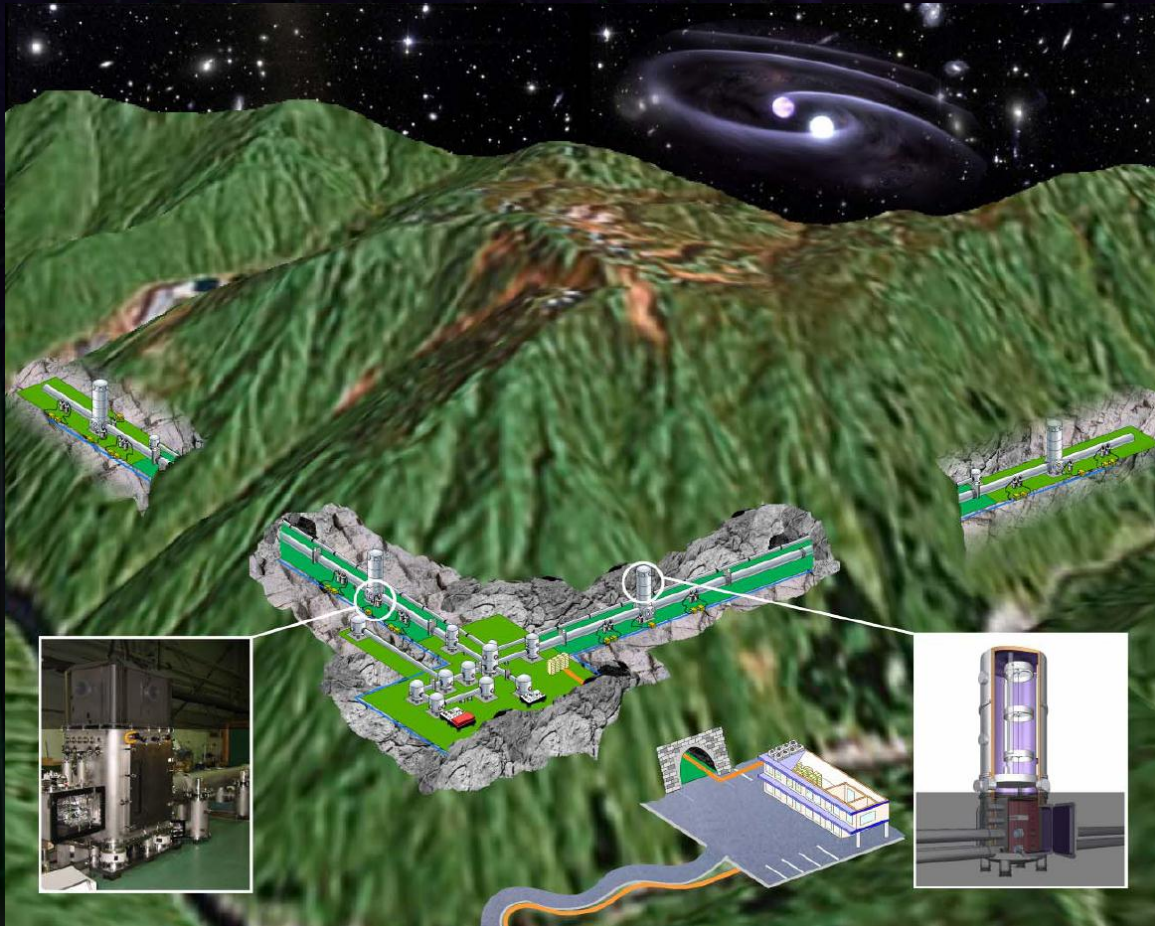


# Special working group for KAGRA (LCGT) Roadmap



**Masaki Ando**  
(Department of Physics,  
Kyoto University)

On behalf of LCGT  
special working group

# LCGT Roadmap Special working group

## Roadmap special working group

### Scope

To recommend the roadmap to realize LCGT.

- Make a recommendation of the master schedule,
- Summarize subsystem bottom-up plans.
- Construct a progress evaluation system.
- Summarize information of risk factors during construction.

- Open for all collaborators, nominally ~20 participants.
- Brainstorm-type meeting with free discussions.
- 20 meetings since Oct. 25, 2010.

