KAGRA Roadmap and Risk Management

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Outline

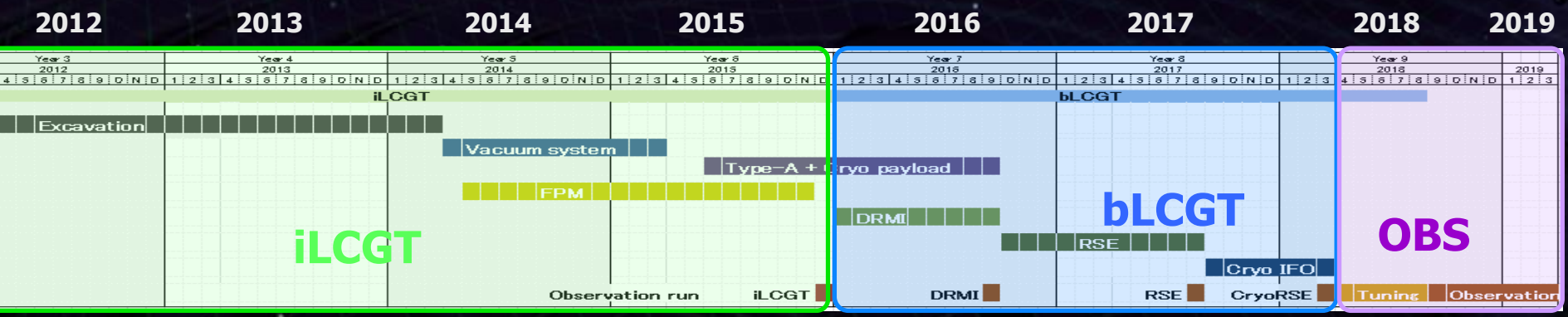
- Master schedule and
  subsystem bottom-up plans
- Progress evaluation
- Risk Management

Master Schedule/Bottom-up plan

- Update of the KAGRA construction schedule.
  - Mainly because of delay in the excavation schedule.
  - Good chance to refine the schedule.

- Roadmap special working group
  - Iteration between the project constraint and the bottom-up plan.
  - Open discussions in the collaboration
    → Recommendation approved by EC (Jan. 2012).

Major milestones of KAGRA



Tunnel and Facility (2014.3)

Vacuum (2015.3)

Type-A+Cryo (2016.9)

obs.

FPMI (2015.12)

obs.

DRMI (2016.9)

obs.

RSE (2017.8)

Tuning and observation

First Science run

Cryo RSE (2018.3)

Sapphire test mass (2016.3)

installation

Important Updates

- Updates from the previous schedule.

  - Excavation end ~1 year delay
  - Longer iKAGRA commissioning term
    * 18 months after tunnel finish → 21 months
  - No Silica RSE step

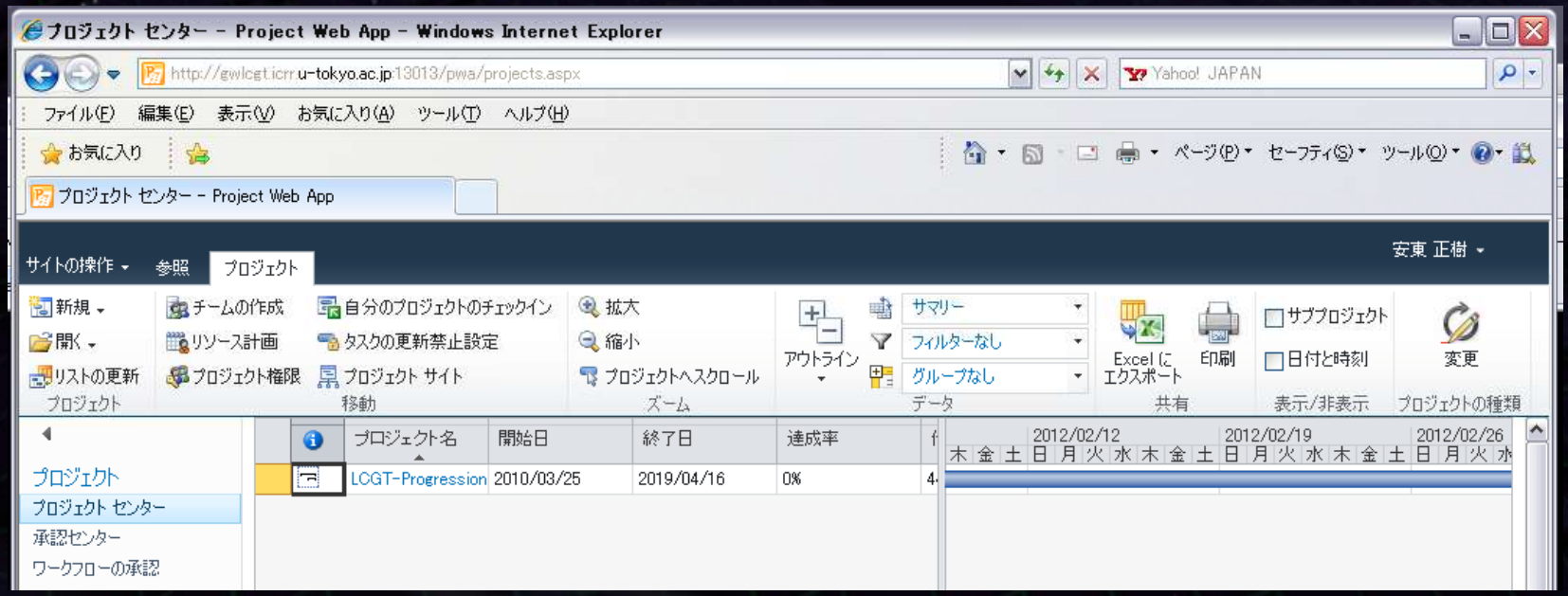
    New plan: iKAGRA → Silica DRMI → Sapphire RSE
  - Minimized delay in observation start.
    * First observation run March 2018 (end of FY2017)
      with bKAGRA full configuration.
    * Noise hunting and tuning for full performance
      → Observation phase from Sept. 2018.

