JGWC
1 October, 2013

Status of KAGRA

Kazuaki Kuroda

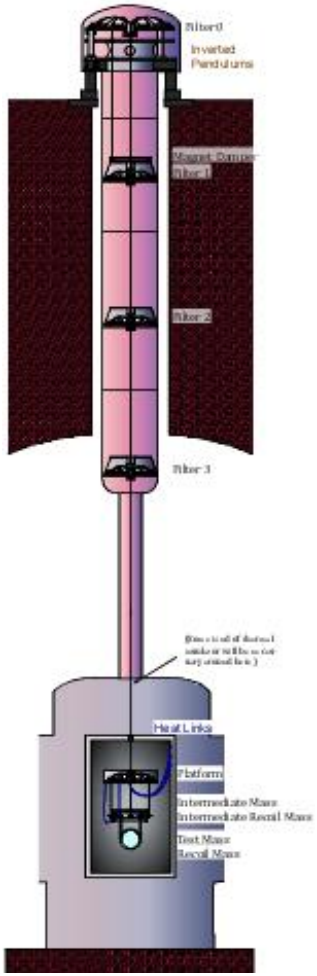
On behalf of KAGRA Collaboration

KAGRA Collaboration in the world

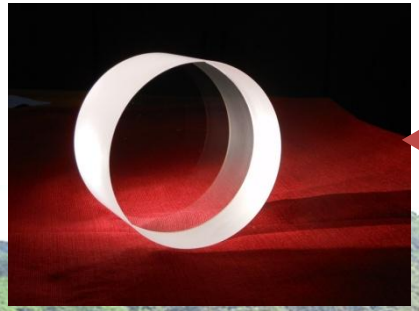
- Research organizations of laboratories and universities are 41 in Japan and 38 in overseas
- 157 researchers in Japan and 67 in abroad, 224 members in total