Main topic  
In this talk

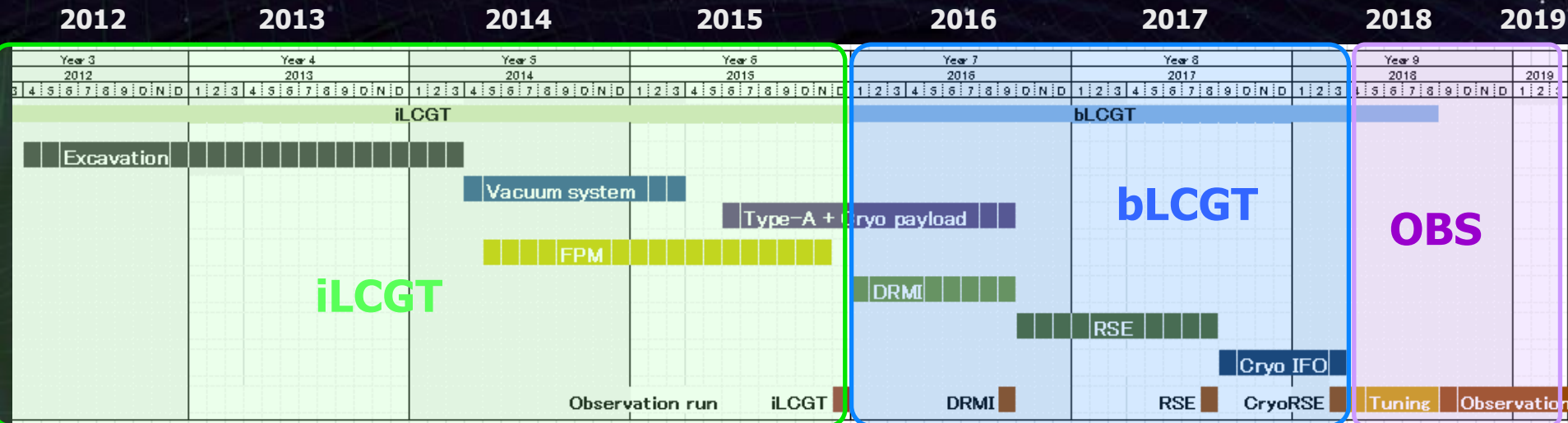


# Master Schedule

# Project Master Schedule

- We have updated the LCGT construction schedule.
  - Mainly because of delay in the excavation schedule.  
(or financial decision of the government)
- Good chance to refine the schedule.
  - Previous schedule was not a well-defined one.
    - \* Challenging and aggressive schedule.
    - \* There were some inconsistencies between project master schedule and subsystem bottom-up plan.
  - We need better schedule management system.
    - \* Quantitative evaluation of project progress both in project management and sub-system development.
    - \* The status should be open for collaborators clearly.
  - Recommendation in the Last PAB:  
Progress evaluation system, sub-system bottom-up plan.

# New Constraint on the master plan



Tunnel and Facility  
(by the end of FY2013)

Vacuum system  
by the end of FY2014

Start observation run  
By the end of FY2017



- \* Completion the installation of the vacuum system is a strict constraint. Detailed schedule will be determined with iterations with subsystem bottom-up plans. However, Earlier start of observation run is preferable.

# Timeline to decide the master plan

2011

Oct. Call for participation to the roadmap working group.

Nov. Collection of on bottom-up plans of subsystems.

Dec. 5 weekly meetings and  
several small ones with a few subsystems.  
Recommendation document on the master schedule.  
Circulation to SEO and all the LCGT collaborators.

2012

Jan. Submission to EC (Executive Committee)

→ Approval with minor revision.

Decision announced to collaborators.

Feedback to subsystem bottom-up plans

→ Checked in the series of internal reviews.

Feb. Explanation in the face-to-face meeting (Now).

# Commissioning Plan

- **LCGT schedule is extremely tight.**

- We should reduce the amount of the on-site commissioning tasks.  
Intensive tests are required for each sub-system before installation.  
Avoid additional tasks only for intermediate steps.  
Basic policy 'Do not use LCGT as an R&D facility'.

- **It is hard to test the full cryogenic test-mass system.**

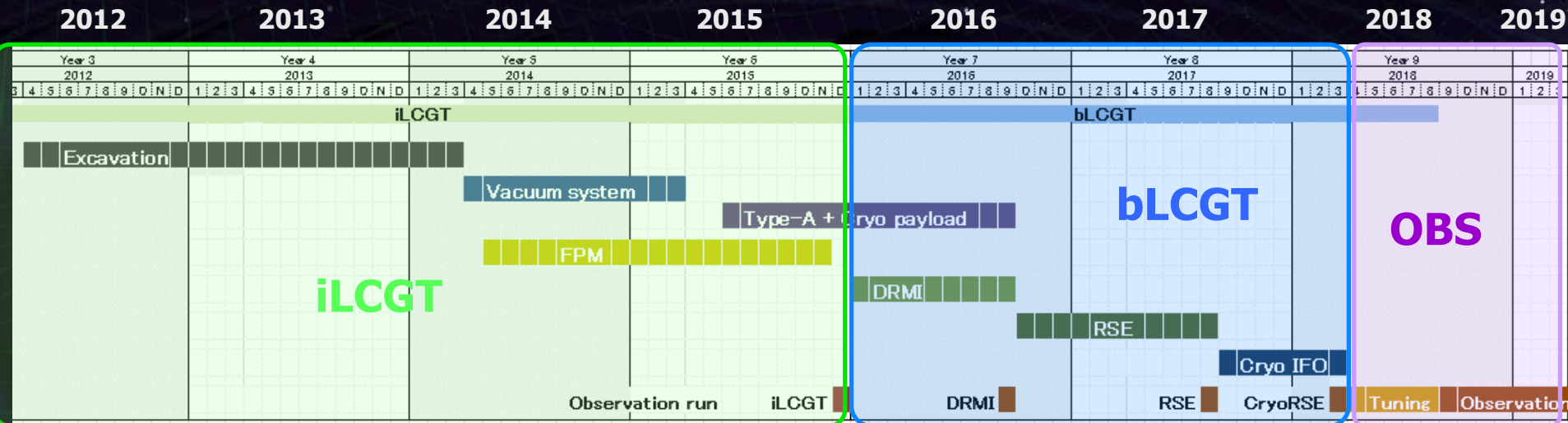
- Type-A isolator test requires a large facility and a quiet site.
- Cryogenic system requires long test time  
for a cool-down and warm-up cycle.
- Hard to avoid technical and schedule risks.



- **Roadmap to solve these concerns.**

- Install ETMs in front of the original positions (by ~35 m)  
for the room-temp. interferometer commissioning.
- Step-by-step commissioning for the interferometer (FPM → DRMI → RSE)
- Full test of the real VIS and cryogenic system at the end rooms.

# New Constraint on the master plan



→  
Tunnel and Facility  
(by the end of FY2013)