Progress Evaluation

- Schedule management system for quantitative evaluation of project progress.

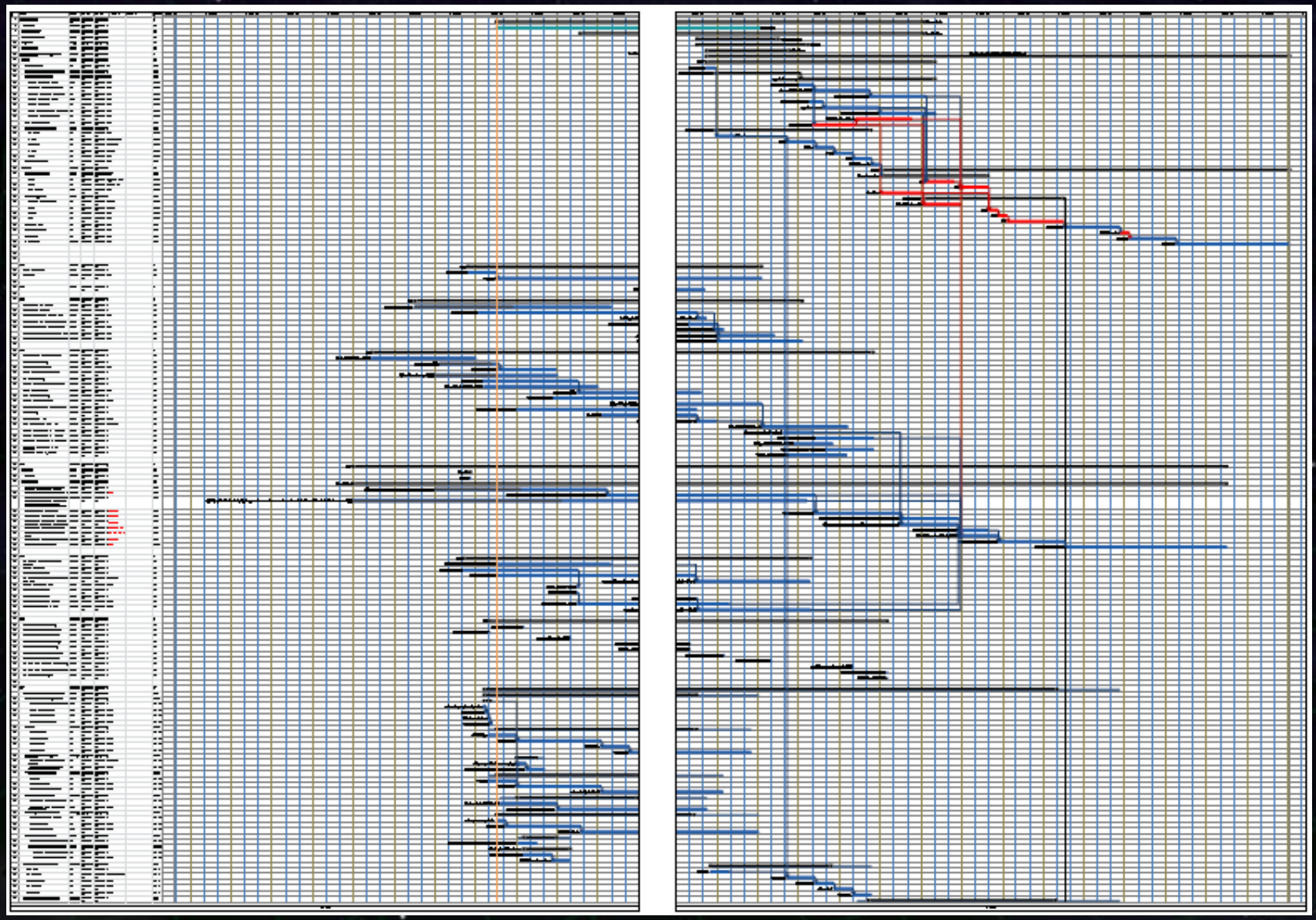
- Progress evaluation by a 'Milestone scheme'.
  - Set ~10 milestones for each subsystem, picked up from a detailed schedule of each subsystem.
  - Status for the milestones will be checked in regular meetings, progress evaluation with ~20% resolution.
  - The status will be open for all the collaborators.
  - A software and network system :
    MS Project and Web server for it.
    The system are being prepared in SEO.

Progress evaluation system



LCGT Schedule (Microsoft Project on Web server)

Currently, SEO and Subsystem Chiefs have access accounts.



Risk Management

- Potential risks are important information for the project management.
  - Effective distribution of project resources.
  - Careful progress evaluation for major risk factors.
  - Back-up plans to Minimize project delay.

Technical and schedule risks by each subsystem

→ Being summarized up by SEO.

KAGRA Risk Register

- Collect risk information from subsystem.
  - Total ~150 risk factors
    (~10 risks for each subsystem)
  - Risk ID,
    Item, Explanation, Impact, Mitigation/Back-up plan
    Quantitative evaluation

Probability P	0 The probability is extremely low and will almost never occur.
	1 The probability is not large and will probably not occur.
	2 The probability is around 0.5.
	3 The probability is large and will probably occur.
Seriousness S	0 It will not affect the successful completion of the project.
	1 It will to some degree affect the successful completion of the project.
	2 It will to some degree endanger the successful completion of the project.
	3 It will result in the failure of the project.

Degree of risk R = P x S.

