GWADW 2014
May. 26, 2014
Takayama, Gifu, JAPAN

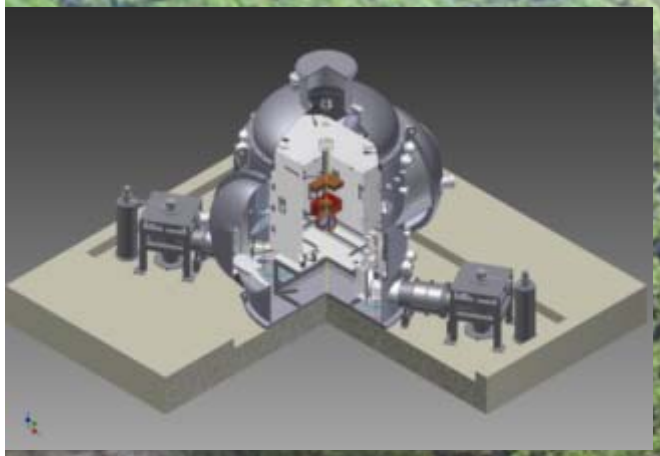
Commissioning of KAGRA

Seiji Kawamura (ICRR, UTokyo)
for the KAGRA collaboration

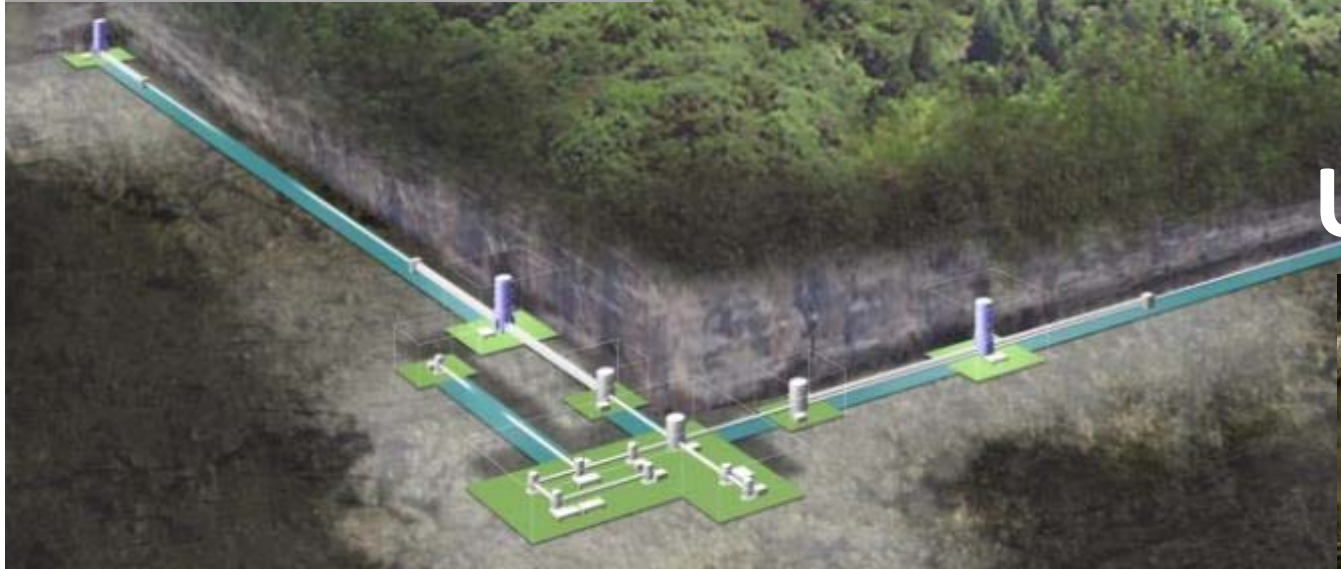
JGW-G1402436-v1

Key features of KAGRA

Cryogenic Mirror

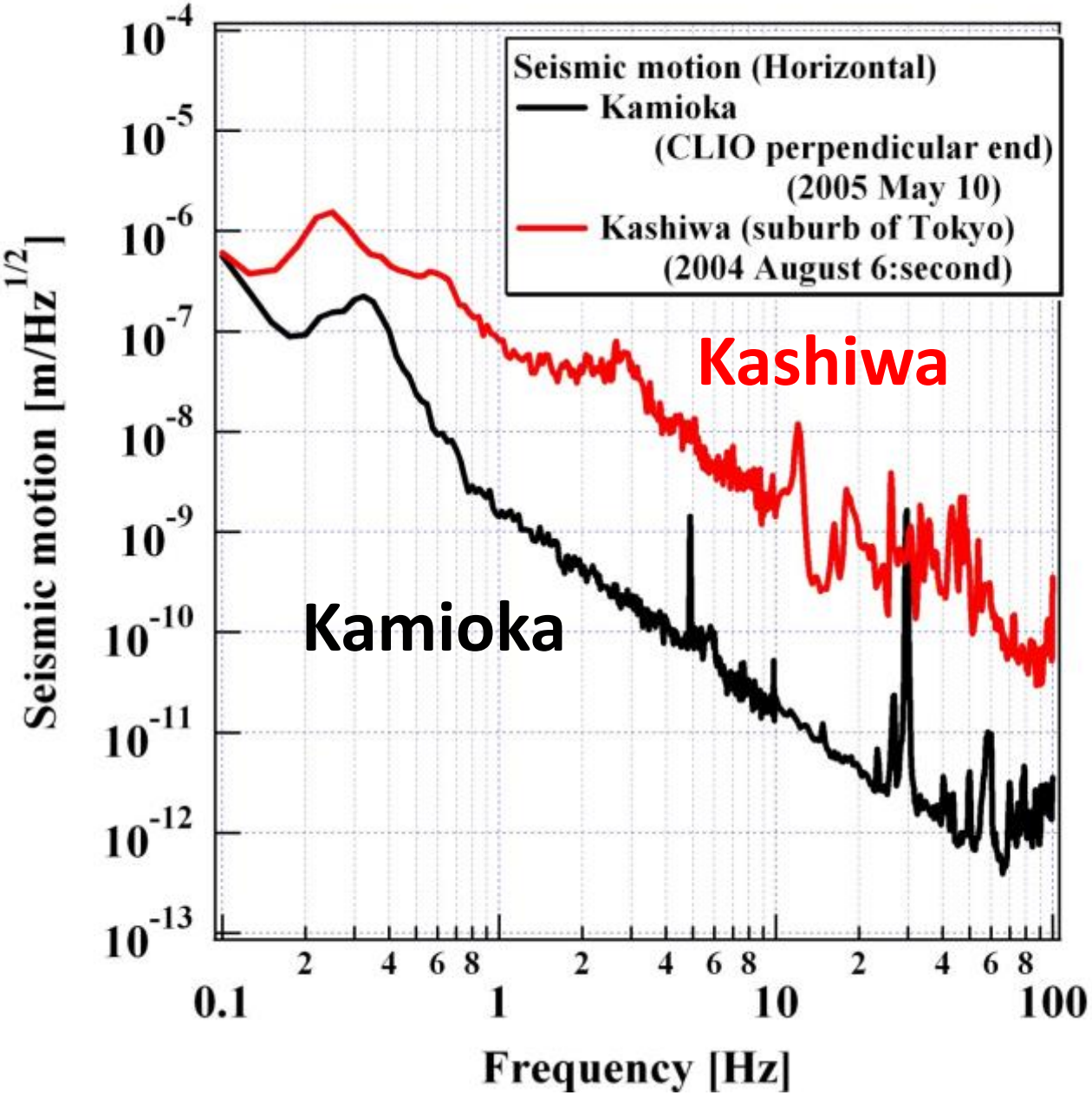


Underground



Technologies crucial for the 3rd-generation detectors; KAGRA can be regarded as a 2.5-generation detector.

Ground motion in Kamioka mine



Vibration isolation system

2nd floor

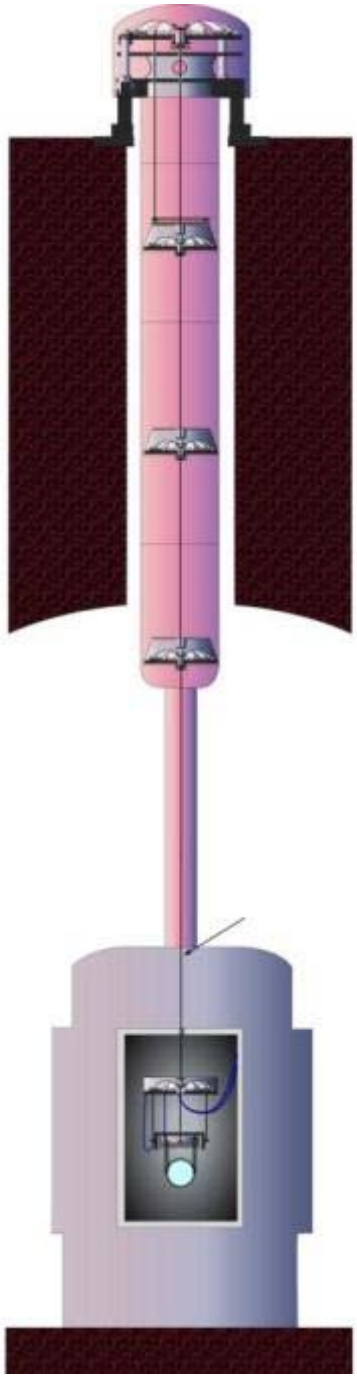
Inverted pendulum
Geometrical antispring (GAS) filter

Multi-stage pendulum (with GAS filter)

1st floor

Another pendulum (with GAS filter)