→  
Vacuum system  
by the end of FY2014

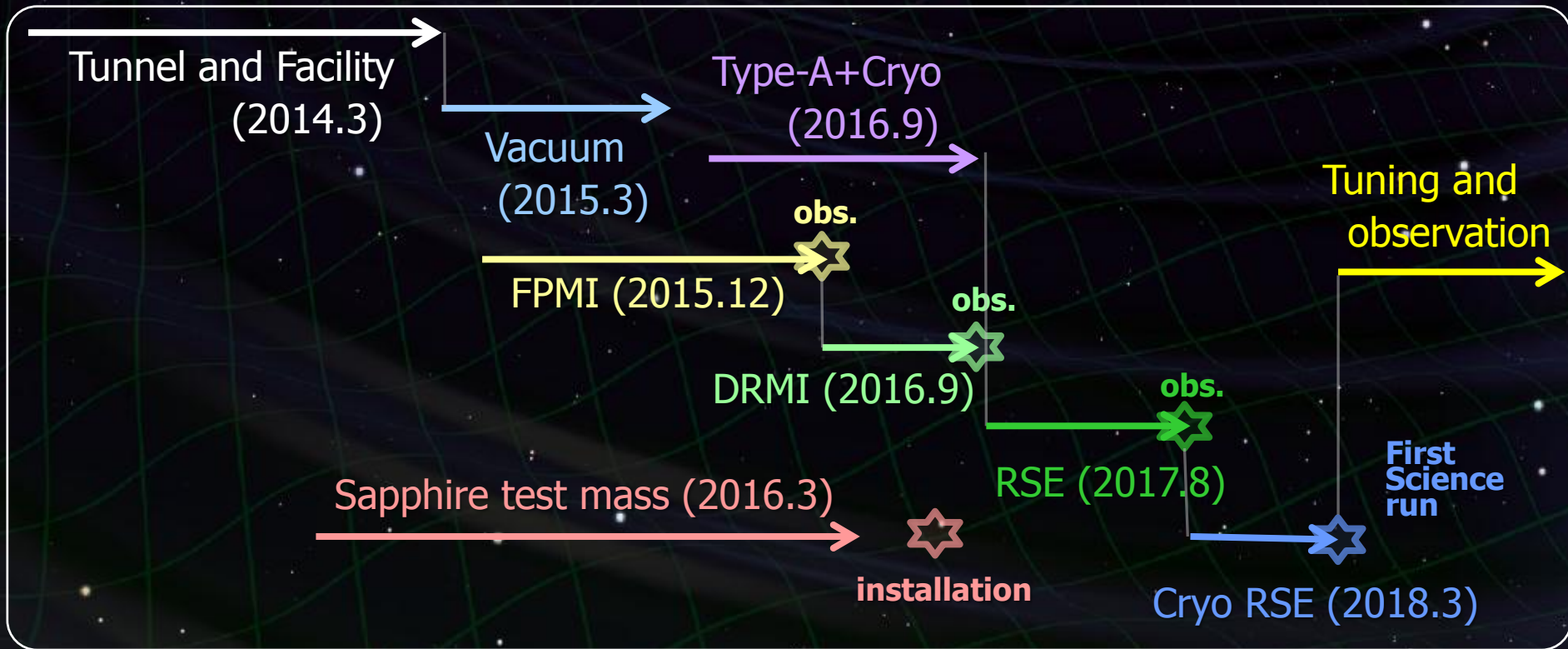
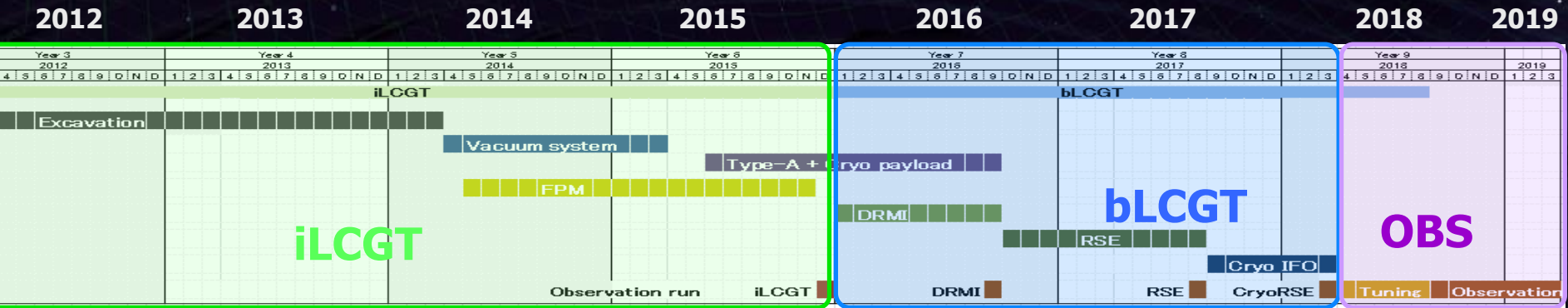
→  
Start observation run  
By the end of FY2017