KAGRAリスク要因 (KAGRA Risk Factors)

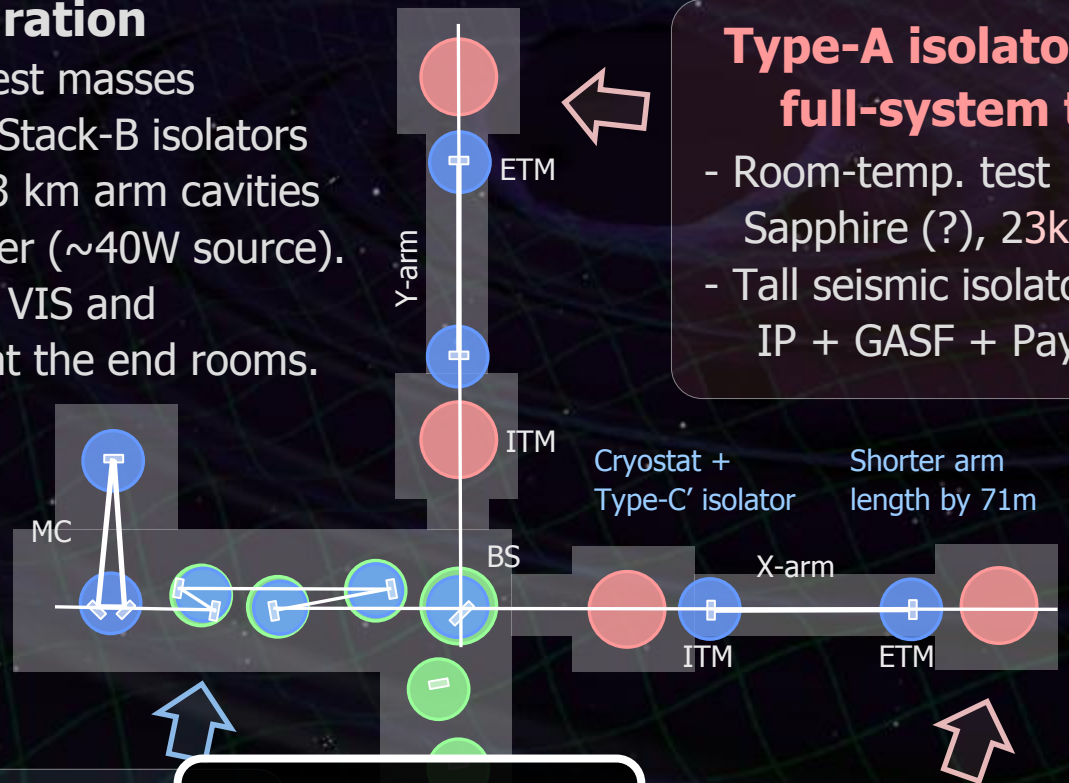
2012.3.12

仮ID	No.	サブシステム Subsystem	項目 Item	説明 Explanation	インパクト Impact	対応 Design/back-up plan	P Likelihood of Probability	S Degree of Serious ness	R Degree of Risk	Selection MA	Selection KS	Selection SM	情報元 Source
TUN-1	1	トンネル Tunnel (TUN)	静穏環境	期待しているほどの静穏環境が得られない。地面振動や多量の地下水による音響雑音、大気環境など。	望遠鏡の安定度・感度の劣化。	各サブシステムの性能向上。防音設備等の充実。							SEO
TUN-2	1	TUN	避難経路の確保	X-endからの避難経路が確保されていない。	重大な危険。					10		10	Int.Rev.2012
TUN-3	1	TUN	掘削完成遅れ	掘削完成遅れ	全体スケジュールに影響有り。	掘削業者がすべての責任を持つ。				10			Uchiyama Feb. 14
TUN-4	1	TUN	防振用縦穴位置ずれ	防振用の縦穴掘削位置が設計値からずれる。	全体設計に影響有り。	測量を正確に行う。防振グループは余裕のある設計を行っておく。							Uchiyama Feb. 14
FCL-1	2	施設 Facility											
VAC-1	3	真空 Vacuum (VAC)	真空リーク	真空系のリーク	干渉計安定度・感度の低下。ダクトにリークが起きた場合には、真空復帰に1ヶ月以上を要する。	ダクトに取り付けられたイオンポンプ等は真空を破ることなく交換可能なように、バルブを取り付けておく。							Int.Rev.2012 Saito Feb. 14
VAC-2	3	VAC	イオンポンプの寿命	Ion pump replacement is once per 5 years when operated at 10-7 Pa	not serious; replacing without breaking arm vacuum.								Saito Feb. 14
VAC-3	3	VAC	ゲージの故障	Ion or hot gauges may fail due to contamination for first one year operation, then the probability will decrease	not serious; replacing without breaking arm vacuum.								Saito Feb. 14
VAC-4	3	VAC	ガスケット等	Erroision of gasket and electric feed-through may happen; probability is unknown although humidity test has shown no erroision.	serious if the erroision takes place in the arm. one month is necessary for recovering vacuum.								Saito Feb. 14
VAC-5	3	VAC	窓板等の破損	View port crack or fracture may happne; the probability is much higher in a window of 200 mm in diameter, or more.	serious. one month is necessary for recovering vacuum. windows of 100 mm in diameter, or shorter, is preferable.	修復後再度真空引きを行う。						10	Saito Feb. 14
VAC-6	3	VAC	大規模真空リーク	大きな真空リーク。		真空サブグループによる使用材料・部品の査定。場合によっては、試験・測定を予め行なう。						10	Int.Rev.2012
VAC-7	3	VAC	真空内部品の材料	真空槽内に置かれている部品材料からの、ガス放出・発塵・油脂性分干渉散による鏡の汚染および系内の圧力上昇	干渉計感度の低下								Saito Feb. 18

Recent Updates

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.