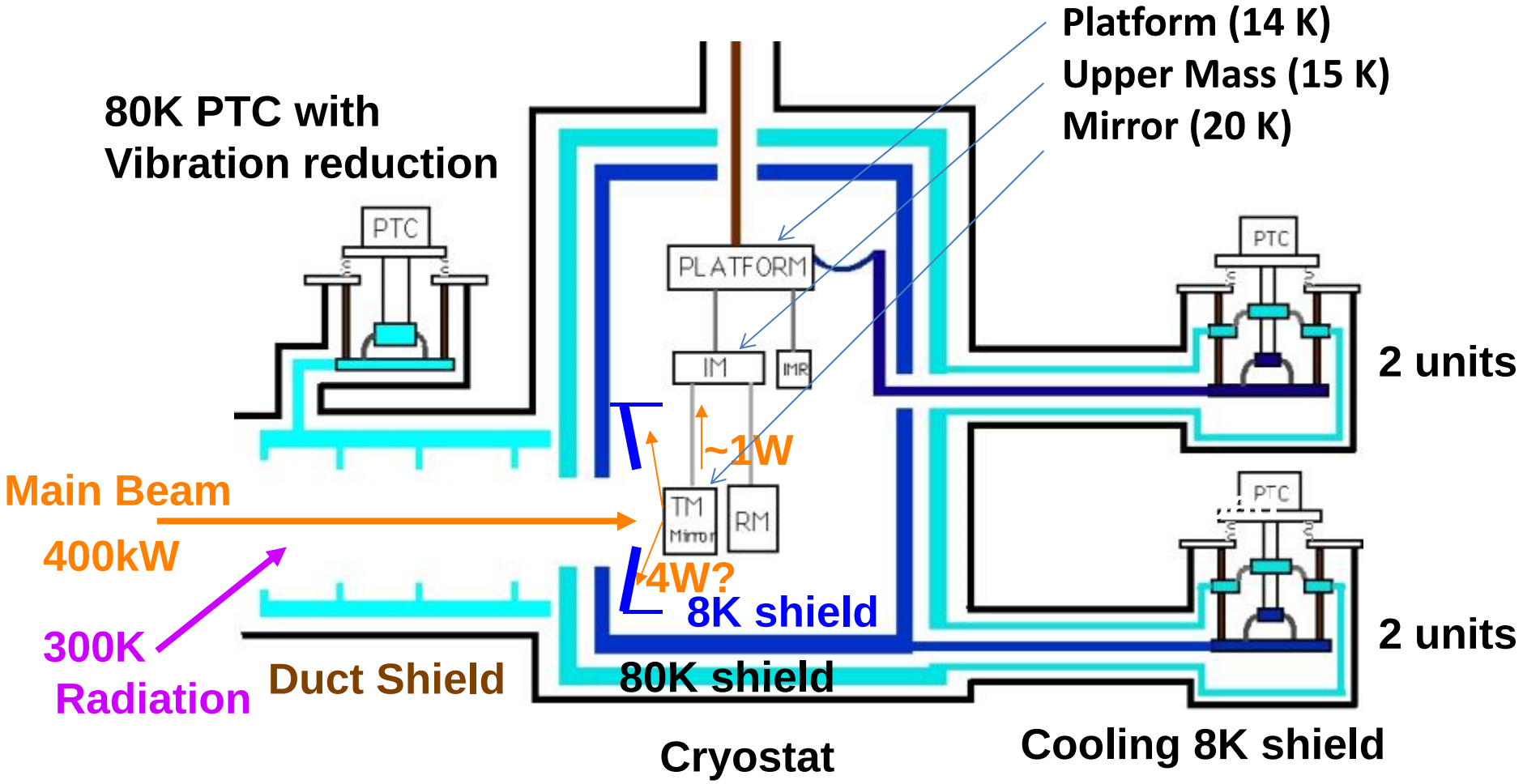
Mirror suspension



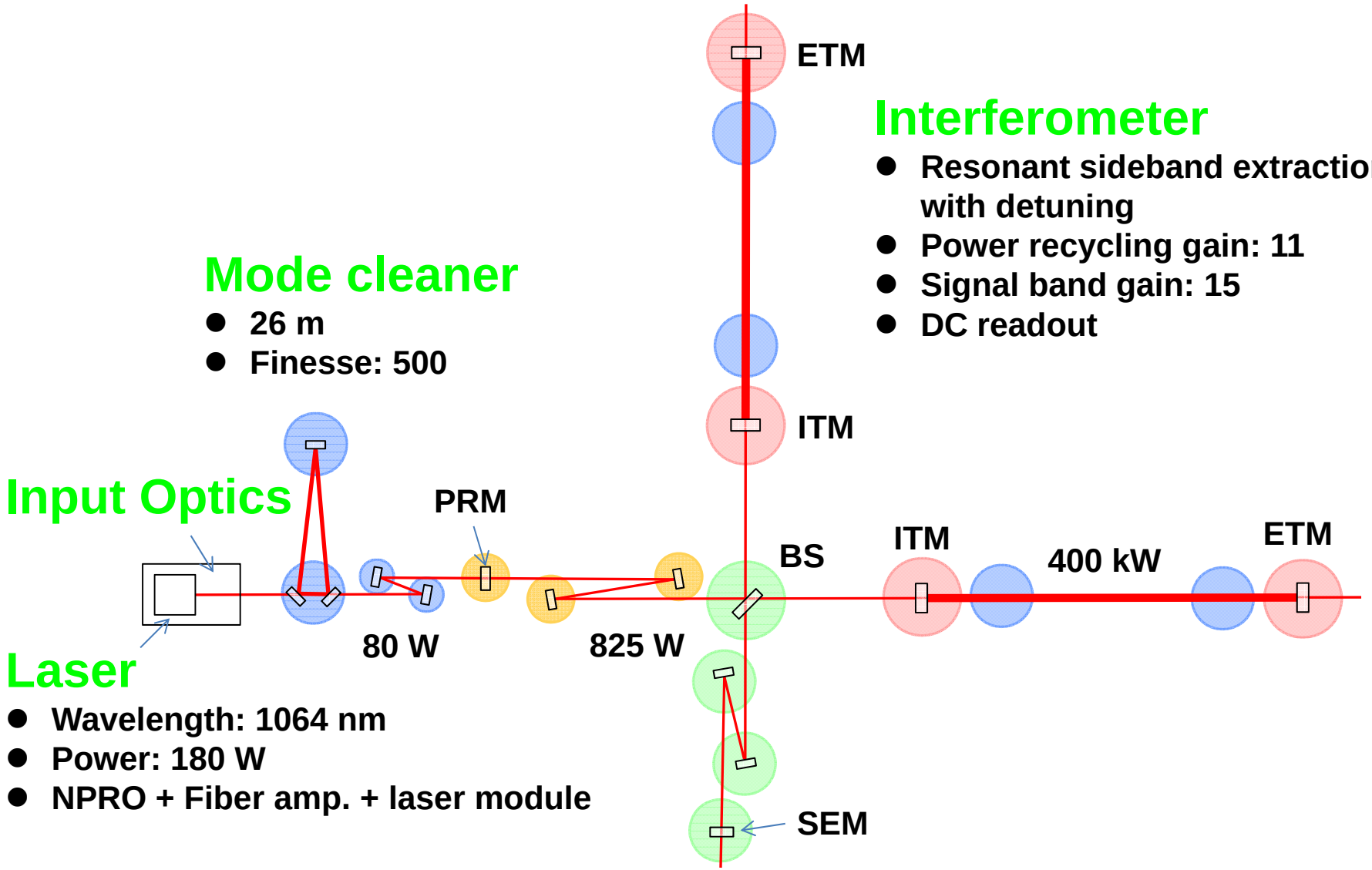
GAS filter

Two-tunnel structure to avoid the cost and resonances of a tall support structure.

Cryogenic System



Optical configuration



Interferometer

- Resonant sideband extraction with detuning
- Power recycling gain: 11
- Signal band gain: 15
- DC readout

Mode cleaner

- 26 m
- Finesse: 500

Input Optics

Laser

- Wavelength: 1064 nm
- Power: 180 W
- NPRO + Fiber amp. + laser module

Output mode cleaner

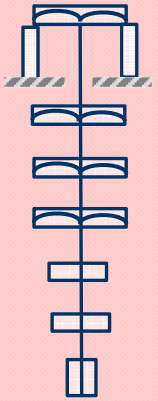
Mirror/suspension configuration

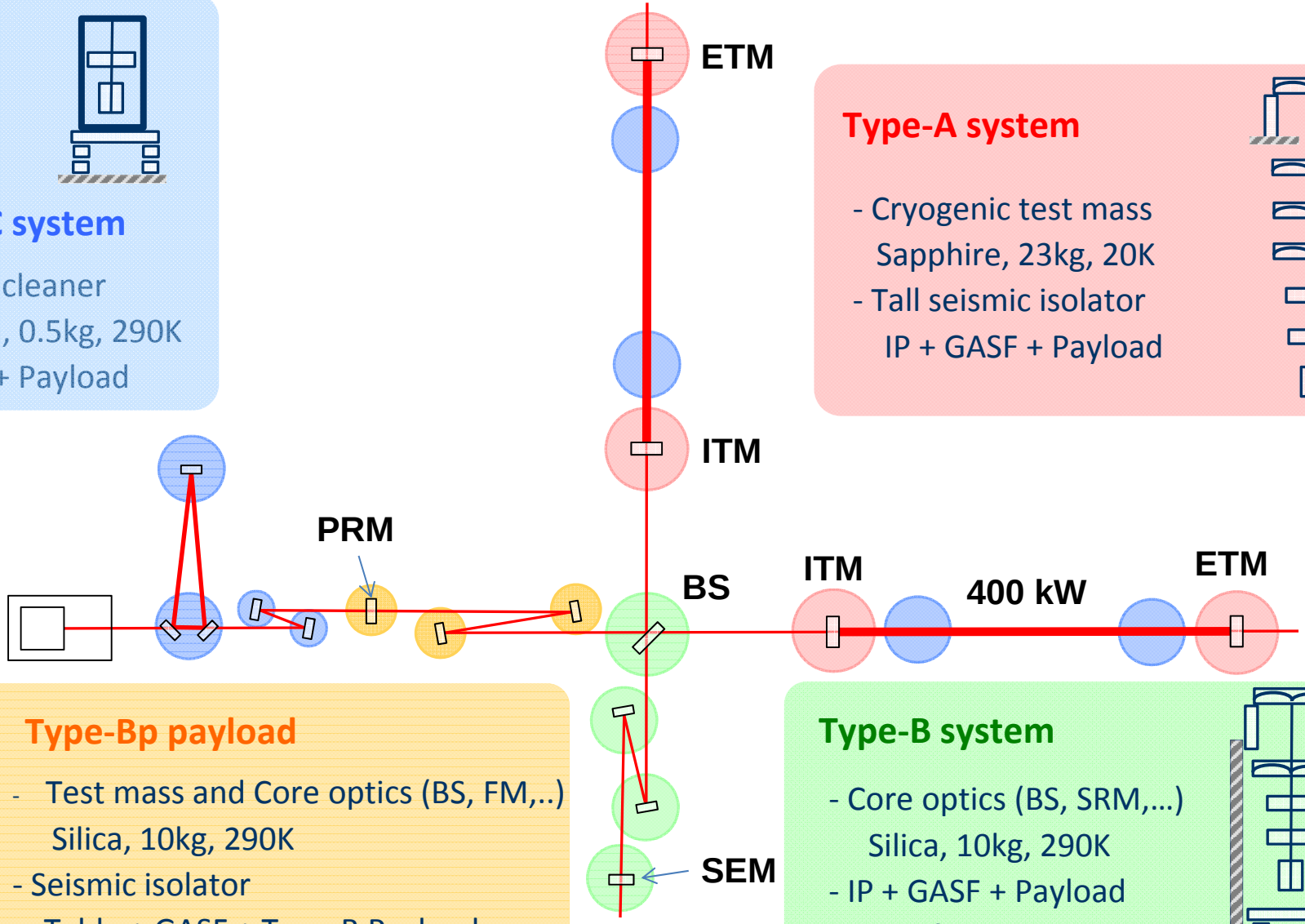
Type-C system

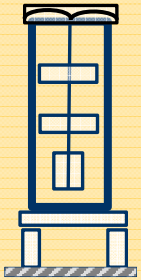
- Mode cleaner
  Silica, 0.5kg, 290K
- Stack + Payload