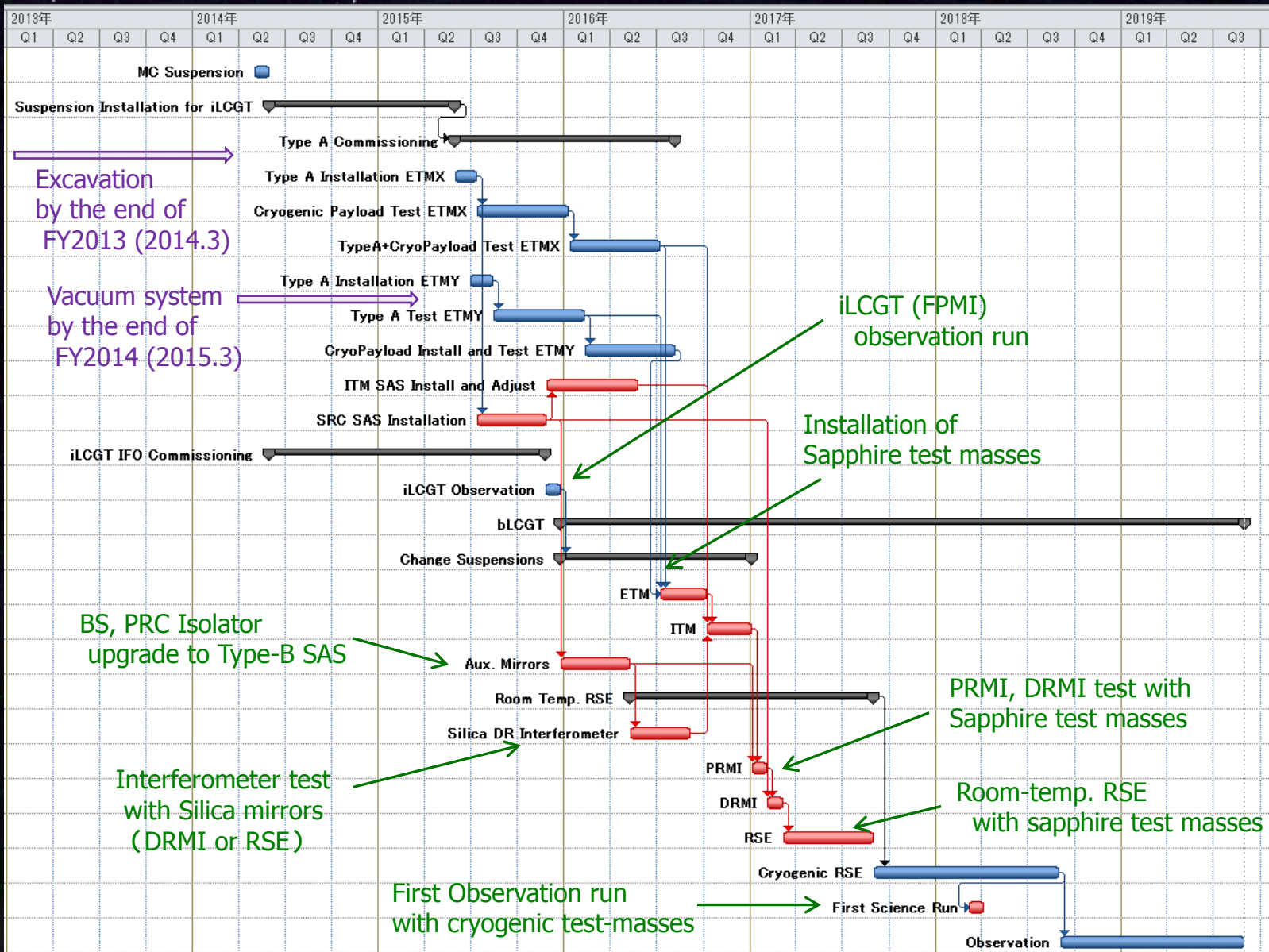


- \* Completion the installation of the vacuum system is a strict constraint. Detailed schedule will be determined with iterations with subsystem bottom-up plans. However, Earlier start of observation run is preferable.



# Major milestones of KAGRA

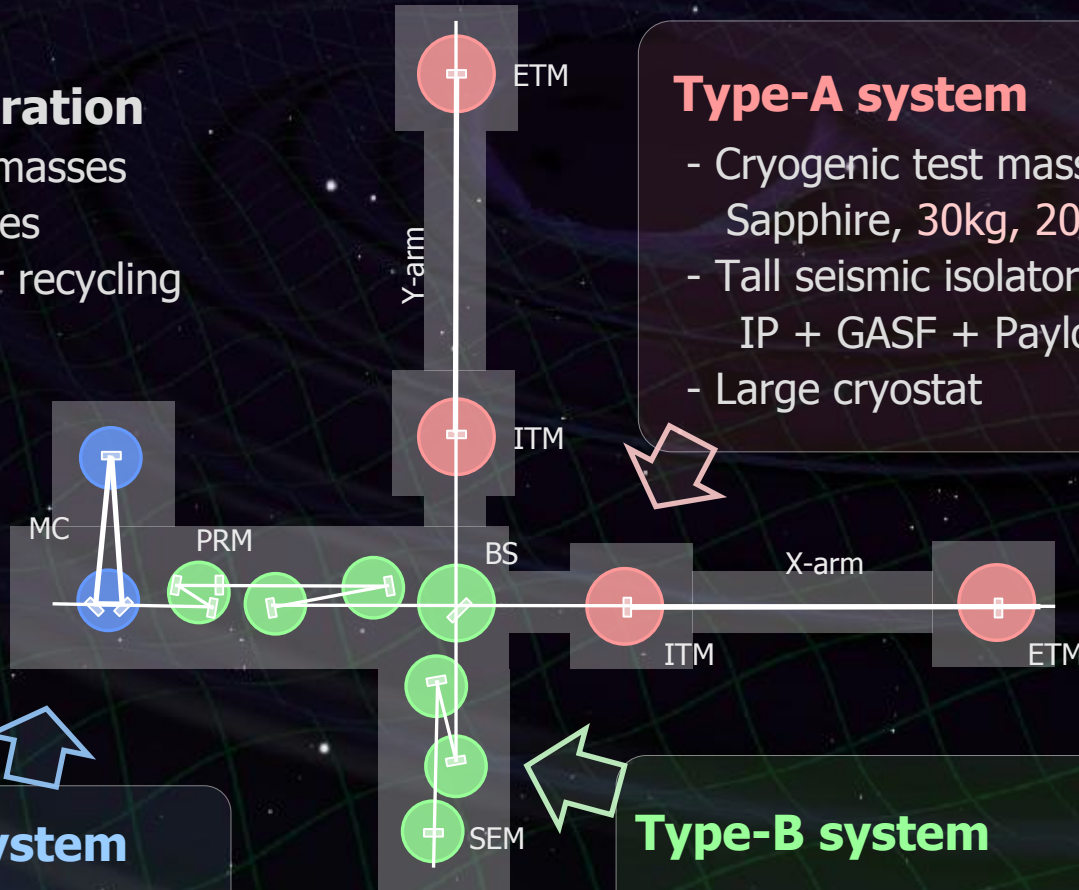




# bLCGT configuration

## bLCGT configuration

- Cryogenic test masses
- 3 km arm cavities
- RSE with power recycling



## Type-A system

- Cryogenic test mass  
Sapphire, 30kg, 20K
- Tall seismic isolator  
IP + GASF + Payload
- Large cryostat



## Type-C system

- Mode cleaner  
Silica, 1kg, 290K
- Stack + Payload



## Type-B system

- Core optics (BS, RM, ...)  
Silica, 10kg, 290K
- IP + GASF + Payload
- Stack for aux. optics