Overview of KAGRA

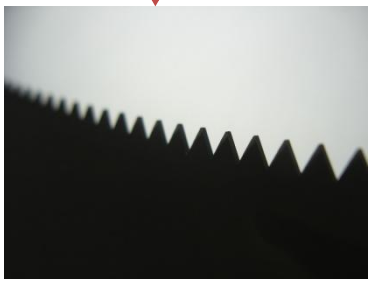
Double floors
SAS system



Pathfinder
Highest quality
Sapphire substrate

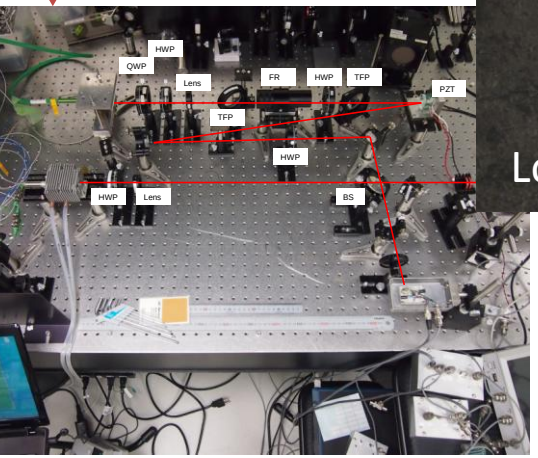


Laser sawed optical baffle

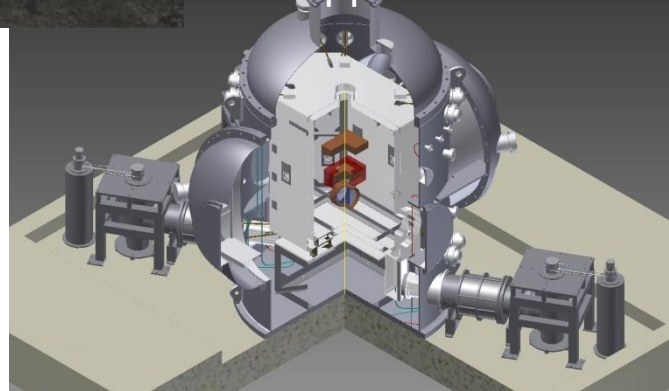


Located underground at Kamioka mine

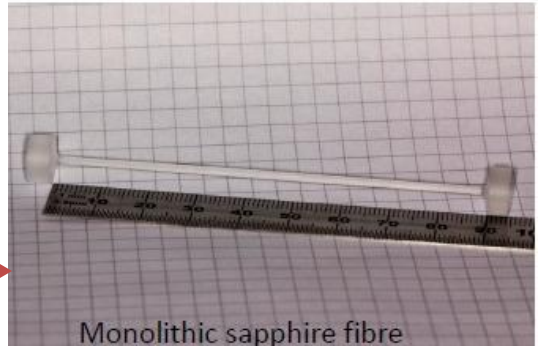
High power laser:
Coherent addition



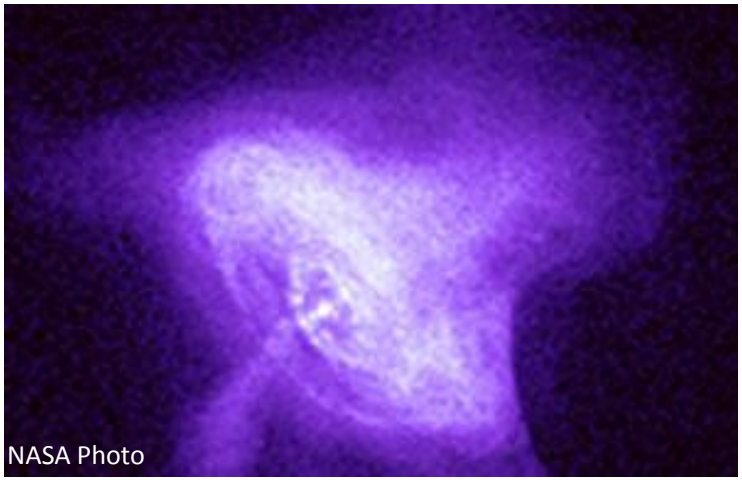
20K sapphire mirror



Suspension fiber

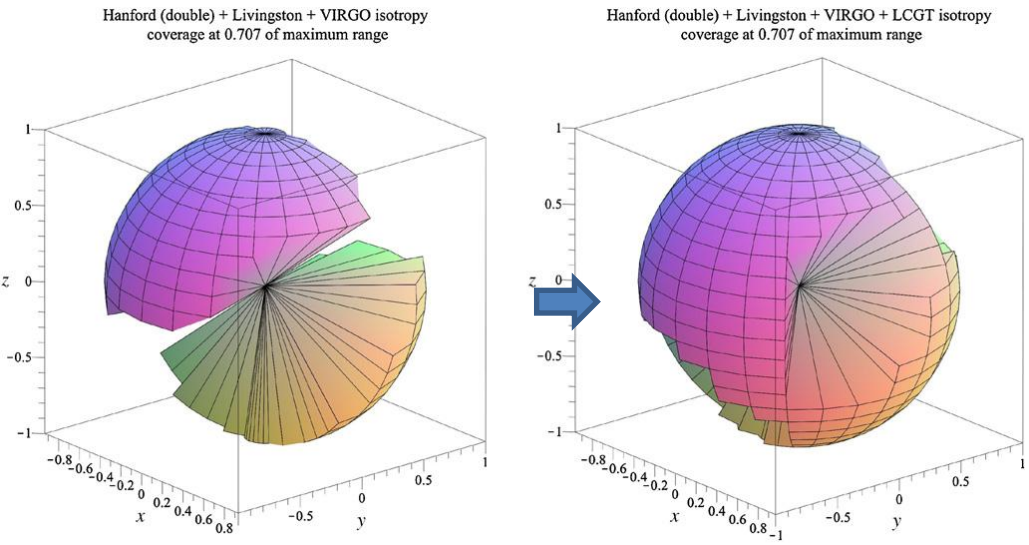


KAGRA Science



- Scientific objective
  - Direct detection of GW in one year observation
  - Opening GW astronomy
    - World wide network
    - Collaboration with other projects

KAGRA enhances sky coverage !



Establishing high sensitive GW detector is needed to catch events occurring in more than 100Mpc.

CQG 28 (2011) 125023 B.F.Schutz

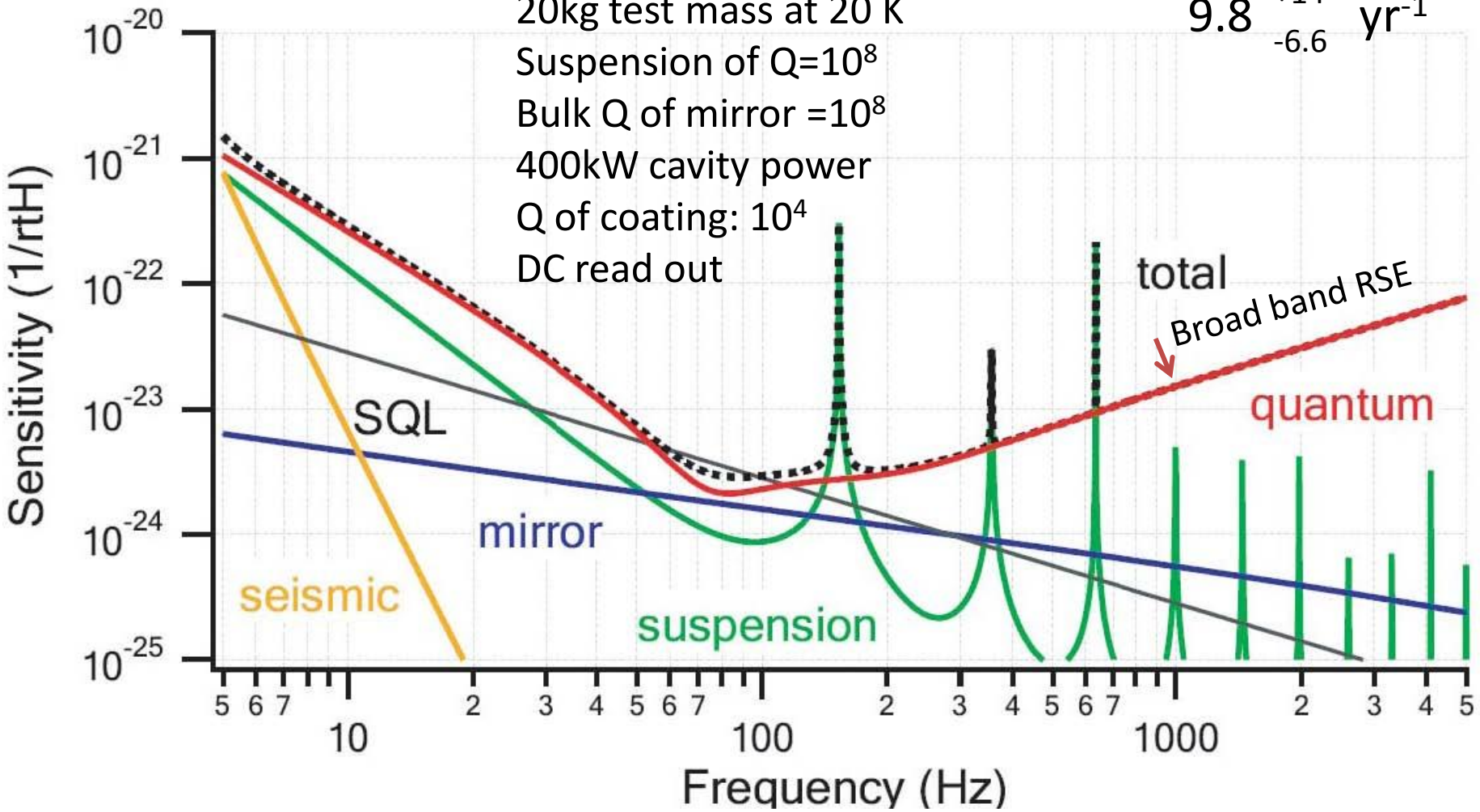
Ultimate design sensitivity of KAGRA

This sensitivity achieves 167 Mpc for coalescence GW of 1.4 Ms NSB.