Type-A isolator full-system test

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

iLCGT obs. run
in Dec. 2015
~1 month

Stack-B system

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

Folding and BS: Type-B system with fixed upper stages

TM: Type-B payload

Cryogenic system test

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

Risk Management Activities

- Collect risk information from subsystems (Feb. 2012 -).
- Summarize them and present at PAB (Feb. 23).
- Some suggestion from PAB members.

⇩

- Visit P. Grey (TMT sub-PM,)
  to hear about the TMT risk management (March 5).
  - Simple is better (~200 risks at most)
  - Categorize the risks (subsystem and phase)
  - New risks are become formal after risk meetings.
  - Risk meetings ~ every 3 months.
  - Using Web-based system developed in TMT.
- Updating the risk table.

Request to subsystem leaders

To summarize the schedule and risks is not a goal.

- Progress evaluation.
- Continuous update.

Please update the milestones

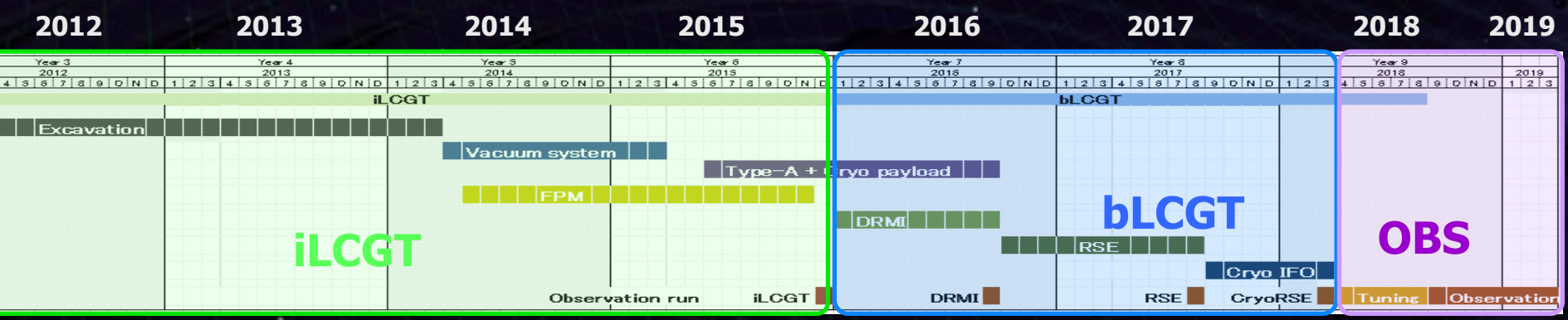
- No intervals,
- Proper timescale ~ 3 months scale

Please update the risk registers

- Proper risk items and quantities.
- Recognize the risks continuously for the success.

Appendix

Major milestones of KAGRA



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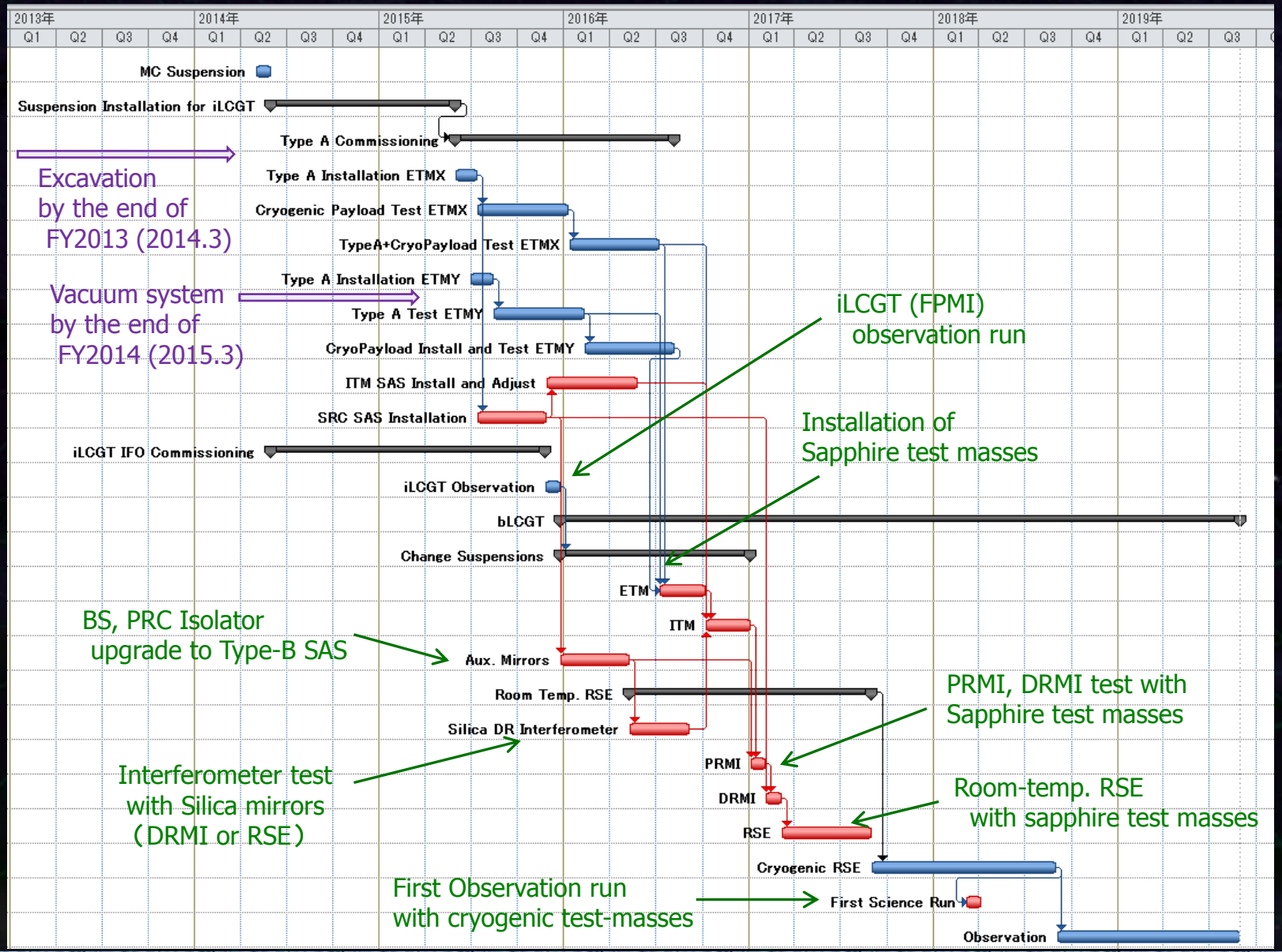
installation