# Vacuum systems (- 2015.3)

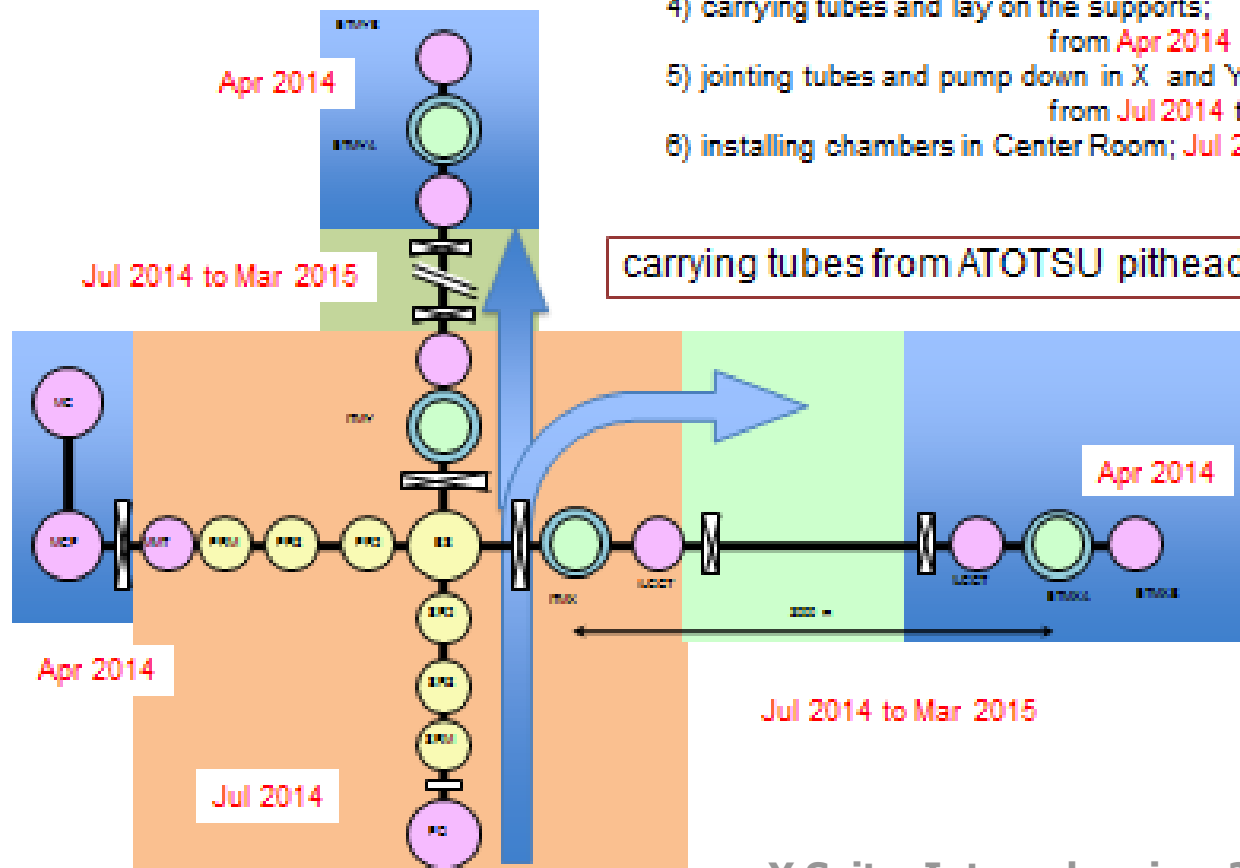
## LCGT Vacuum System

120123 VAC (YS)

### 3. Schedule

expected schedule for installing (2)

- 1) manufacturing 478 of tubes; from Apr 2011 to Mar 2013
- 2) manufacturing chambers; from Sep 2012 to Mar 2014
- 3) installing chambers in X and Y ends; Apr 2014
- 4) carrying tubes and lay on the supports;  
from Apr 2014 to Jun 2014
- 5) jointing tubes and pump down in X and Y arm  
from Jul 2014 to Mar 2015
- 6) installing chambers in Center Room; Jul 2014



Y.Saito, Internal review 2012

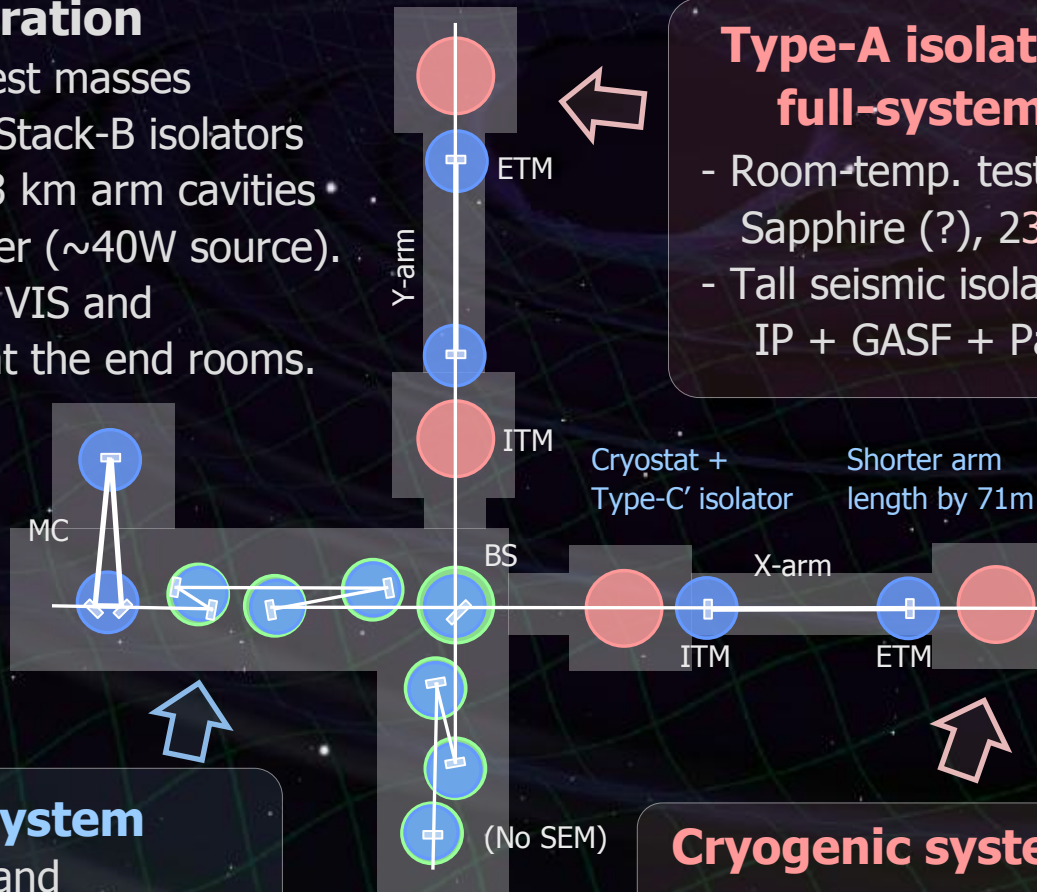
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# iLCGT commissioning (- 2015.12)