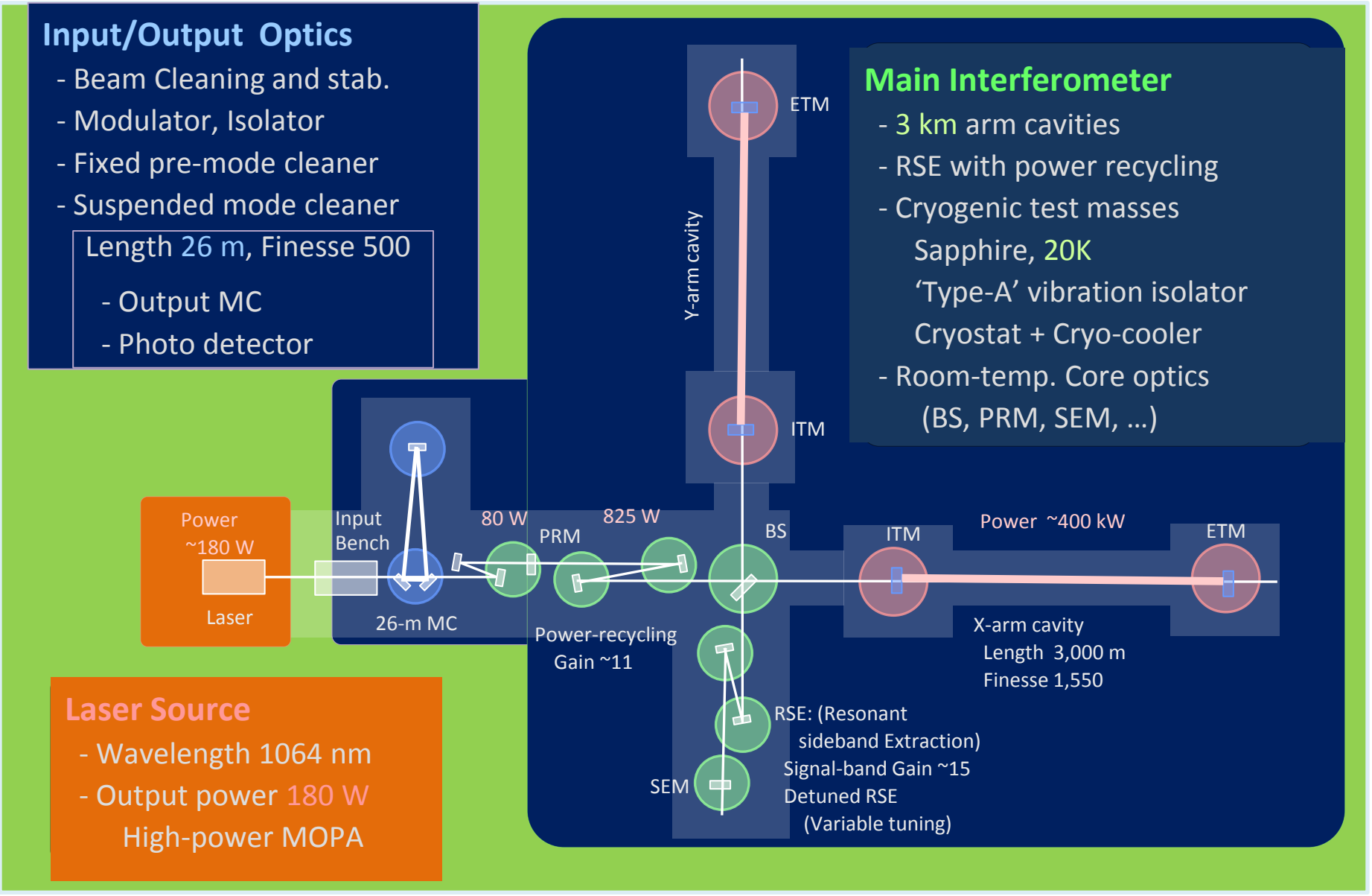
Duty factor: > 80%

Expected event rate

$9.8\ ^{+14}_{-6.6}\ \mathrm{yr}^{-1}$

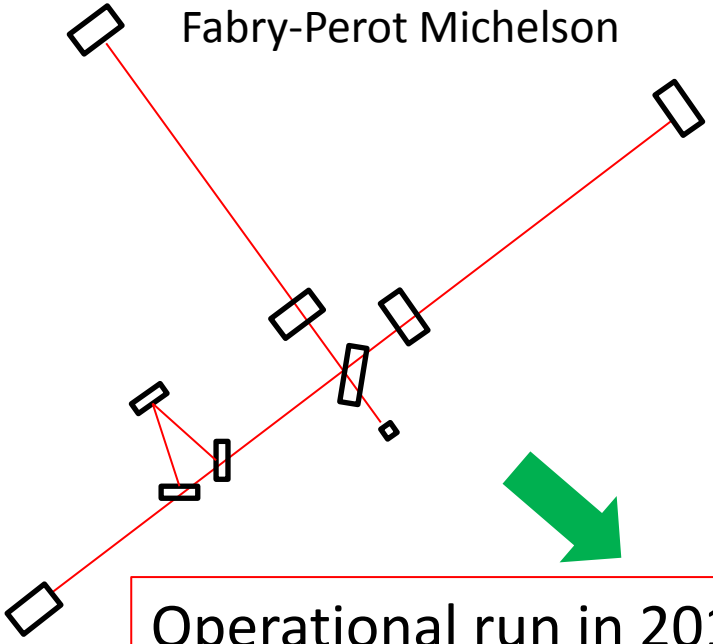


Interferometer configuration



From iKAGRA to bKAGRA

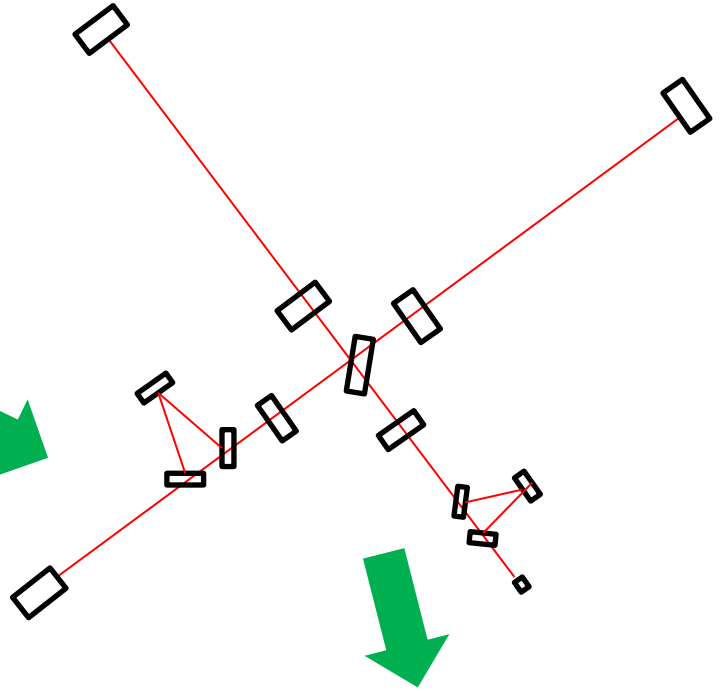
Fabry-Perot Michelson