Type-A system

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





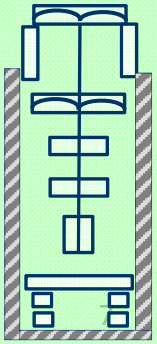


Type-Bp payload

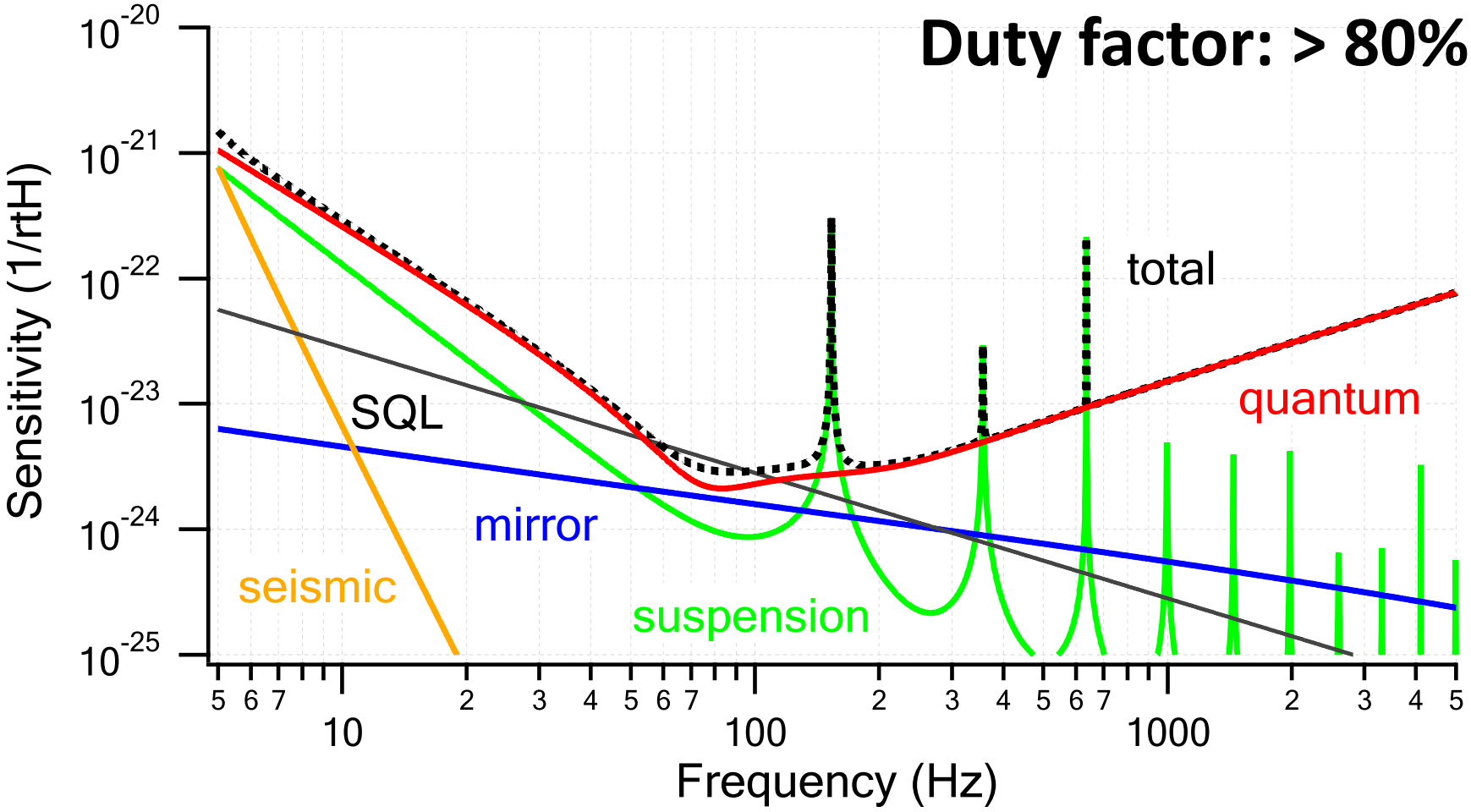
- Test mass and Core optics (BS, FM,..)
  Silica, 10kg, 290K
- Seismic isolator
  Table + GASF + Type-B Payload

Type-B system

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



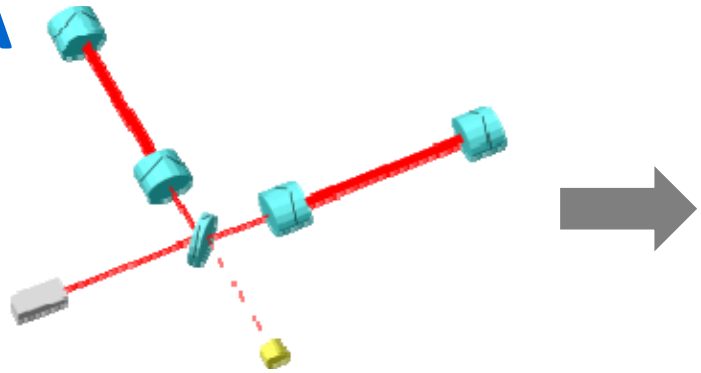
Target Sensitivity of KAGRA



Schedule of KAGRA

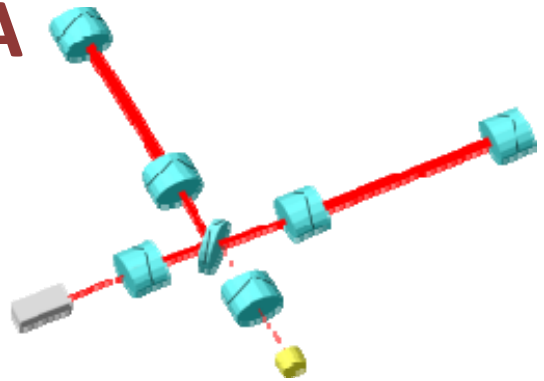
Calendar year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Project start	→								
Tunnel excavation			▭	▭	▭	(~1 year delay…)			
initial-KAGRA		▭	▭	▭	▭	▭			
						iKAGRA obs. ▭			
baseline-KAGRA					Adv. Optics system and tests	▭	▭		
							Cryogenic system ▭		
Observation								→	

iKAGRA



- Fabry-Perot Michelson interferometer
- Room temperature
- Simple seismic isolation system

bKAGRA

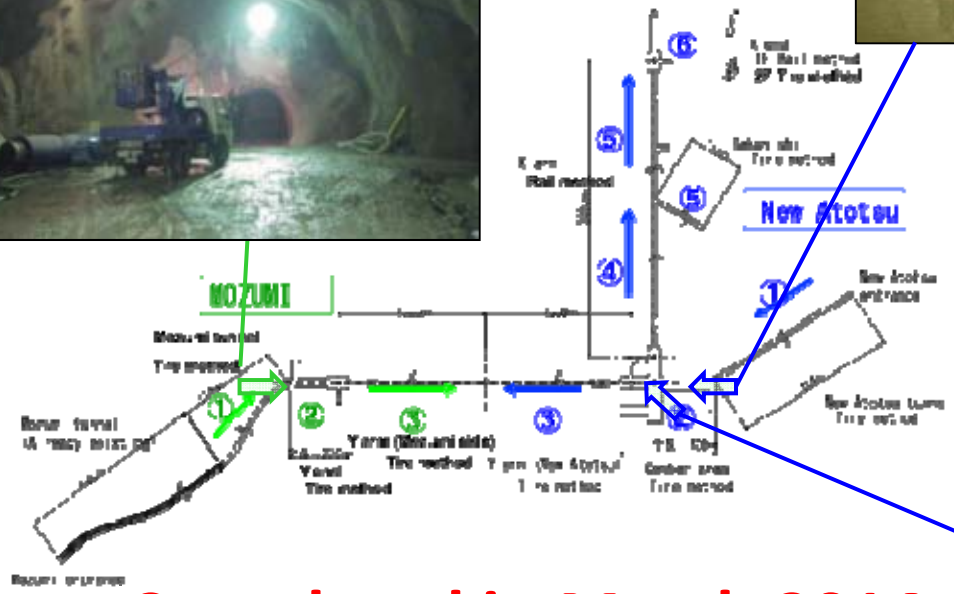


- Resonant sideband extraction
- Cryogenic temperature
- Advanced seismic isolation system

Tunnel excavation

Mozumi Entrance

New-Atotsu Entrance



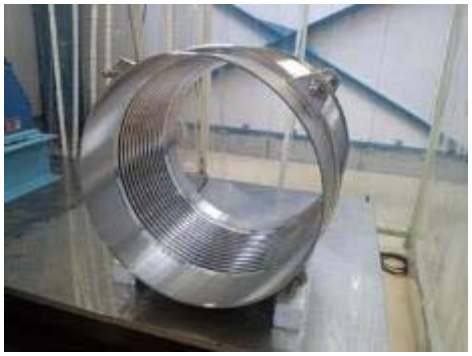
Completed in March 2014

Beam tubes

12m, Φ800mm beam tubes for 3km x 2 arms:

Delivered in 2012

Press to form a beam tube



Bellows for each beam tube

Baking at MIRAPRO Co.
Noda/MESCO, Kamioka

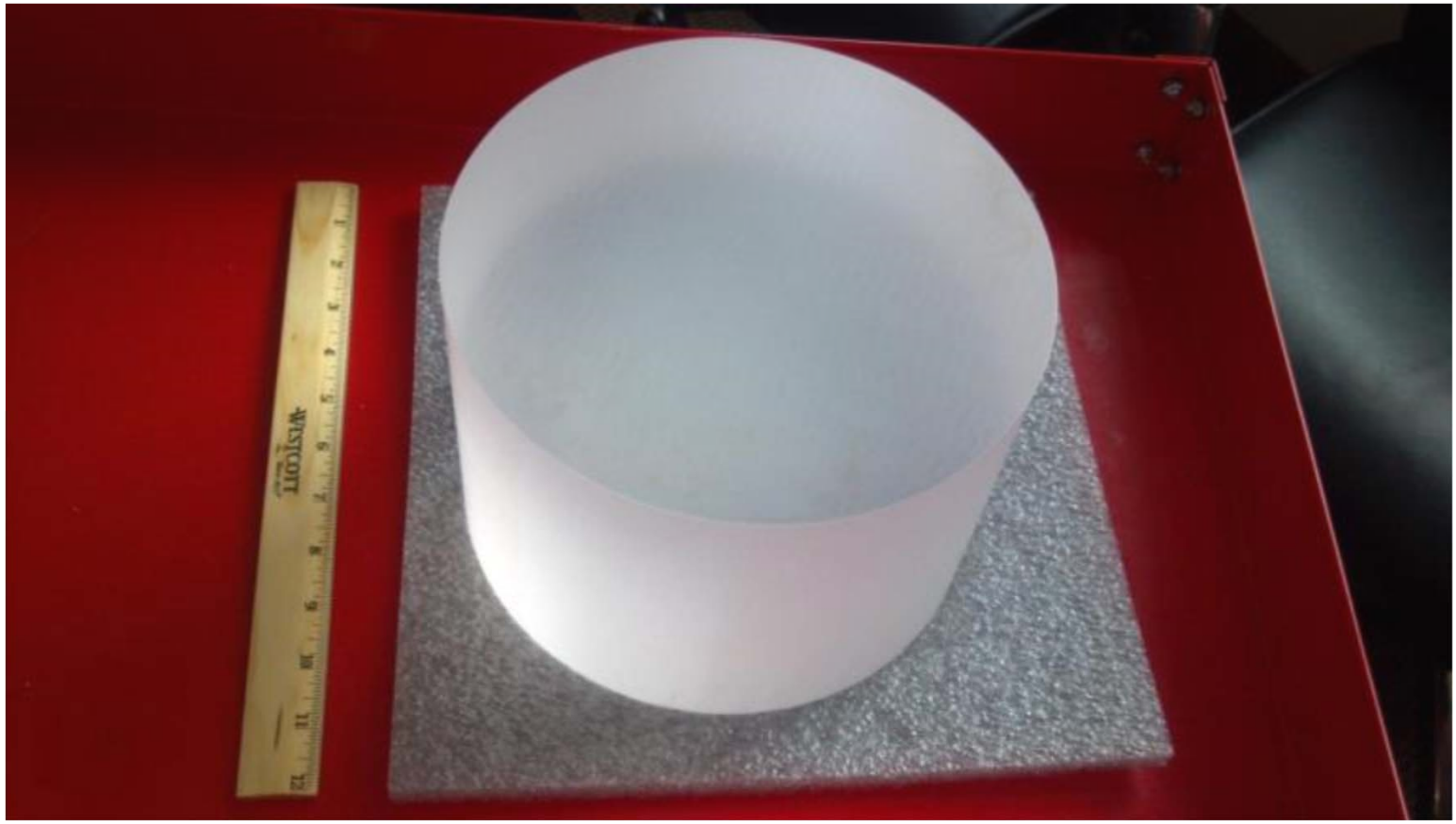
Test at MIRAPRO Co. Noda

Transportation to Kamioka

Cryostat construction and test

Construction and cooling tests were finished!

Sapphire Mirror



Two Sapphire substrates have been delivered.
(Φ220mm, t 150mm, c-axis)