## iLCGT configuration

- Room-temp. test masses suspended by Stack-B isolators
- FPMI with 2.93 km arm cavities
- Low laser power (~40W source).
- On-site test of VIS and Cryo-system at the end rooms.

iLCGT obs. run  
in Dec. 2015  
~1 month



## Type-A isolator full-system test

- Room-temp. test  
Sapphire (?), 23kg, 290K
- Tall seismic isolator  
IP + GASF + Payload



## Stack-B system

- Test mass and  
Core optics (BS, FM,..)  
Silica, 10kg, 290K
- Seismic isolator  
Stack + Type-B Payload



## Cryogenic system test

- Cryostat + Rad. shield duct
- Cryo-cooler
- Cryogenic payload
- Fixed Type-ASAS

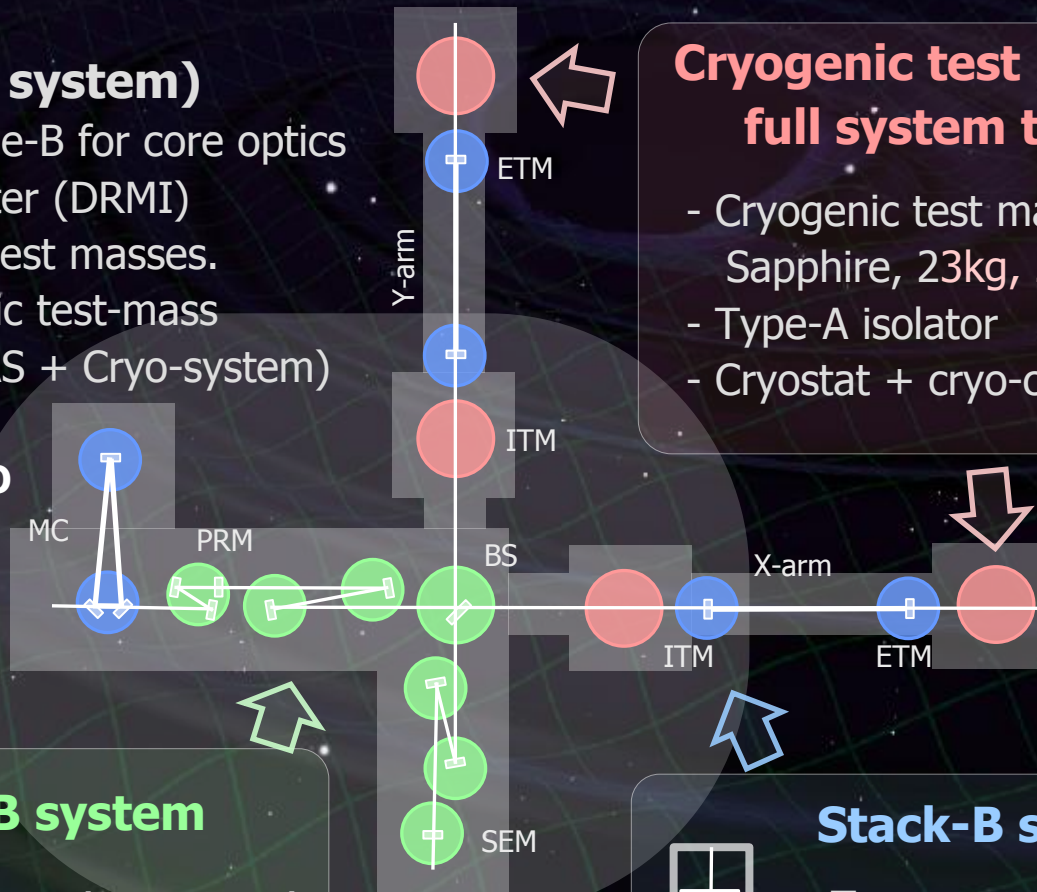
# bLCGT commissioning 1 (- 2016.9)

## bLCGT1

### (DRMI, Cryo full system)

- VIS upgrade to Type-B for core optics
- Center interferometer (DRMI) with room-temp. test masses.
- Full test of cryogenic test-mass system (Type-A SAS + Cryo-system)

### Center IFO (DRMI)



### Cryogenic test mass full system test

- Cryogenic test mass  
Sapphire, 23kg, 20K
- Type-A isolator
- Cryostat + cryo-cooler



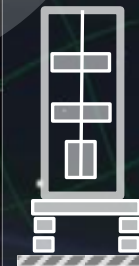
### Type-B system

- Core optics (BS, RM, ...)  
Silica, 10kg, 290K
- IP + GASF + Payload
- Stack for aux. optics