Cryo RSE (2018.3)

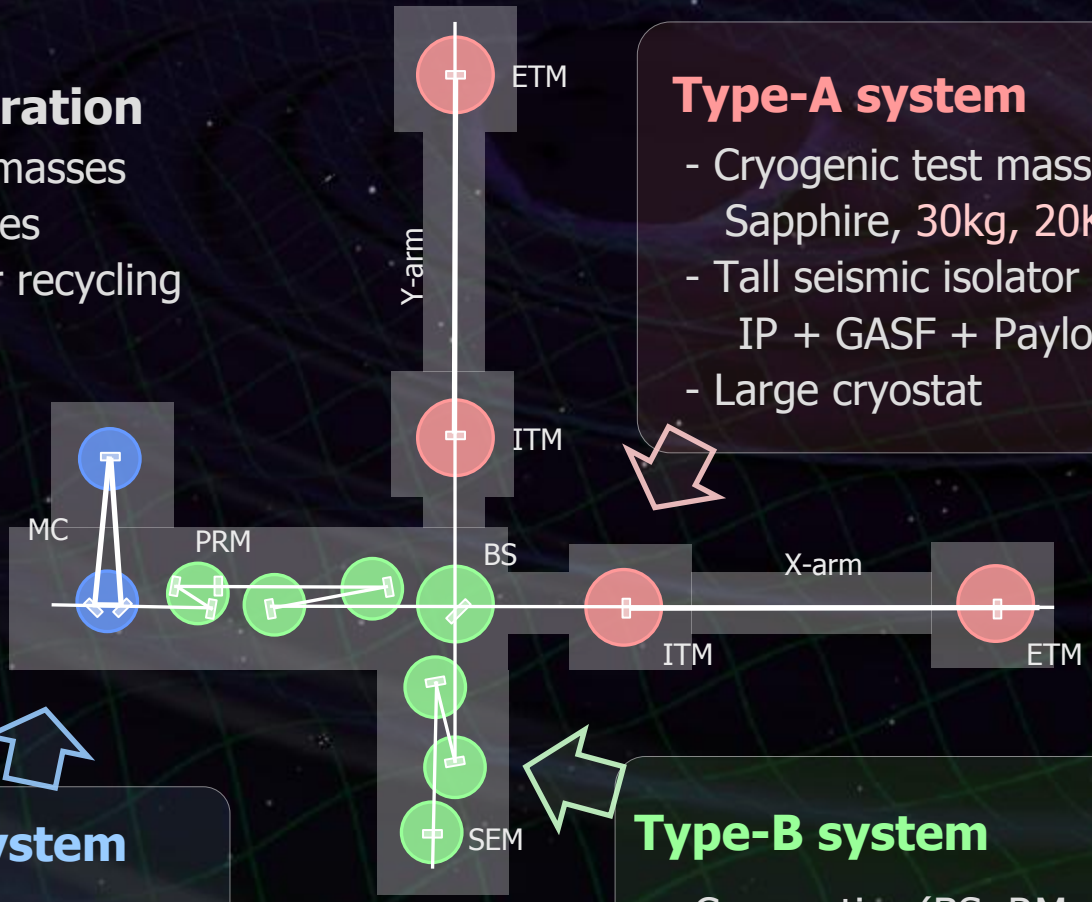
Example of Detailed Schedule



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)

