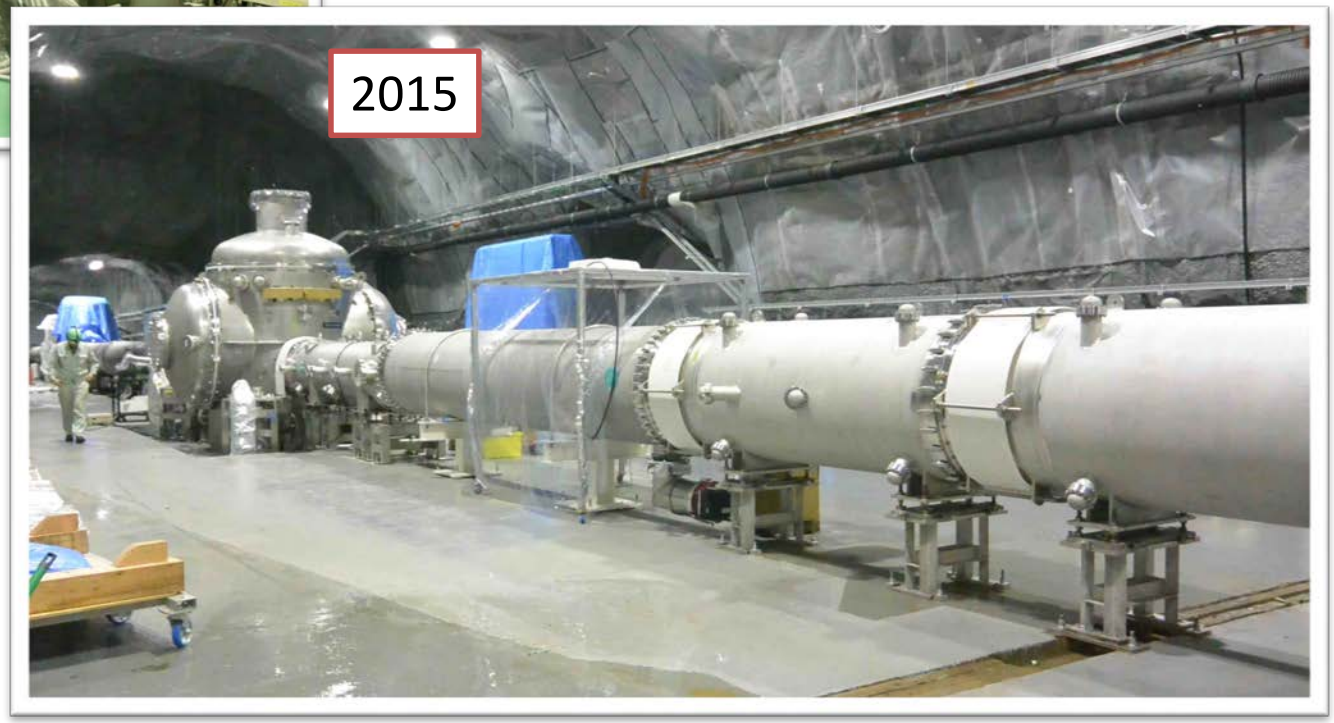
4 cryogenic mirrors

# Status of construction: Cryogenic system

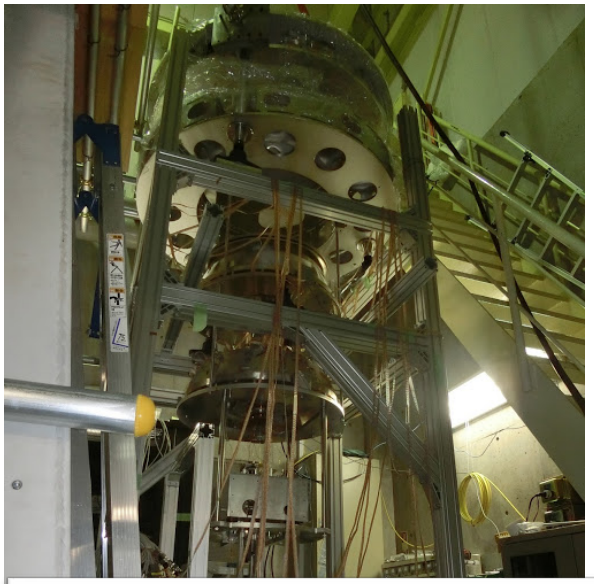