Installation/commissioning schedule

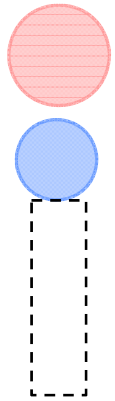
Installation/commissioning schedule

2014.7

Cryostat Y END

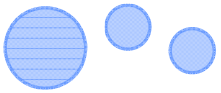
Installation/commissioning schedule

2014.8



Chamber Y END

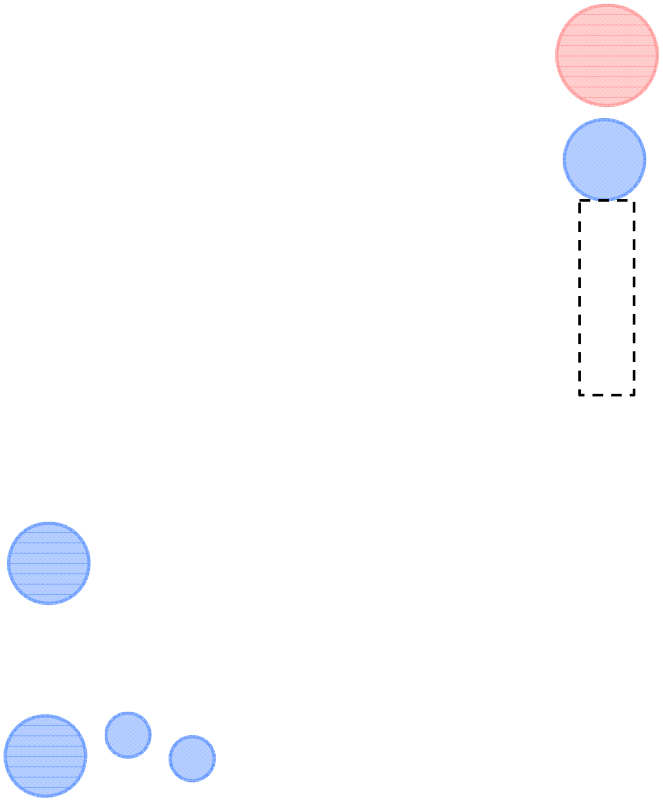
MC Chambers



MMT Chambers

Installation/commissioning schedule

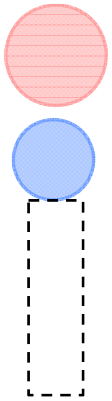
2014.9