Operational run in 2015

Without cryogenic & PR
Fused silica mirror

Power Recycled Fabry-Perot Michelson with broadband RSE
Cryogenic mirror, output MC

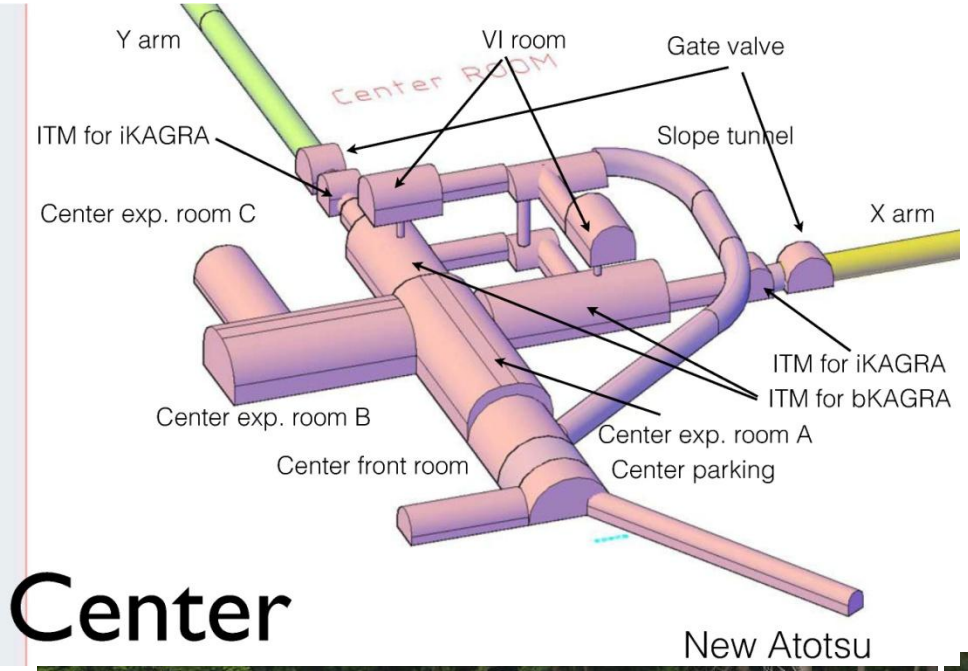


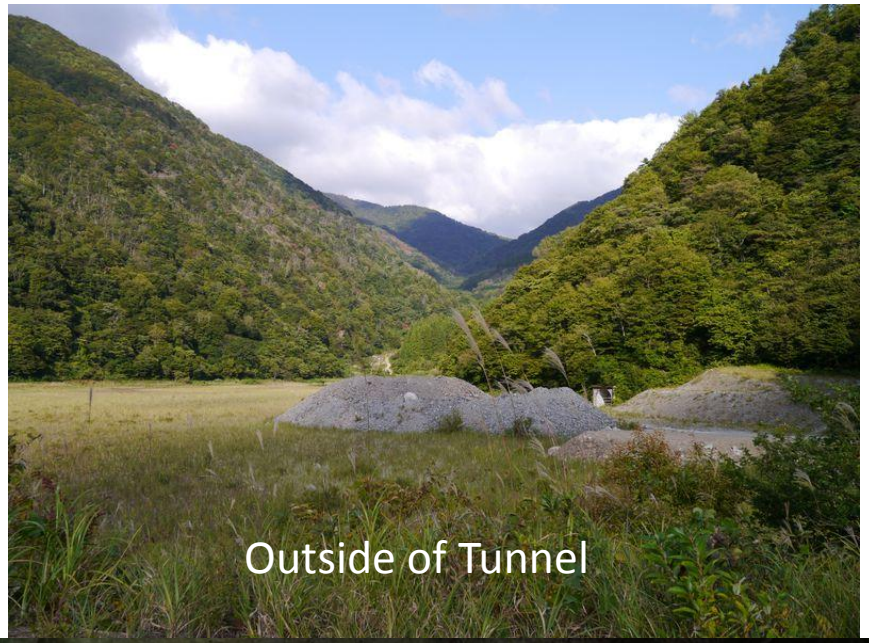
Operation starts in 2017
Observation in 2018