### Stack-B system

- Test mass  
Silica, 10kg, 290K
- Seismic isolator  
Stack + Type-B Payload



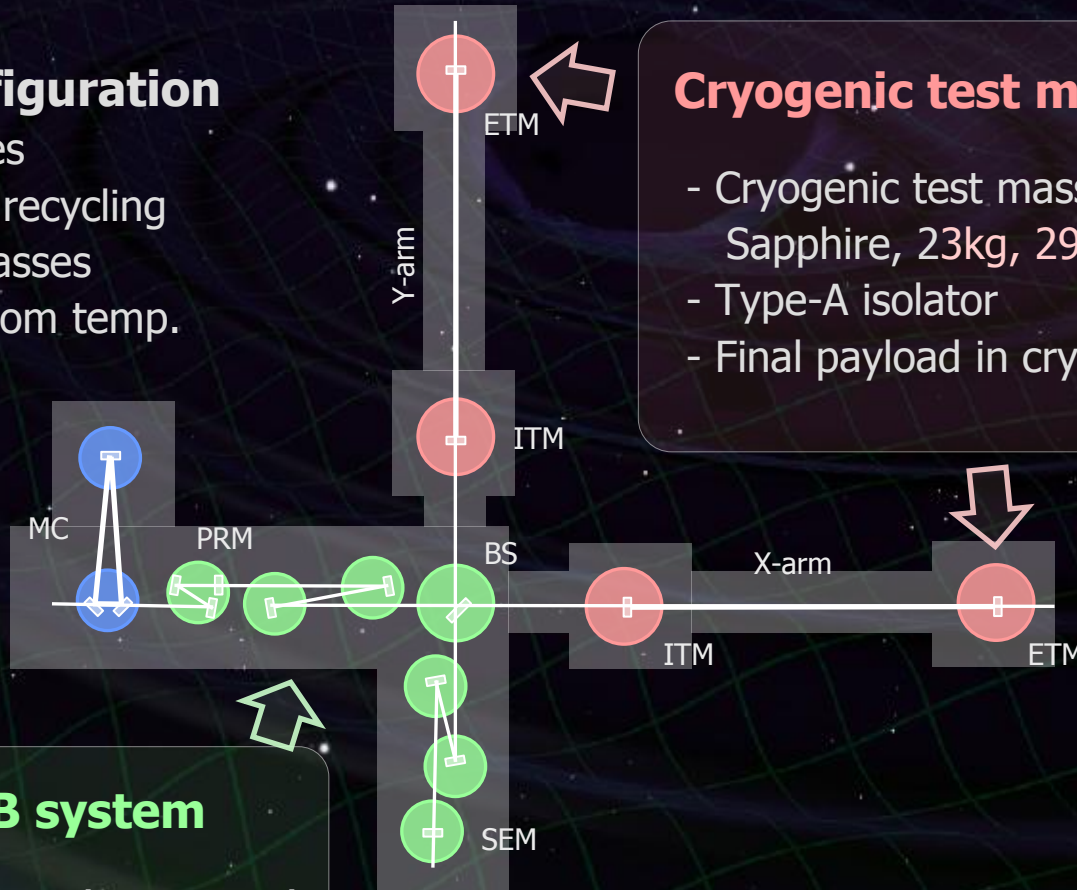
# bLCGT commissioning 2 (- 2017.8)

## bLCGT full configuration

- 3 km arm cavities
- RSE with power recycling
- Sapphire test masses operated at room temp.

## Cryogenic test mass

- Cryogenic test mass  
Sapphire, 23kg, 290K
- Type-A isolator
- Final payload in cryostat



## Type-B system

- Core optics (BS, RM ,...)  
Silica, 10kg, 290K
- IP + GASF + Payload
- Stack for aux. optics

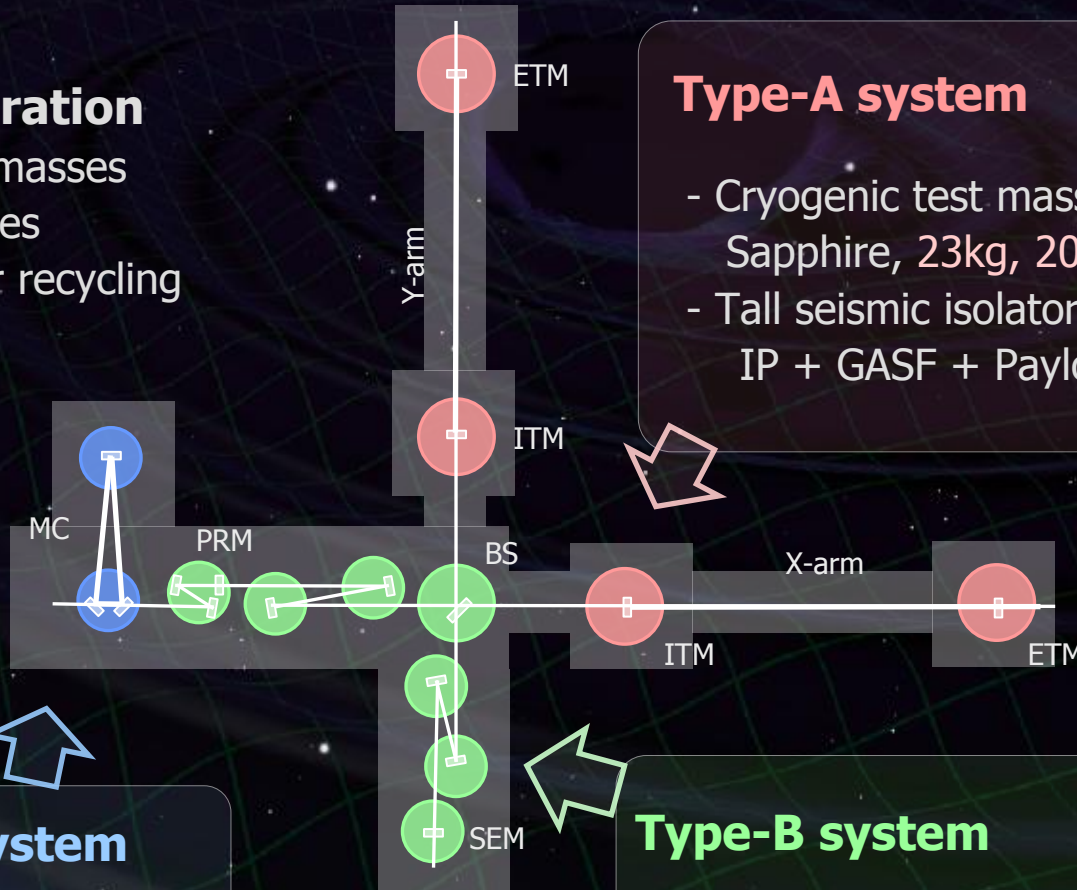


# Cryogenic operation (- 2018.3)

## bLCGT configuration

- Cryogenic test masses
- 3 km arm cavities
- RSE with power recycling

first science run  
in Mar. 2018  
~1 month



## Type-A system

- Cryogenic test mass  
Sapphire, 23kg, 20K
- Tall seismic isolator  
IP + GASF + Payload