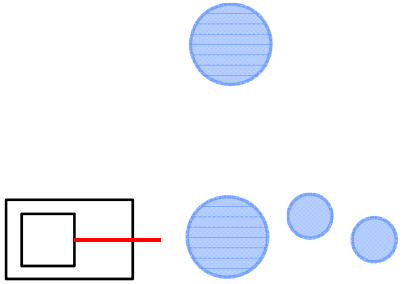


Cryostat X END

Installation/commissioning schedule

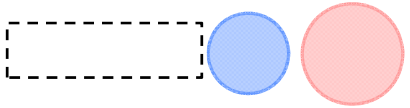
2014.10





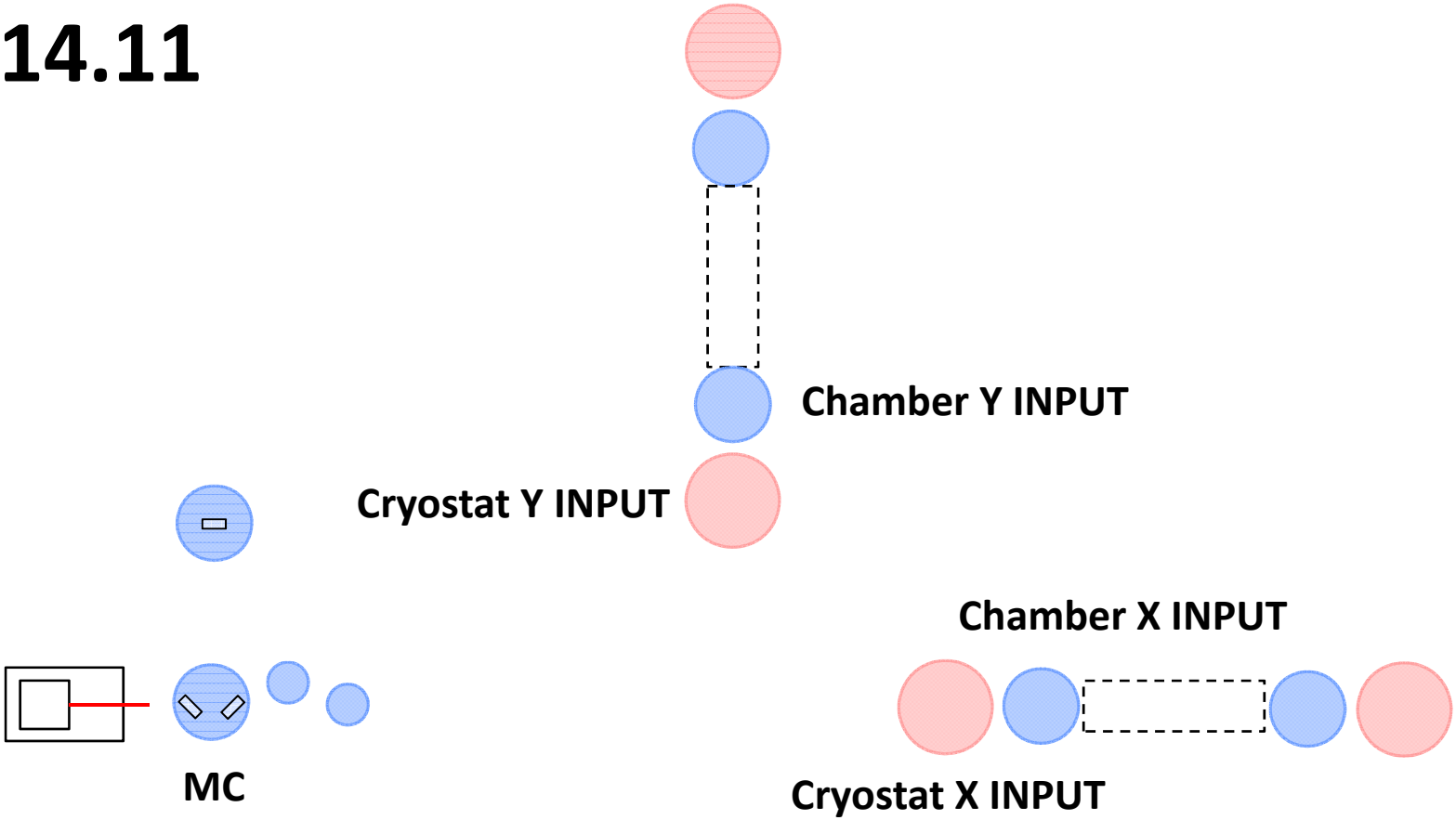
Laser & Input Optics

Chamber X END



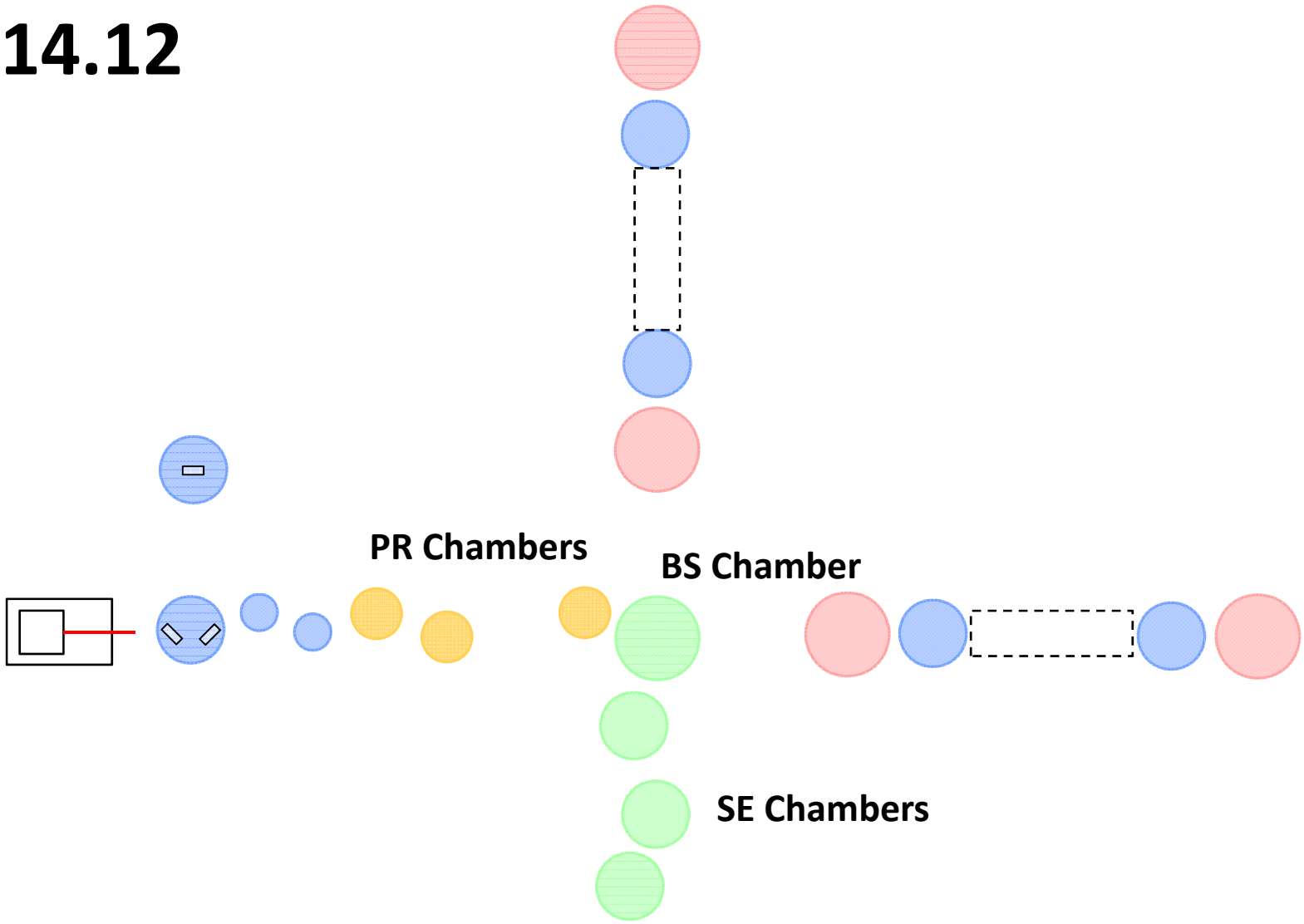
Installation/commissioning schedule

2014.11



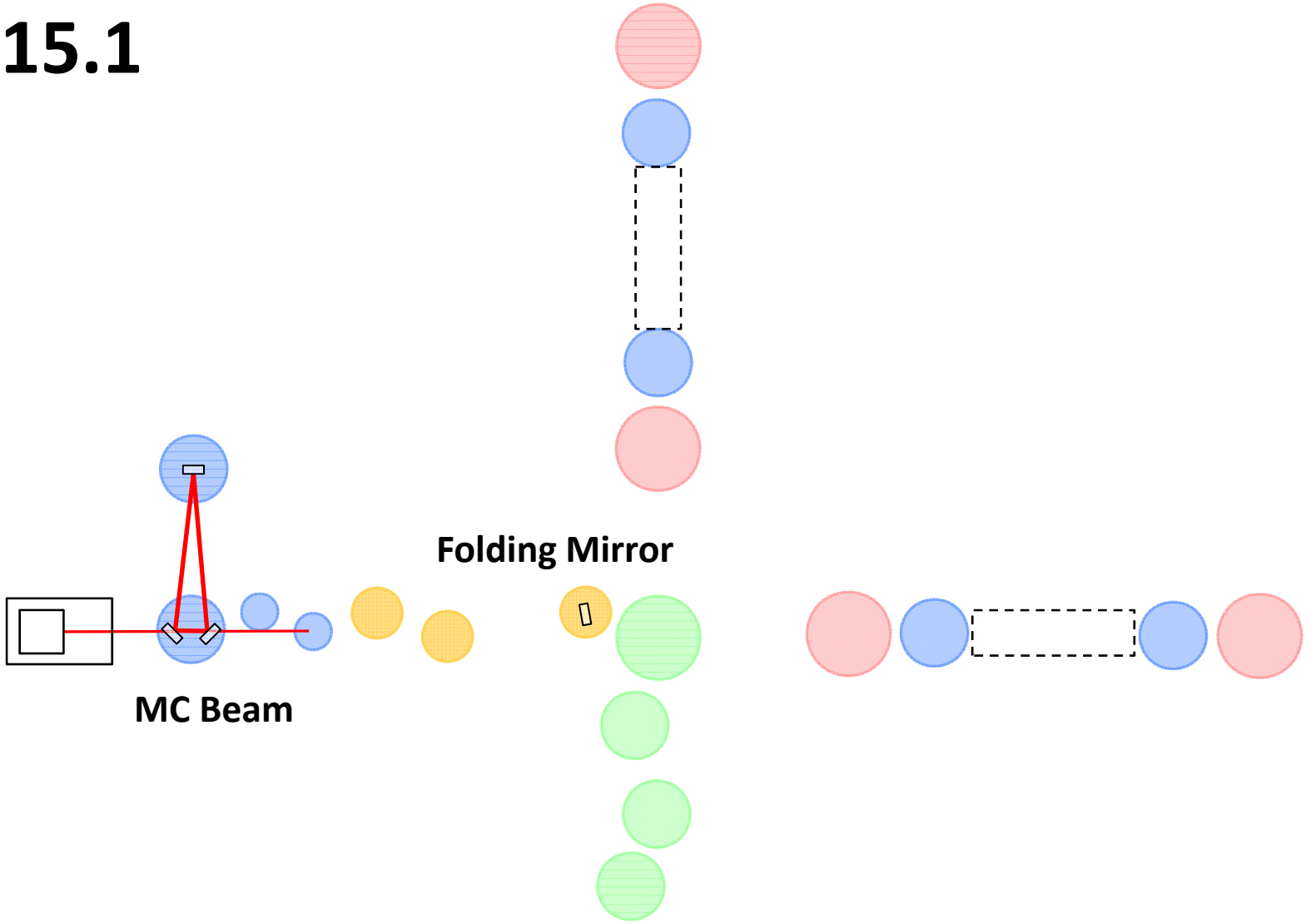
Installation/commissioning schedule