Tunnel excavation: current status

Takashi Uchiyama, ICRR

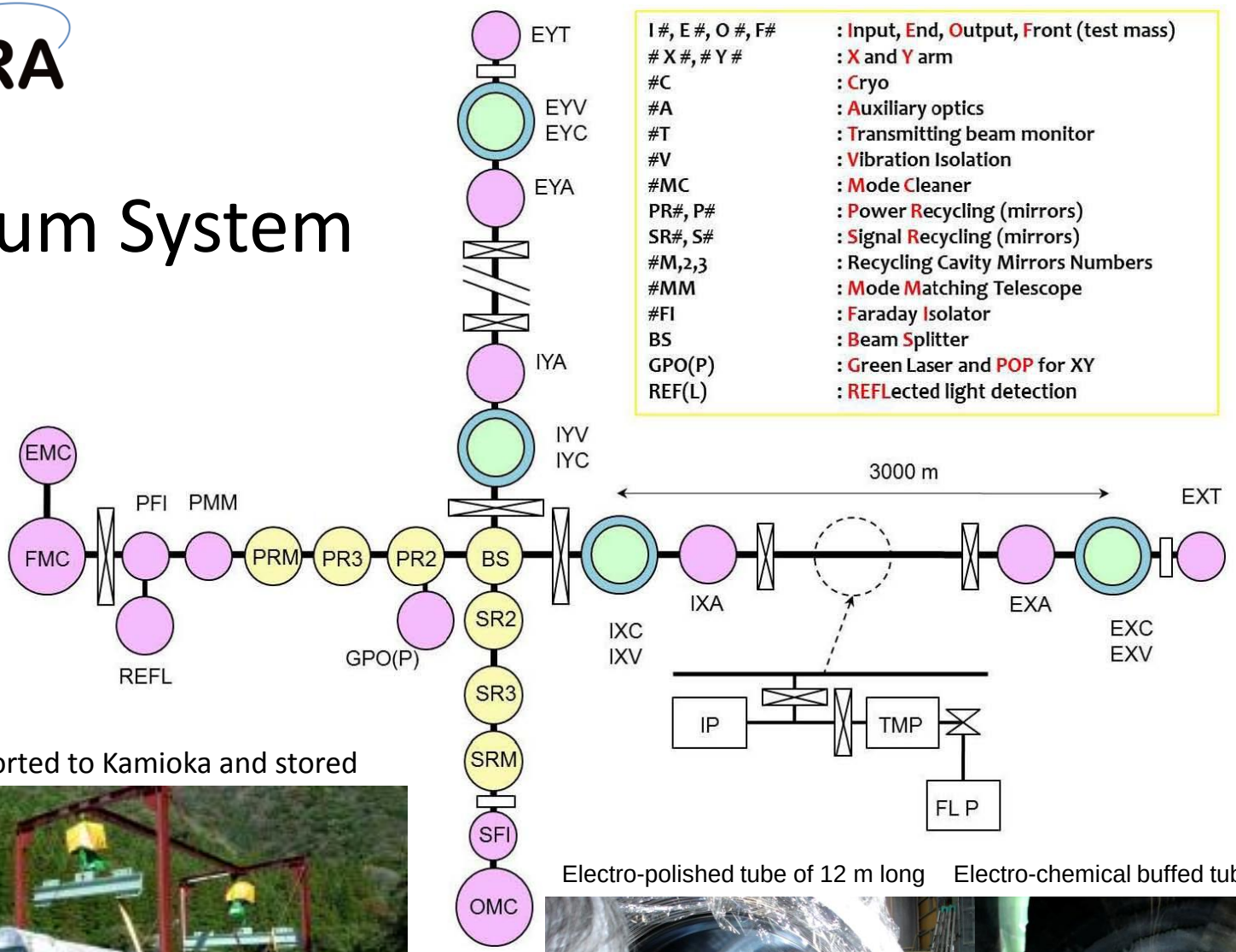
Design and on site pictures





Vacuum System

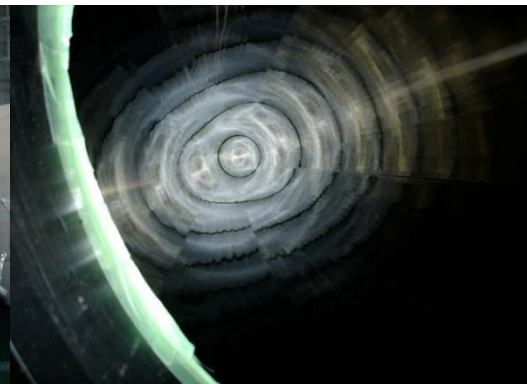
I #, E #, O #, F#	: Input, End, Output, Front (test mass)
# X #, # Y #	: X and Y arm
#C	: Cryo
#A	: Auxiliary optics
#T	: Transmitting beam monitor
#V	: Vibration Isolation
#MC	: Mode Cleaner
PR#, P#	: Power Recycling (mirrors)
SR#, S#	: Signal Recycling (mirrors)
#M,2,3	: Recycling Cavity Mirrors Numbers
#MM	: Mode Matching Telescope
#FI	: Faraday Isolator
BS	: Beam Splitter
GPO(P)	: Green Laser and POP for XY
REF(L)	: REFLected light detection



Transported to Kamioka and stored

Electro-polished tube of 12 m long

Electro-chemical buffed tube of 12 m long



Cryostats manufactured and delivered to Kamioka

Production of No.1 Cryostat

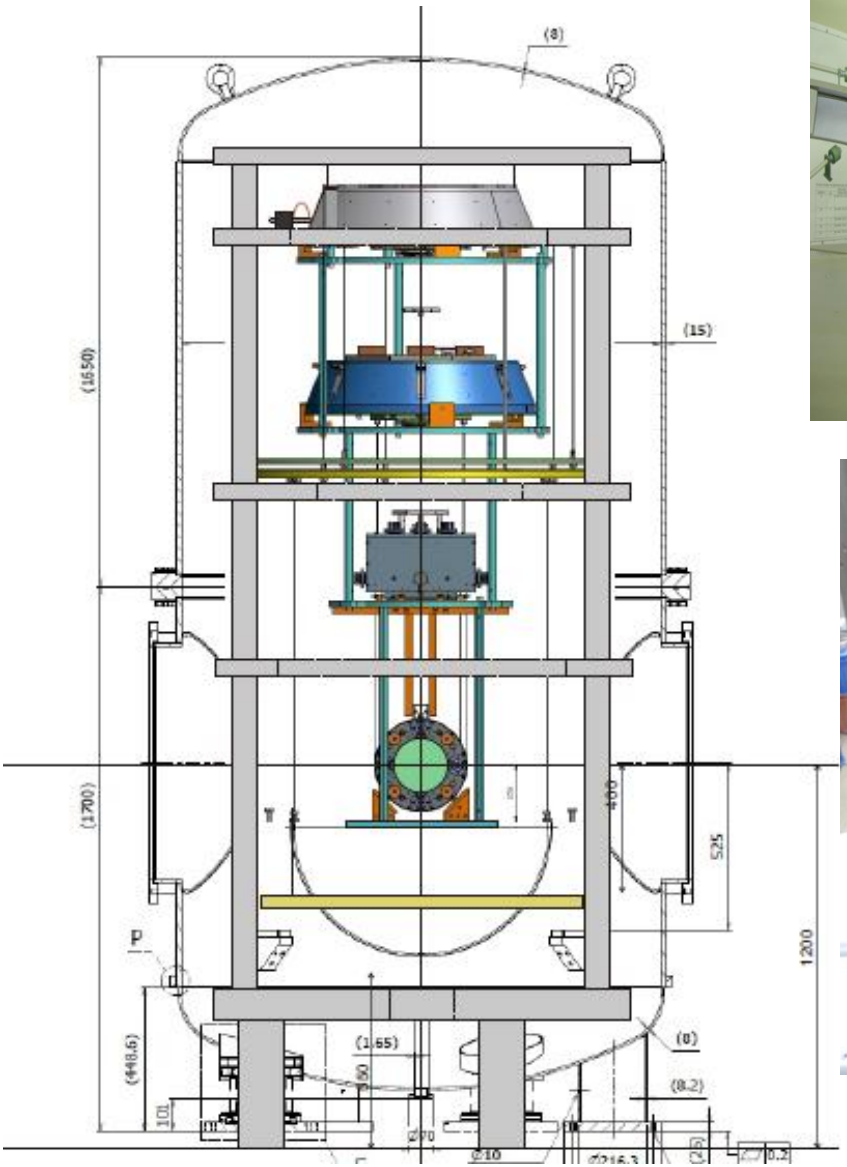
Cryostats have been delivered to Kamioka