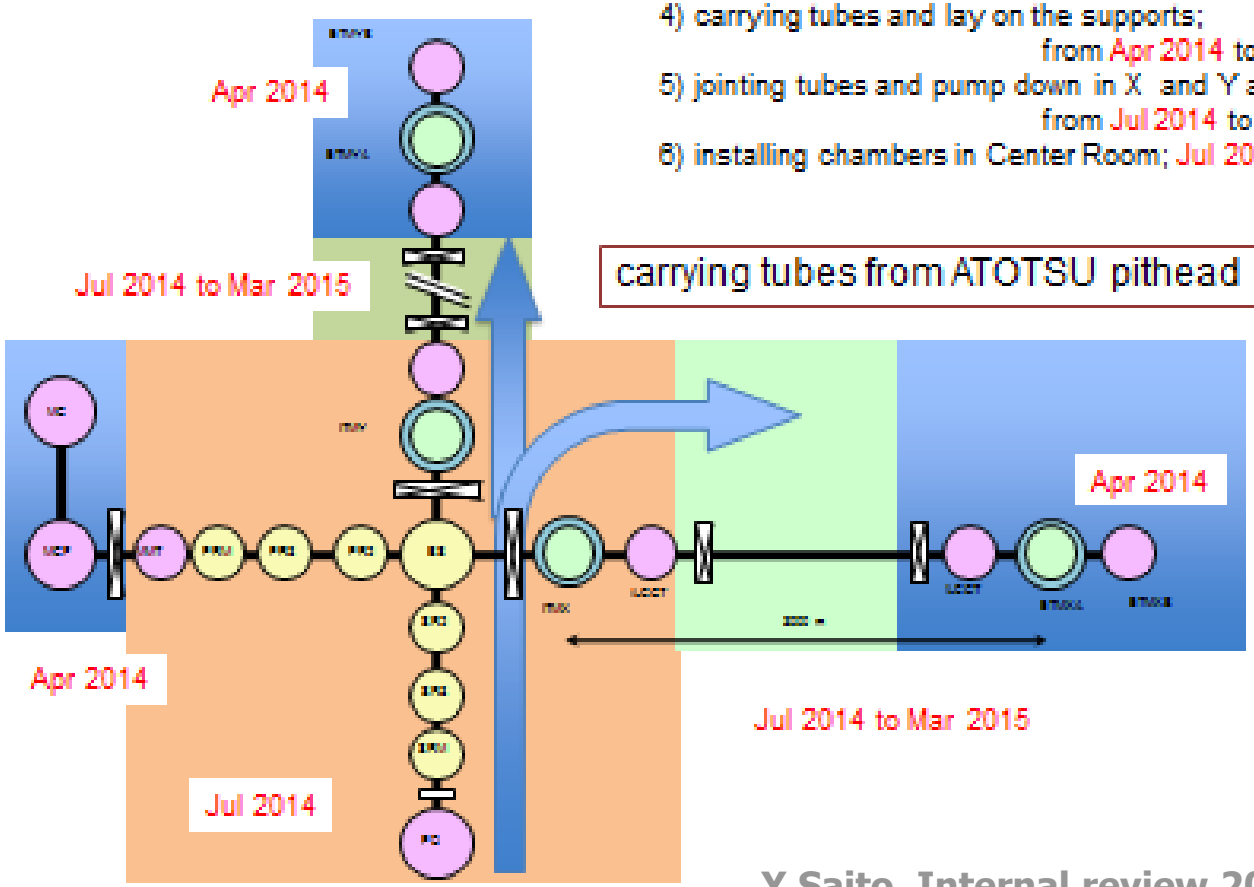
LCGT Vacuum System

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

22

iLCGT commissioning (- 2015.12)

iLCGT configuration

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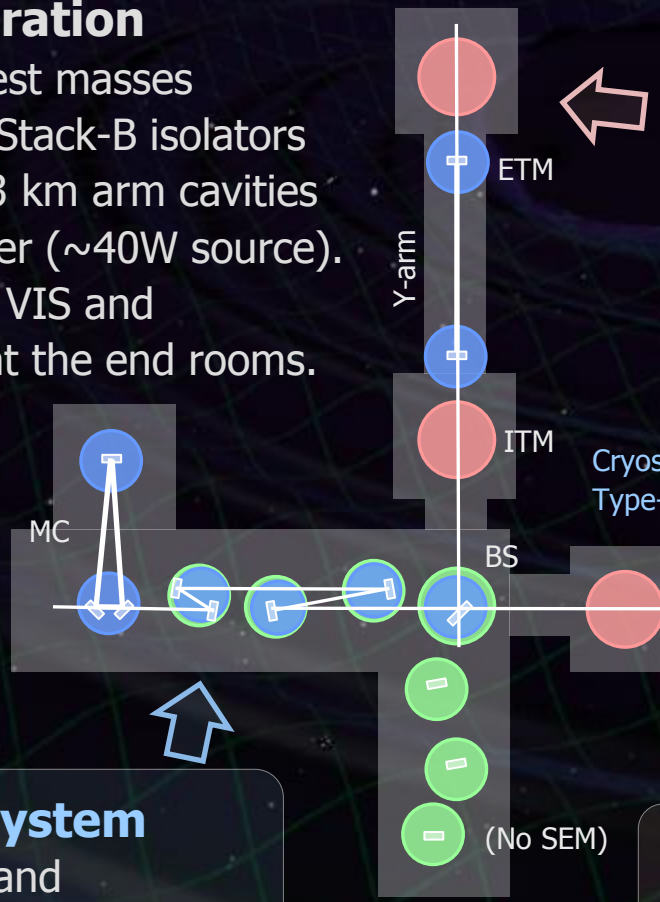

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iLCGT obs. run
in Dec. 2015
~1 month