2014.12



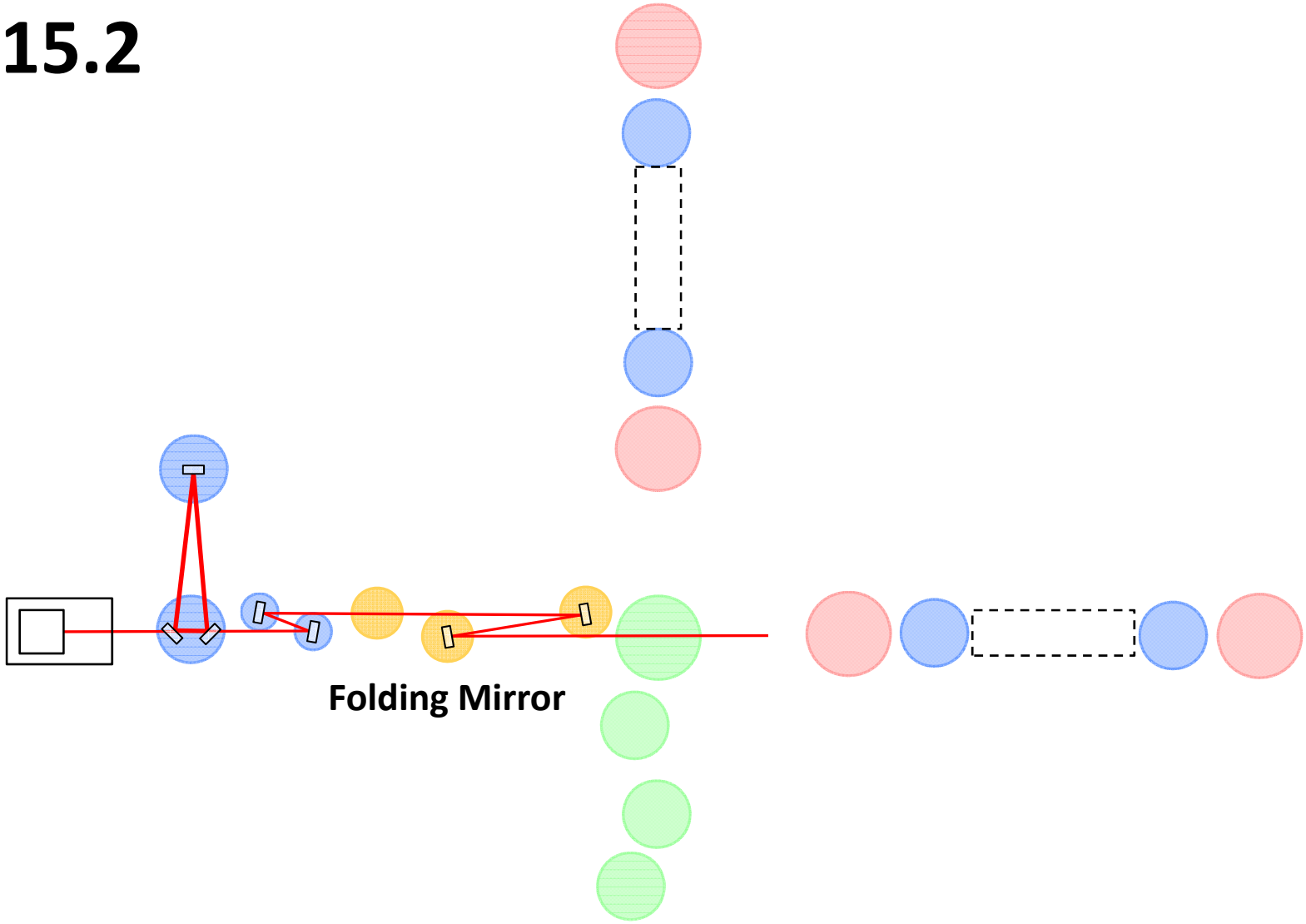
Installation/commissioning schedule

2015.1



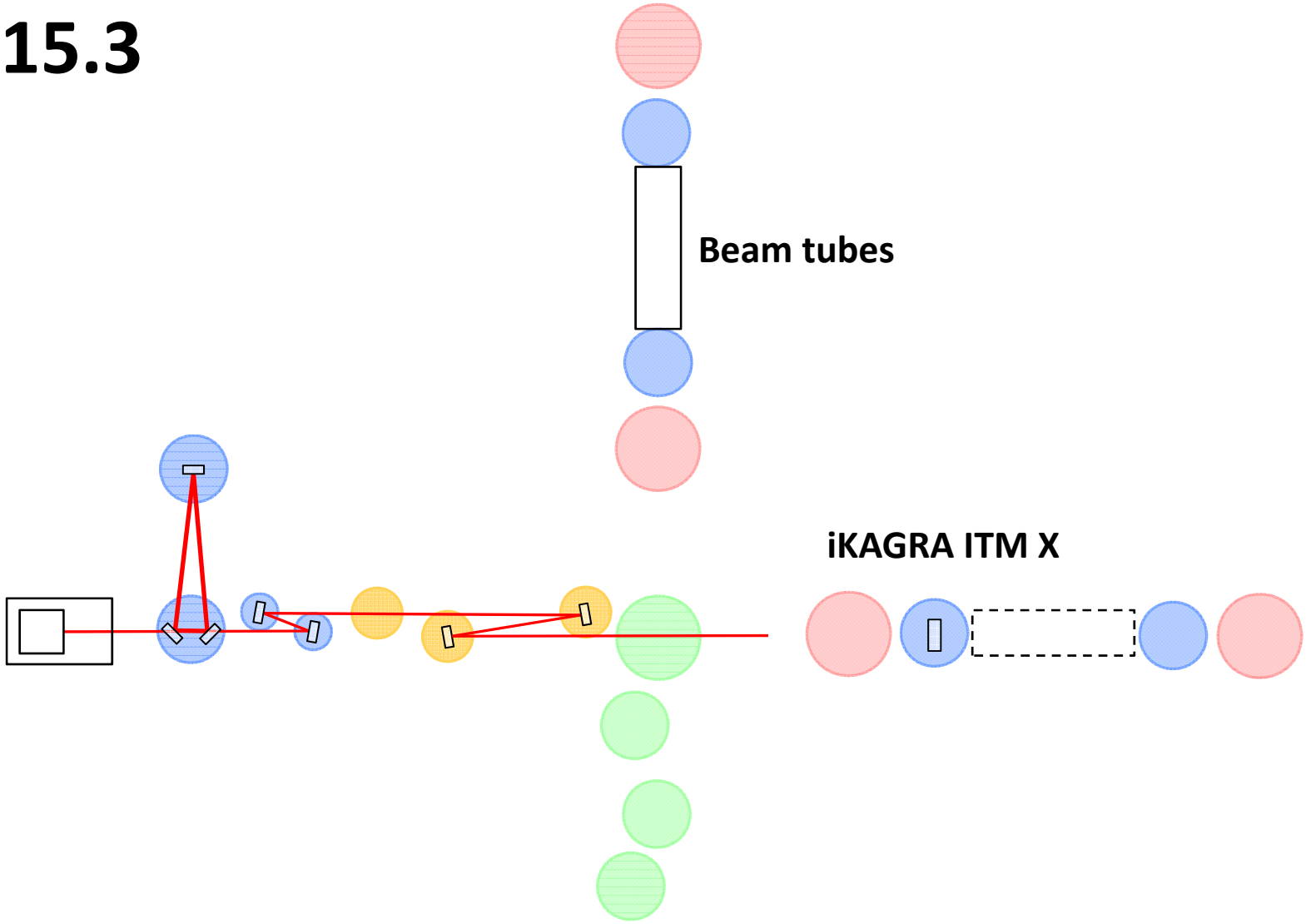
Installation/commissioning schedule

2015.2



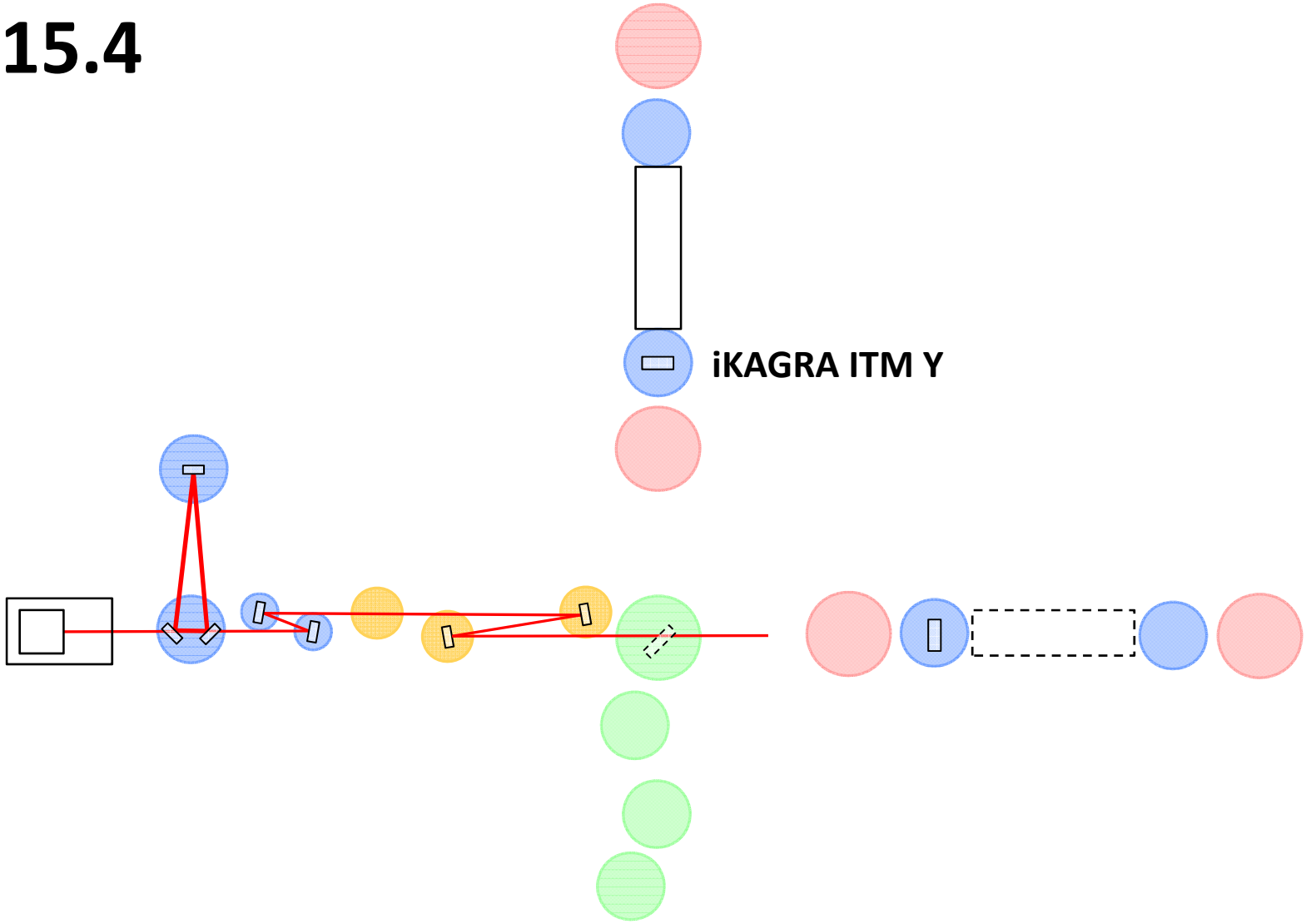
Installation/commissioning schedule

2015.3



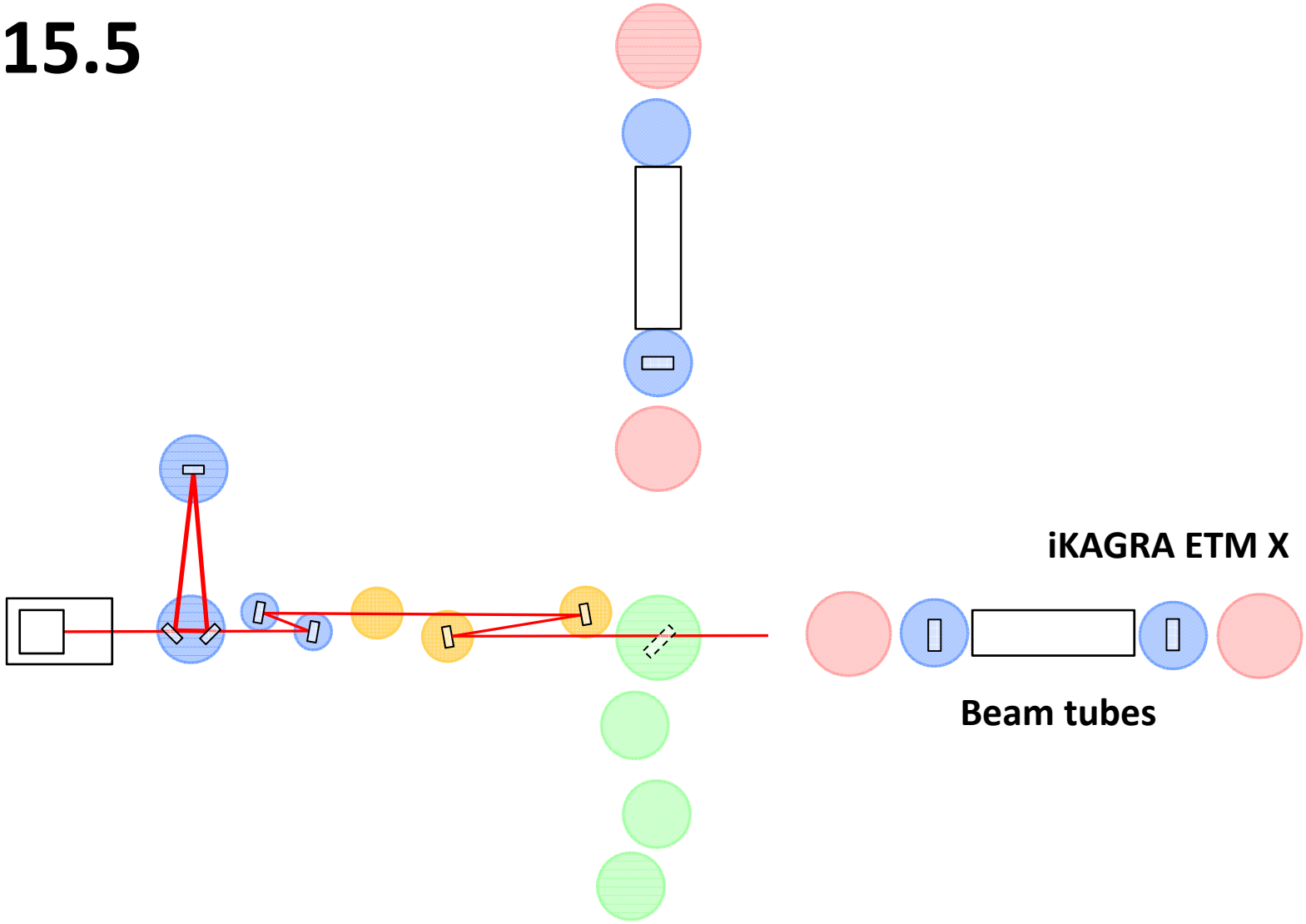
Installation/commissioning schedule

2015.4



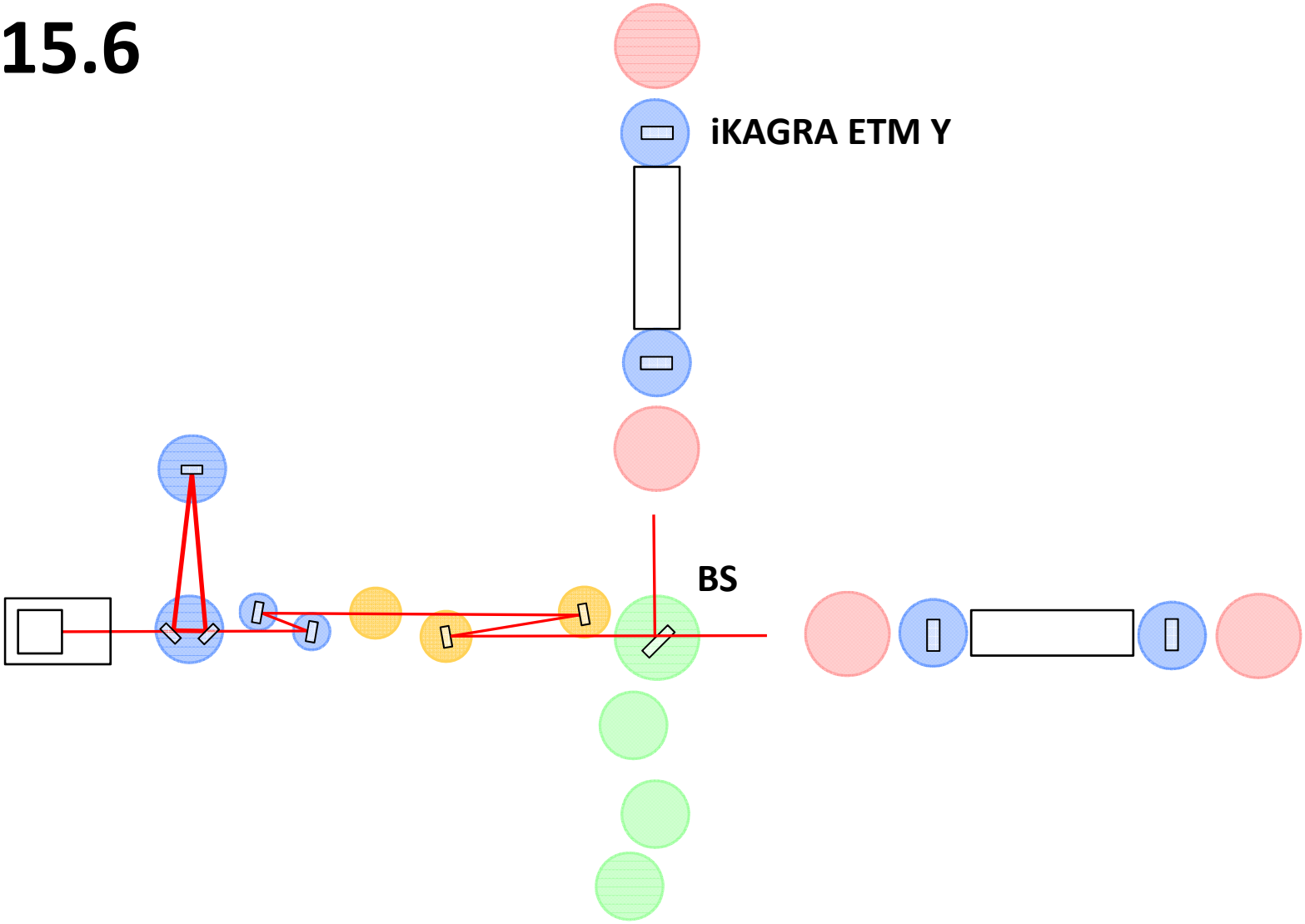