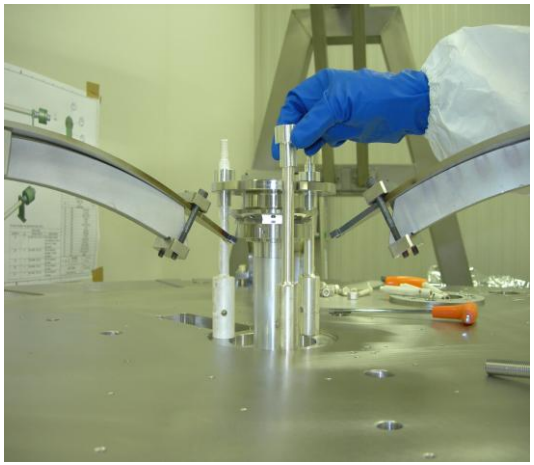
Tests of vibration and cooling speed

Radiation shield tube (17m) is under test

Vibration Isolation

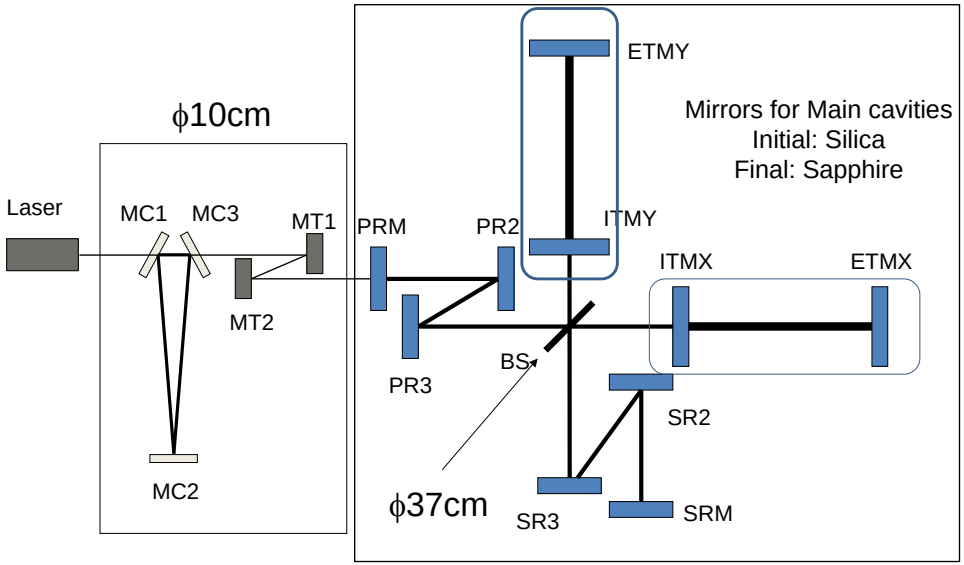
Design of Type B system





- Assembly of the payload prototype is ongoing
- Production of top Six filters has been finished. Resonant frequency was tuned to be 0.2Hz

Core optics

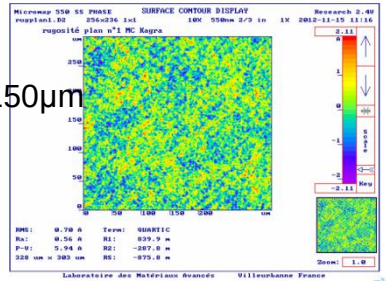


BS:
S-Polarization
37cm diameter , 8cm thickness

iKAGRA cavity mirrors
ETMs: iLIGO mirrors
ITMs: reformed iLIGO mirrors
(wedge angle must be changed)

iKAGRA cavity mirrors
22cm diameter , 15cm thickness
C-Axis Sapphire

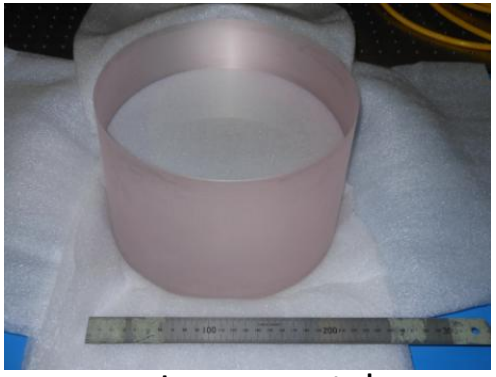
MC &MT mirrors
Polish of MC mirrors has been inspected at LMA.