Stack-B system

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

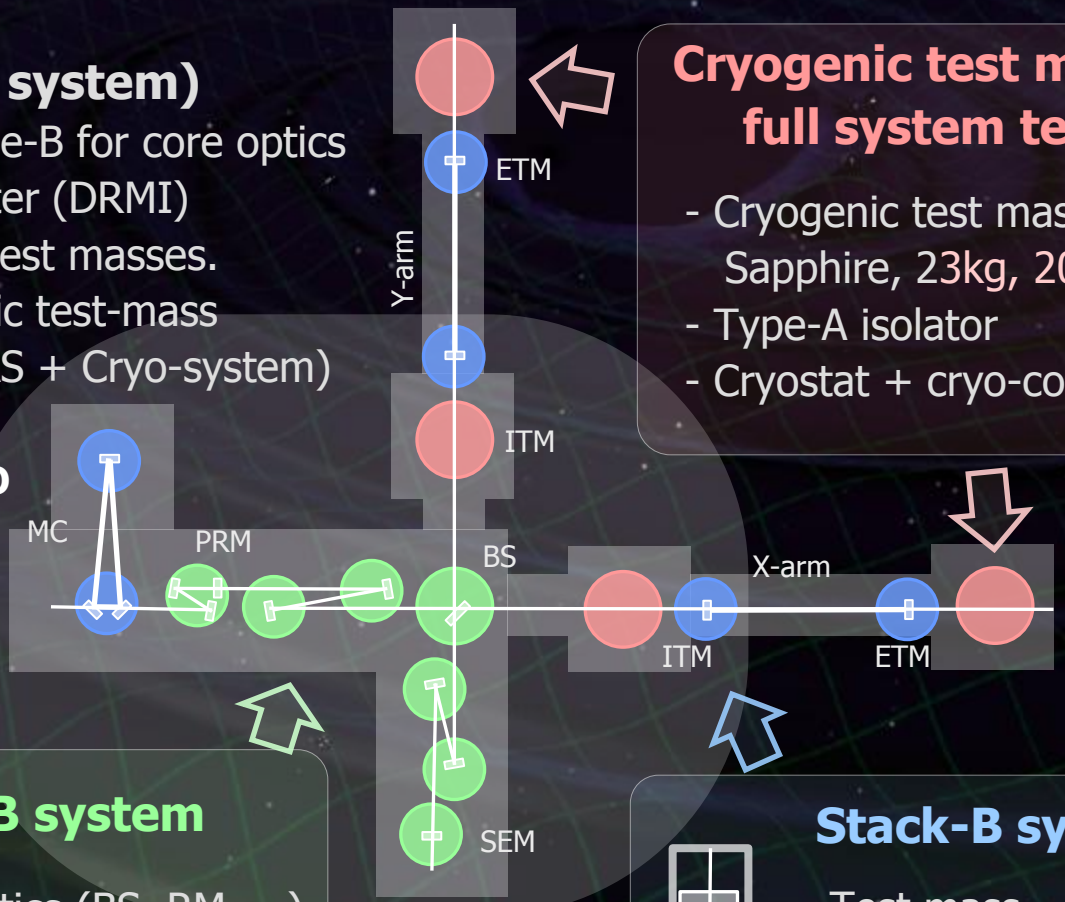
Cryogenic system test

- 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

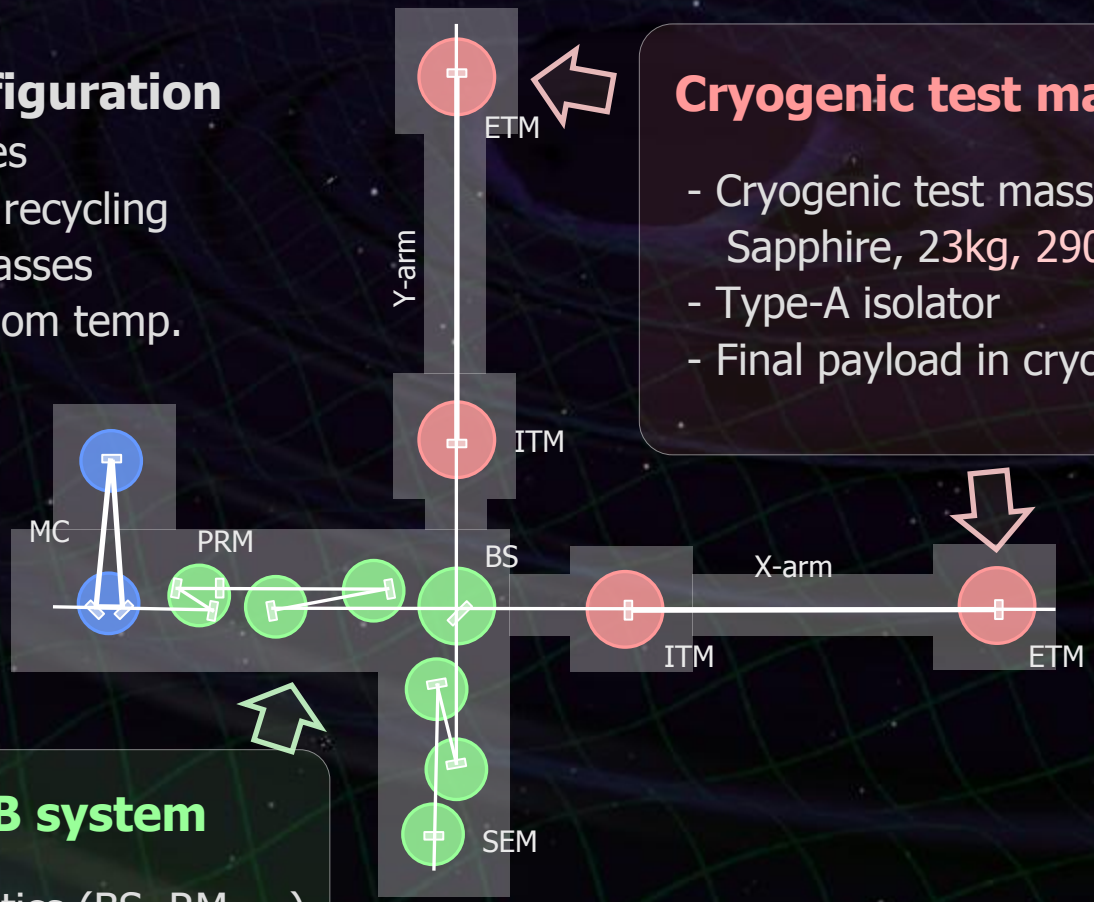
Stack-B system

- 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

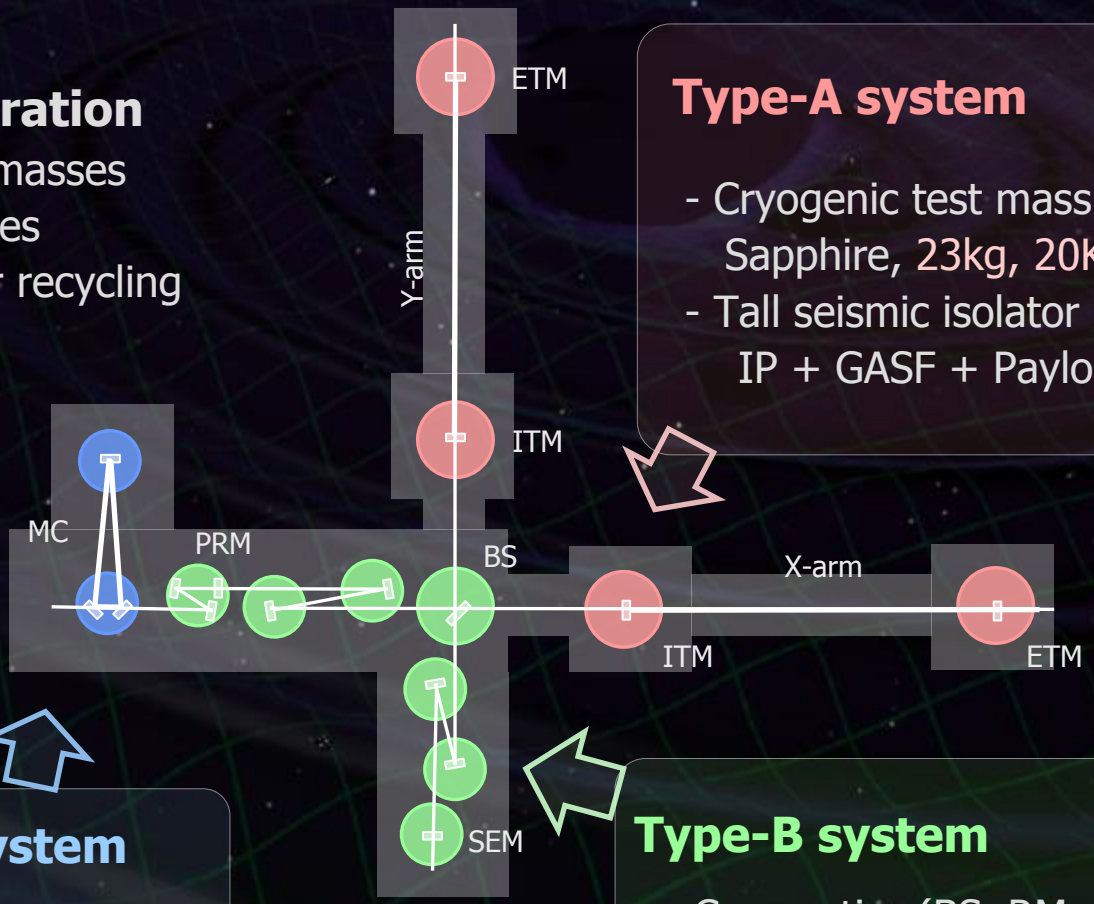
Type-B system