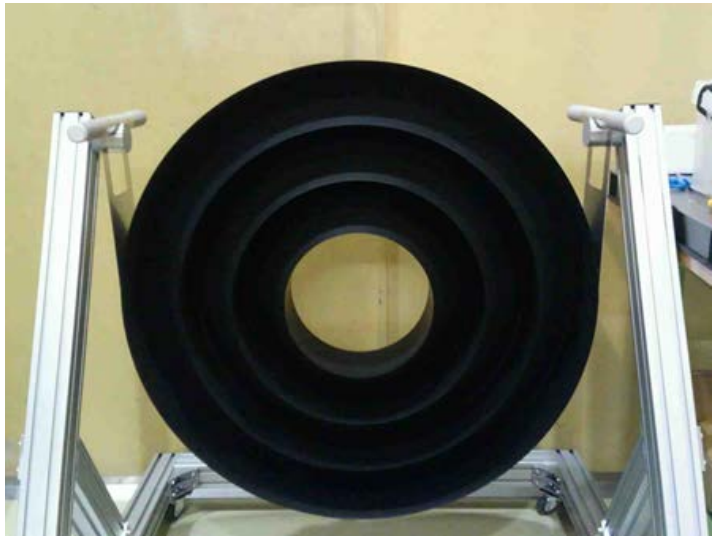

Cryostat testing at Toshiba Co.

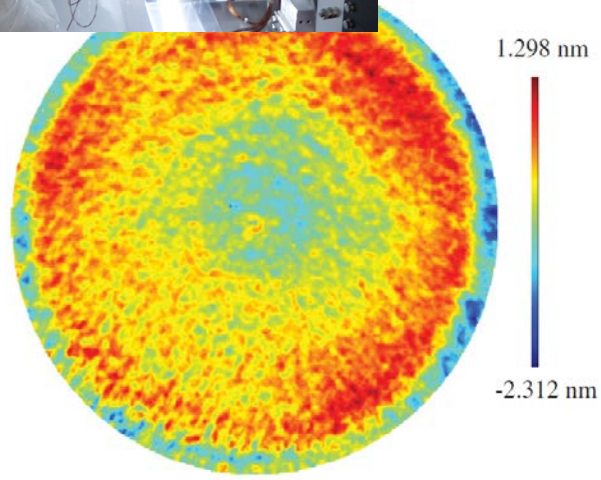
All cryostats and the relevant components installed in the KAGRA tunnel.