~150μm

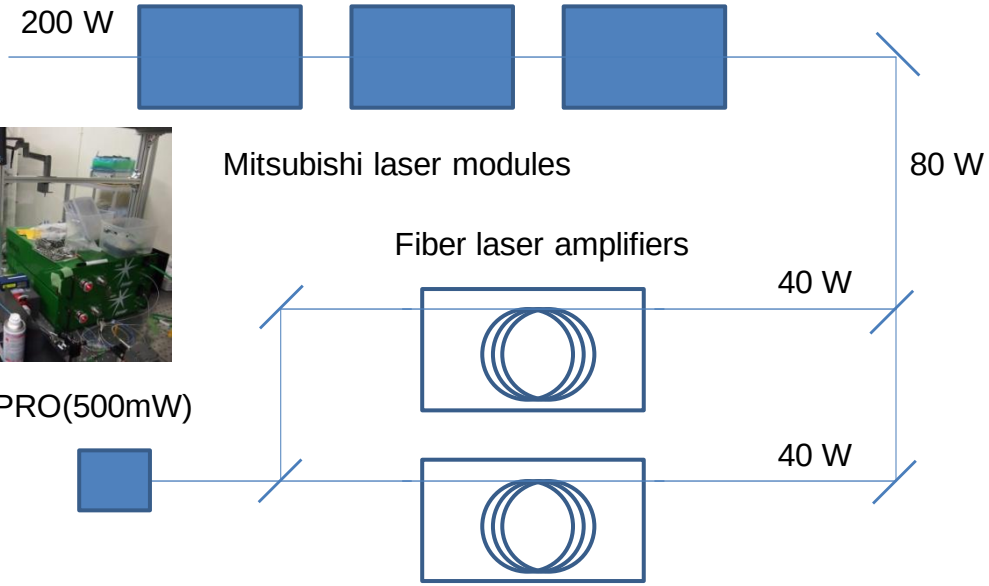
Flat Mirror : < 1 Årms

Recycling & Signal extraction cavities mirrors
reformed iLIGO mirrors
Radius of curvature must be fabricated with extremely small uncertainties.
Ex.
PR2: R=(-3.0764±0.01) m
PR3: R=(24.9165±0.01) m

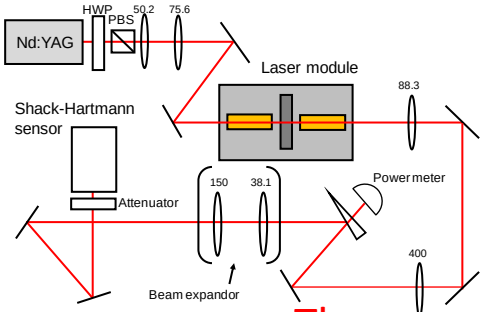


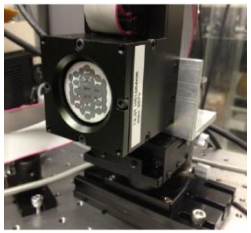
Large crystal

Laser : R&D for high power

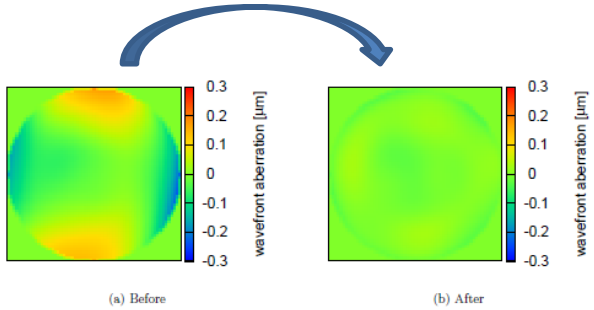


Wave-front distortion caused by a solid-state amplifier

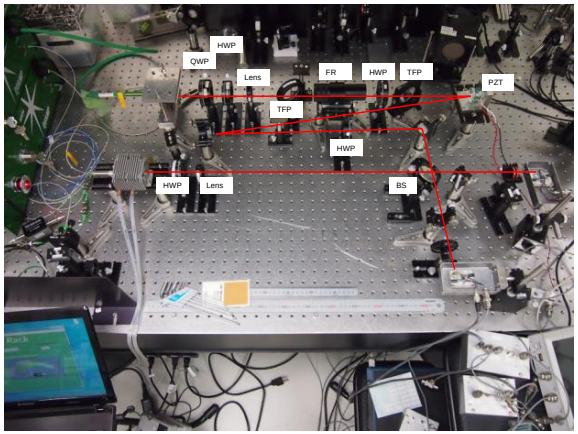




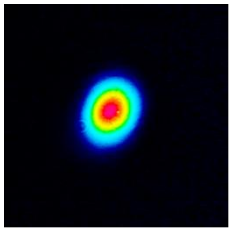
The wave front distortion was corrected by using a deformable mirror.



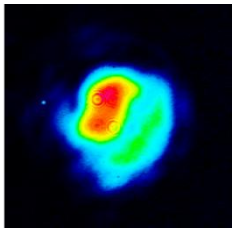
Coherent addition



Bright port 78W



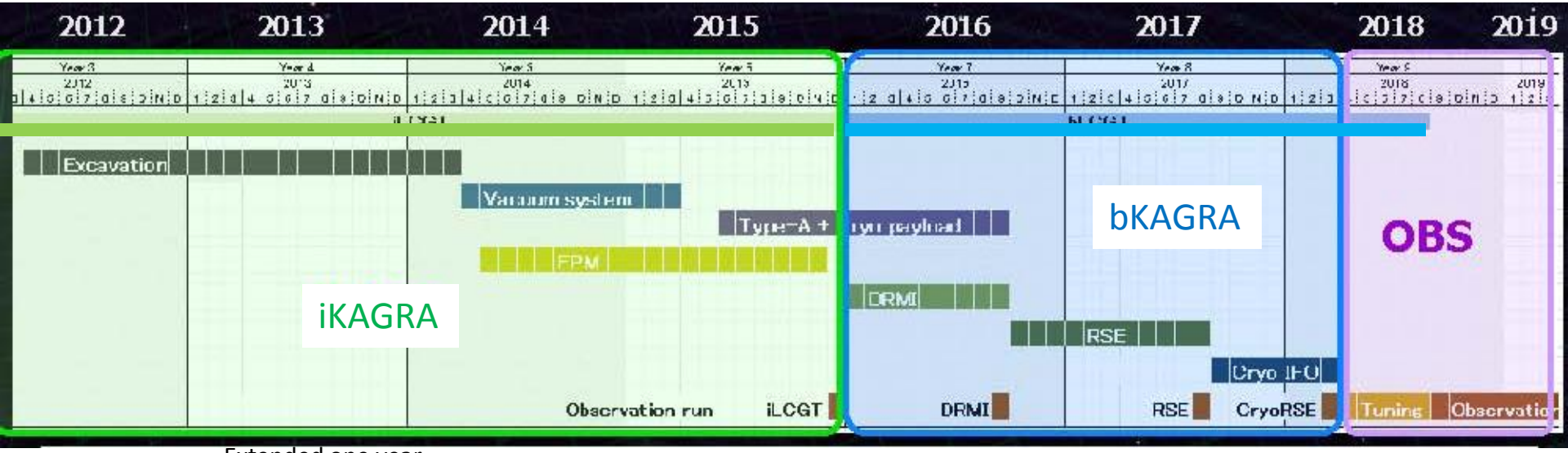
Dark port 4W



The highest power was 78 W obtained from two 41-W outputs.