- 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

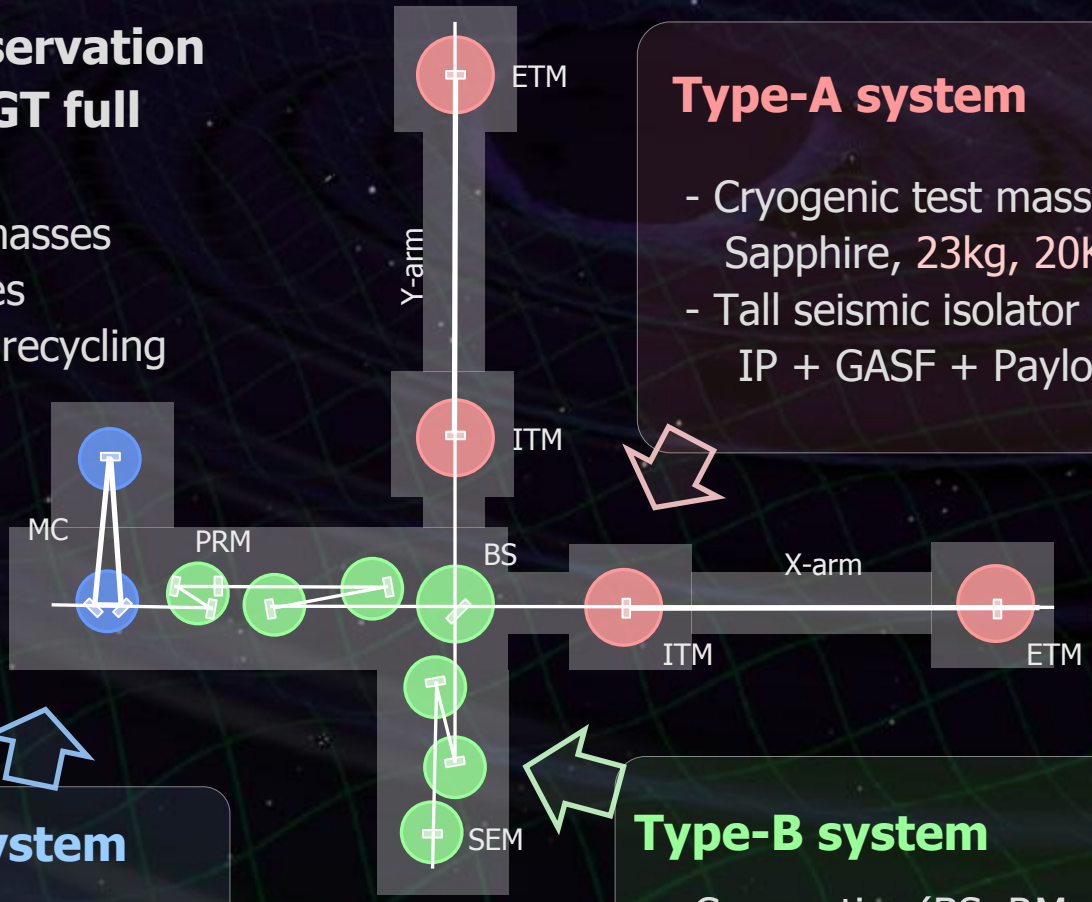
- Mode cleaner
  Silica, 1kg, 290K
- Stack + Payload

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
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Type-B system

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

Type-C system

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