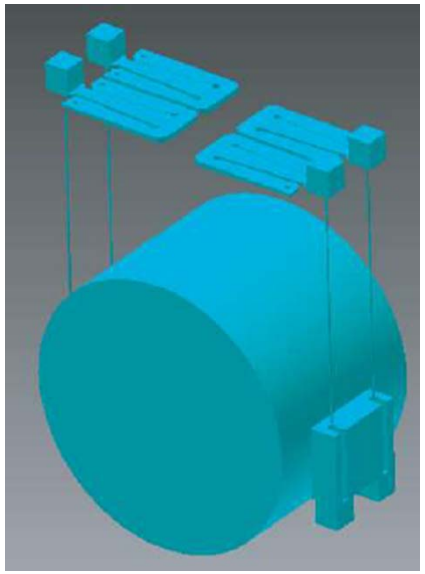


# And much more going on…

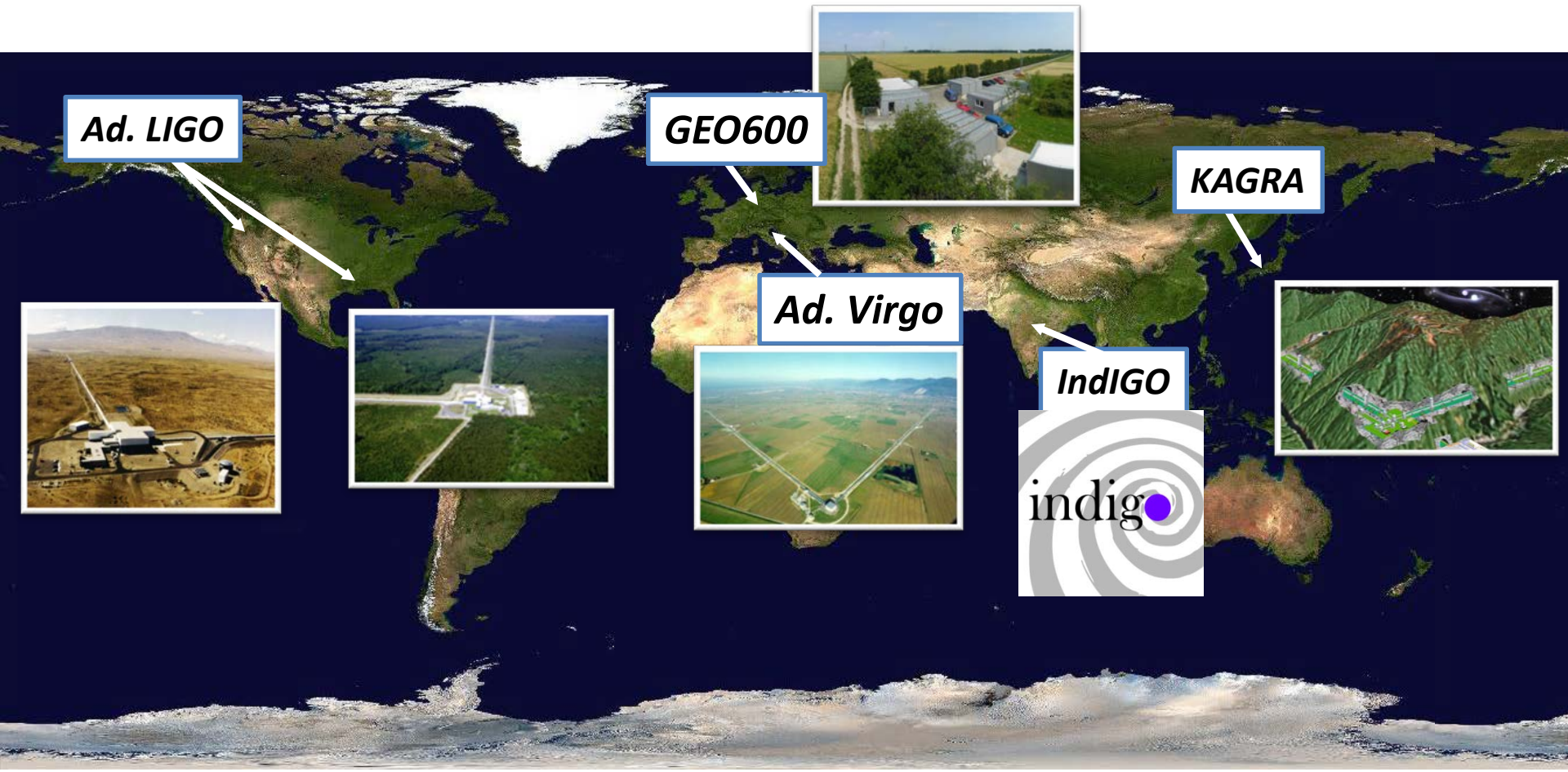






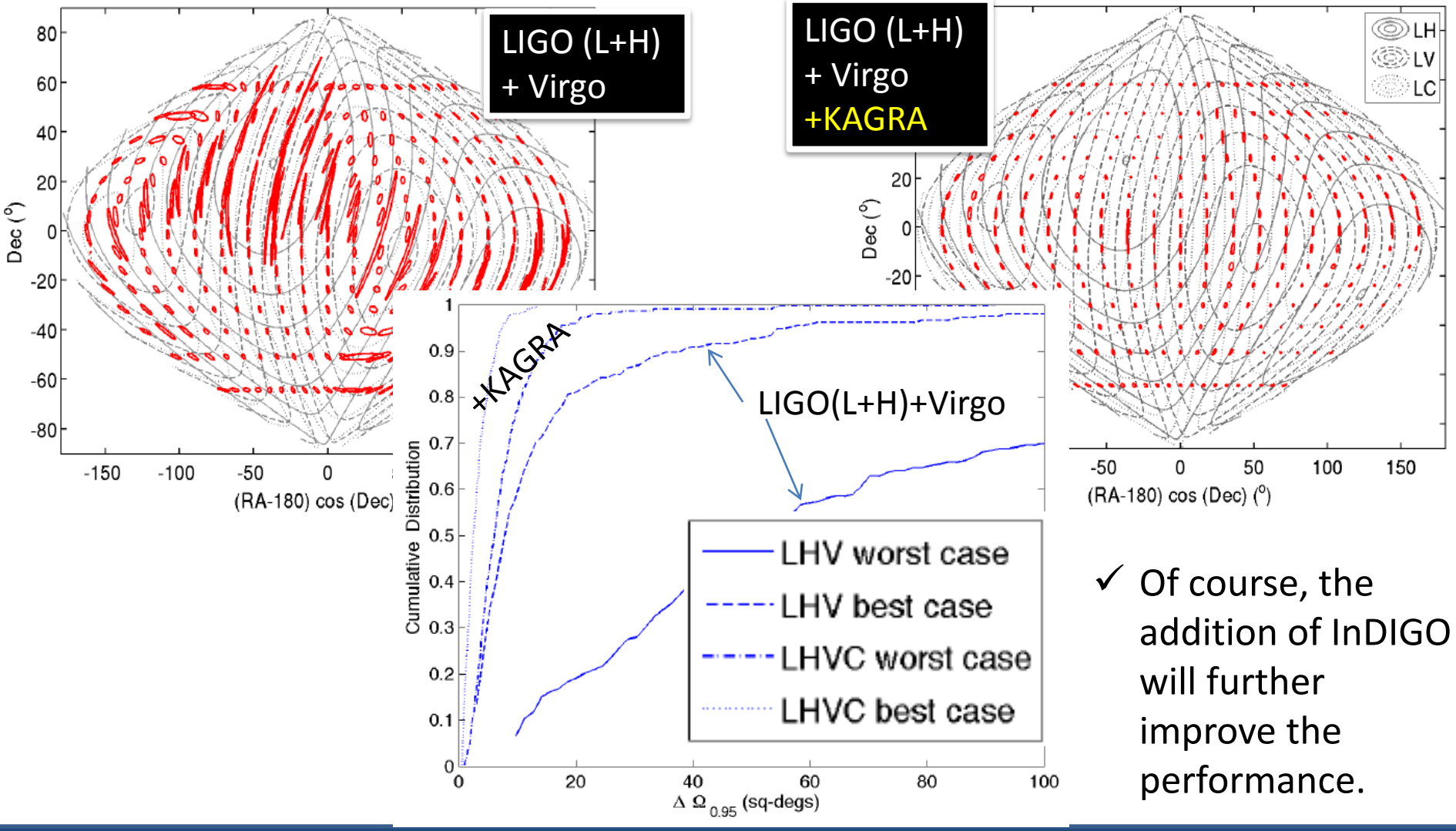
# International GW network



# Importance of Global GW Network: Angular res.

Wen and Chen, arXiv: 1003:2504

Determination of source sky position: 95%CL, supernova, S/N =10




- ✓ Of course, the addition of InDIGO will further improve the performance.

# *KAGRA's hope to join GW network*

- The scientific output will be maximized by the global GW network.
- The addition of KAGRA will improve the performance of the GW network substantially due to its very remote location.
- KAGRA would like to join the international GW network as soon as KAGRA gets high enough sensitivity. (➔MoU already signed between LSC, Virgo and KAGRA.)
- KAGRA has to learn various experiences / technologies from the existing interferometers. (KAGRA has already received a lot of helps. KAGRA would like to thank LIGO/LSC, GEO and Virgo.)
- KAGRA really wishes various helps from LIGO/LSC, GEO and Virgo. In particular, helps by means of the transfer of the experiences and technologies are really appreciated (* next page) .

# *List of KAGRA's wishes to get more helps from LIGO/LSC, Virgo and GEO…*

- KAGRA would like to get helps from;
  - people who have experiences in the digital controls system, specially related to "Guardian" interferometer automation/diagnostic system. For 3 months with 2 people (3 months x 2 people equivalent) starting in August 2015 (or anytime). Maybe later in 2016-17 again,
  - people who have experiences in the vibration isolation system (from Virgo, (1 year X 1 person equivalent)) in 2016,
  - people who have experiences in commissioning, diagnostic approaches of interferometer and noise hunting starting in 2017 for 3 years with initially ~3 people with the reduced number of people with time. (If possible, even a small help during the iKAGRA commissioning would be very helpful to us.).
  - And hopefully more people in high power laser handling (2months in 2016?), data analysis(in the bKAGRA phase), and so on…

(all these numbers and years are still the initial ideas.)

# Summary

- KAGRA is a unique GW interferometer with the underground site and the cryogenic technology.
- The underground water during spring is a problem. Due to this problem, the KAGRA detector construction has been delayed for several months. But, we would like to keep the overall schedule as we initially planed:
  - Initial operation (iKAGRA) in late 2015. We have to work really hard!
  - We plan to start the full cryogenic operation within JFY 2017, and to play an important role as a member of the global GW network.
- KAGRA really hopes to get helps from the experienced colleagues in LIGO/LSC, Virgo and GEO, and would like to join the international GW network as soon as possible.