- The performance of each component is being tested.
- Total system assemble will be started soon as the next step.

Schedule & budget



Extended one year

Leading-edge Research Infrastructure Program (~$99M) for KAGRA

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

Budget from MEXT (~$30M) for excavation

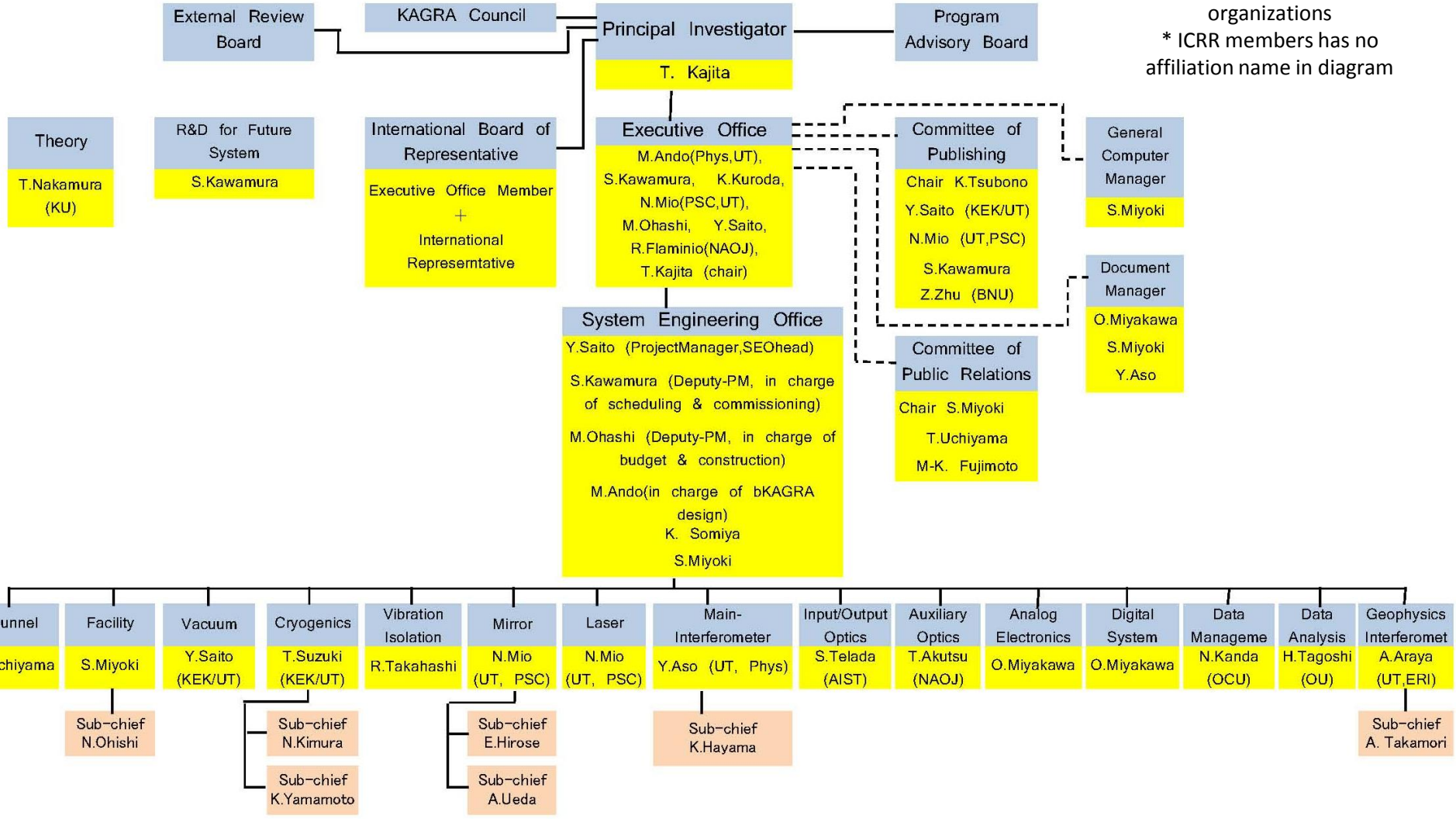
Budget for Maintenance & Operation (request)

Competitive fund for detector upgrade (request)

Scientific Research on Priority Areas (~$1M) for multi-messenger astronomy

Manpower organization

ICRR :Host Institute
NAOJ and KEK : co-host organizations
* ICRR members has no affiliation name in diagram



Collaboration with overseas people & organizations

* Collaborations under formal exchange of academic agreement or MOU with ICRR or UT

  LIGO Lab, EGO, Glasgow, SUCA, UWA, Tsinghua U, SIC, LSU, U Sannio

* Agreement between collaborations MOU among LSC & Virgo has been concluded

* Both attachments with LSC and attachment with Virgo have been signed.

* Researchers' exchange with ET under ELiTES

  https://www.et-gw.eu/elitesmainmenu

* Research collaborations under JSPS program

  Korean workshop (2012-2013)

  Germany and Japan (2012-2013)

  Core-to-core program (2013-2017)

Summary

- KAGRA construction is under way
- KAGRA is promoted by UTokyo under collaboration with KEK and NAOJ
- KAGRA collaborates with LIGO/LSC and EGO/Virgo
- First milestone of KAGRA is the operational run in 2015
- bKAGRA operation starts in 2017
- Observation in the world network since 2018