## Type-C system

- Mode cleaner  
Silica, 1kg, 290K
- Stack + Payload



## Type-B system

- Core optics (BS, RM, ...)  
Silica, 10kg, 290K
- IP + GASF + Payload
- Stack for aux. optics

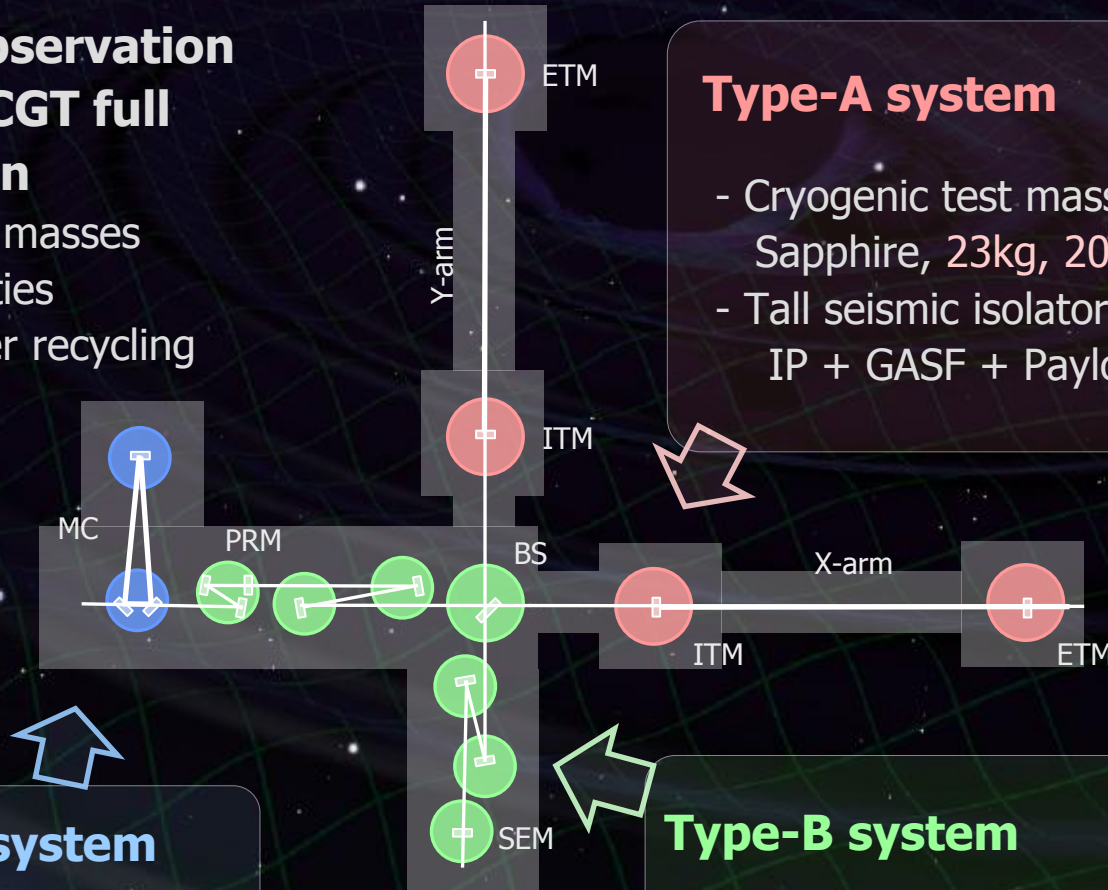




# Tuning and observation (2018.4 -)

## Tuning and observation run with bLCGT full configuration

- Cryogenic test masses
- 3 km arm cavities
- RSE with power recycling



### Type-A system

- Cryogenic test mass  
Sapphire, 23kg, 20K
- Tall seismic isolator  
IP + GASF + Payload



### Type-C system

- Mode cleaner  
Silica, 1kg, 290K
- Stack + Payload



### Type-B system

- Core optics (BS, RM, ...)  
Silica, 10kg, 290K
- IP + GASF + Payload
- Stack for aux. optics



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**Subsystem**

**Bottom-up plans**

**Progress evaluation**

**Risk management**

# Subsystem Plans

- Subsystem bottom-up schedule
  - Detailed subsystem schedule  
(Development, Prototype test, Quality insurance, Installation,...)
  - Should be consistent with the project master plan.
  - Also include risk factors and back-up plans.
- Progress evaluation
  - Evaluated by a 'milestone scheme'
    - \* Set ~10 milestones for each subsystem  
(subset of subsystem bottom-up plan)
    - \* Status for the milestones -- checked in regular meetings.
  - The status will be open for all the collaborators.
  - System: Microsoft Project + Network access.

# Current status/Next steps

- Internal reviews (~Jan. 2012)
  - Subsystem bottom-up plans with the newly decided master plan.
    - Consistencies with the master plan have been checked.
  - Basic information have been presented on the milestones, risks of each subsystem.
- Upcoming tasks (by the next PAB).
  - Summarize the bottom-up plans and milestones for the project management (scheduling and progress evaluation).
    - ← Require a help of each subsystem.
  - Update and summarize the risk factors.
    - ← Also need a help of all the collaborators.

# Summary

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## **Roadmap special working group**

- Master schedule has been decided.
- Detailed tasks to be finished:
  - Subsystem bottom-up plans
  - Milestones and progress evaluation
  - Risk factors