Installation/commissioning schedule

2015.5



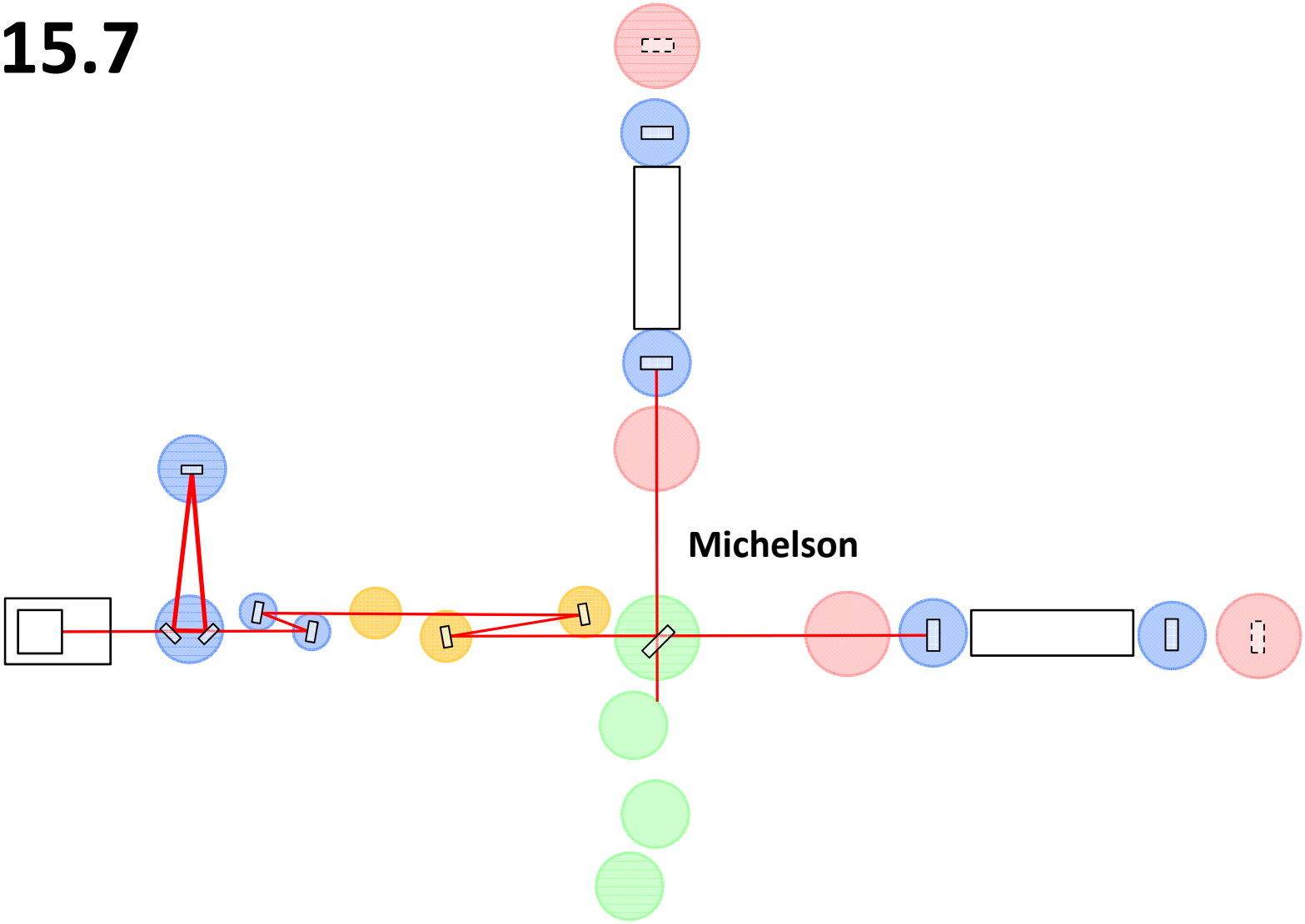
Installation/commissioning schedule

2015.6



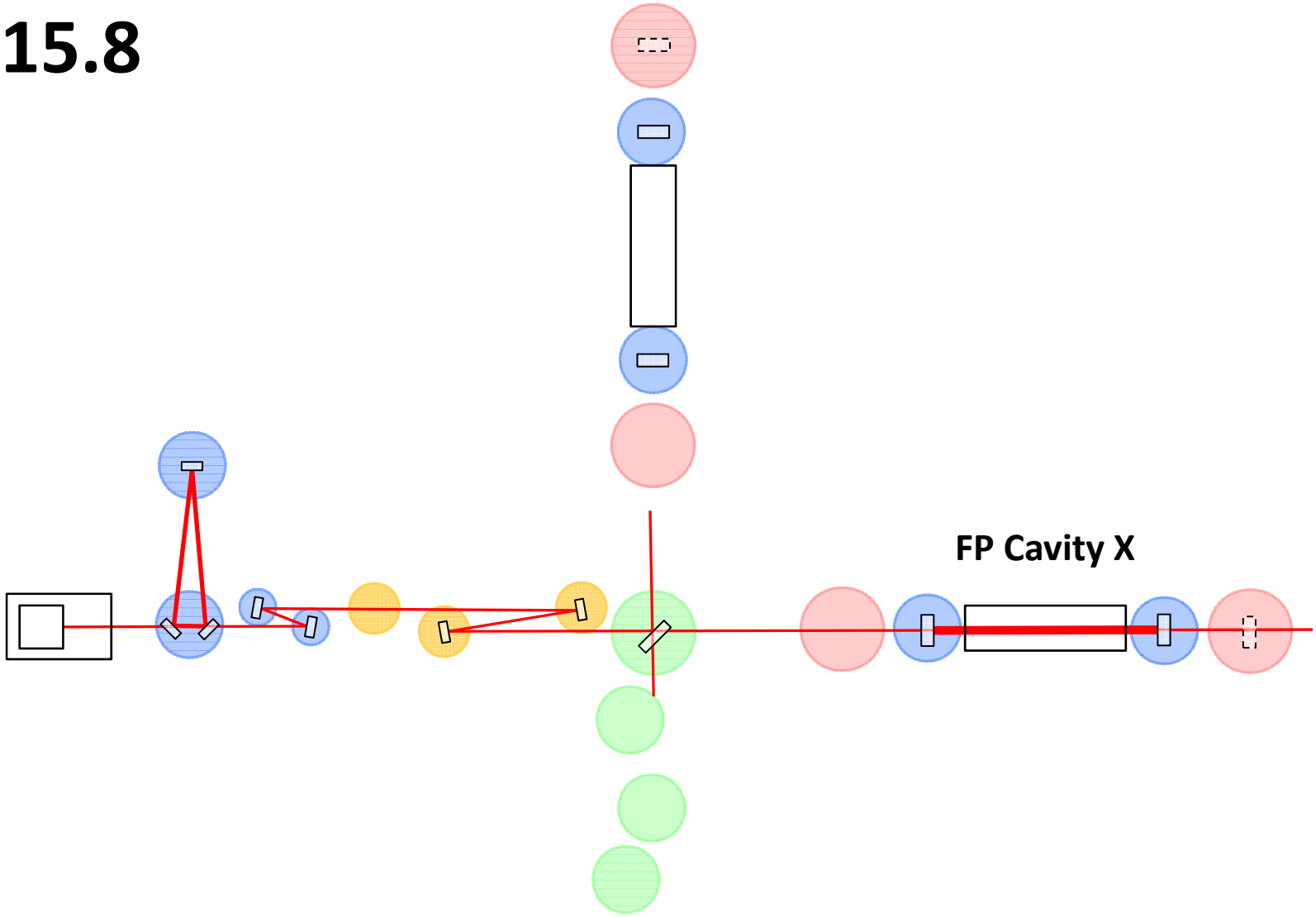
Installation/commissioning schedule

2015.7



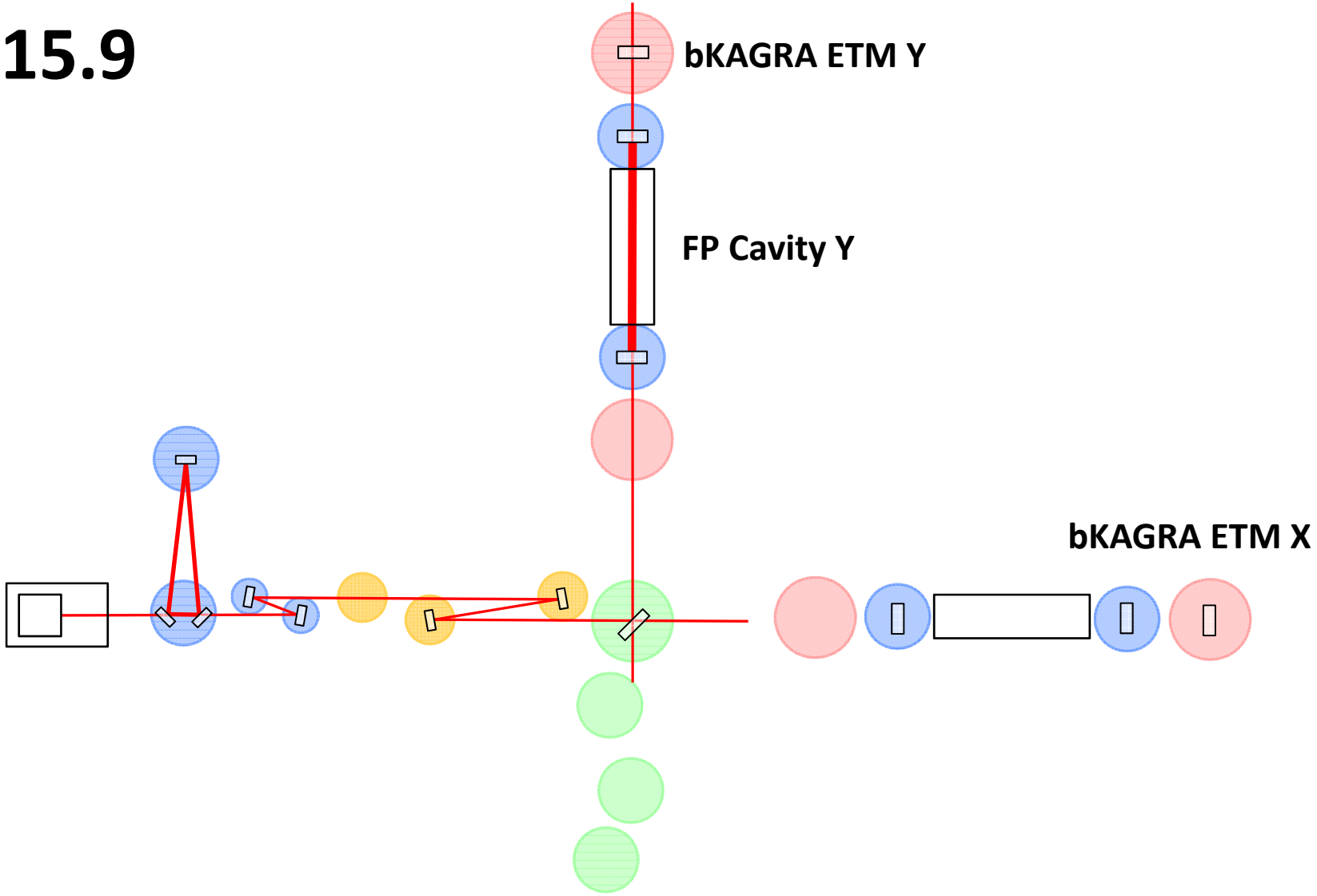
Installation/commissioning schedule

2015.8



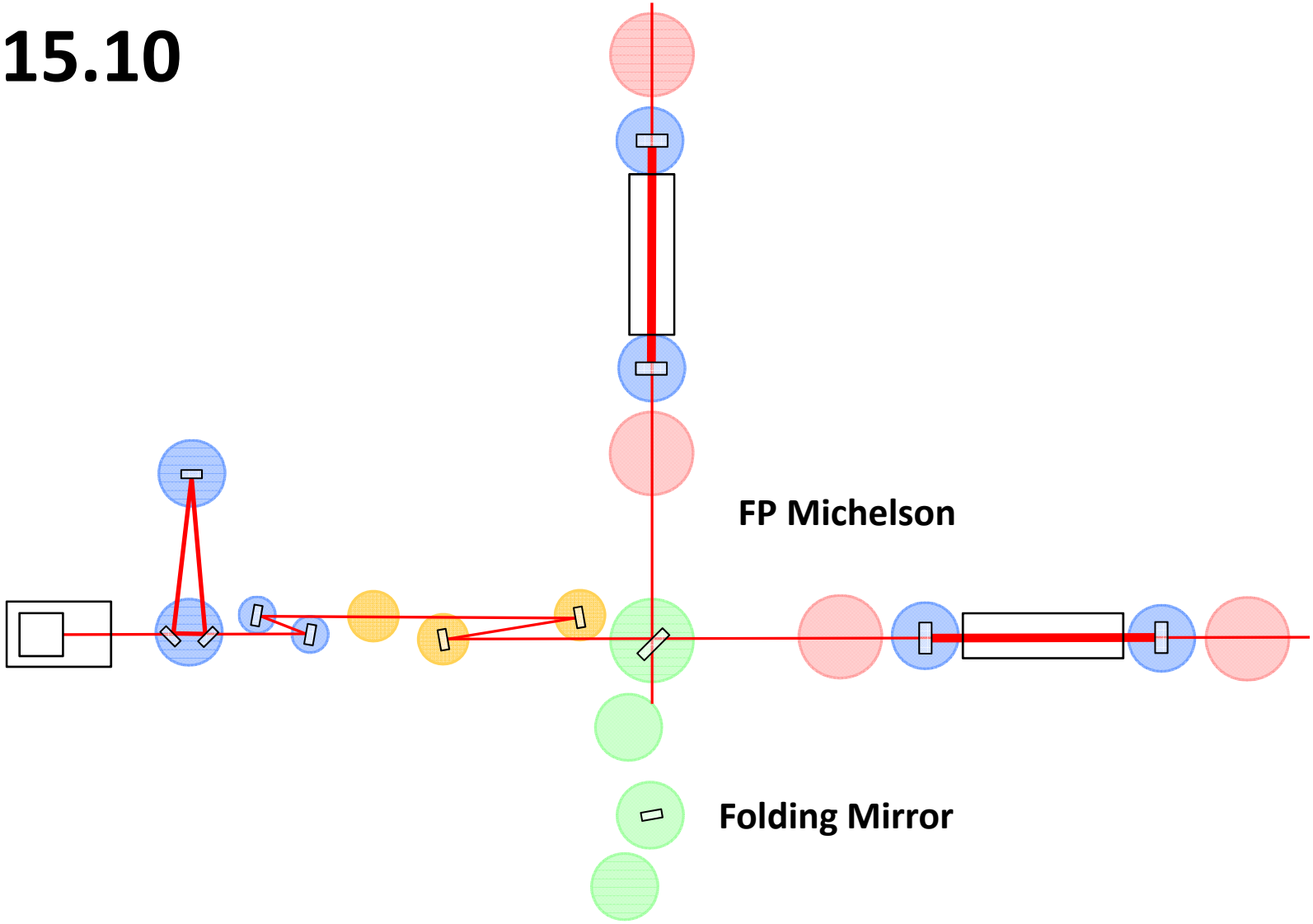
Installation/commissioning schedule

2015.9



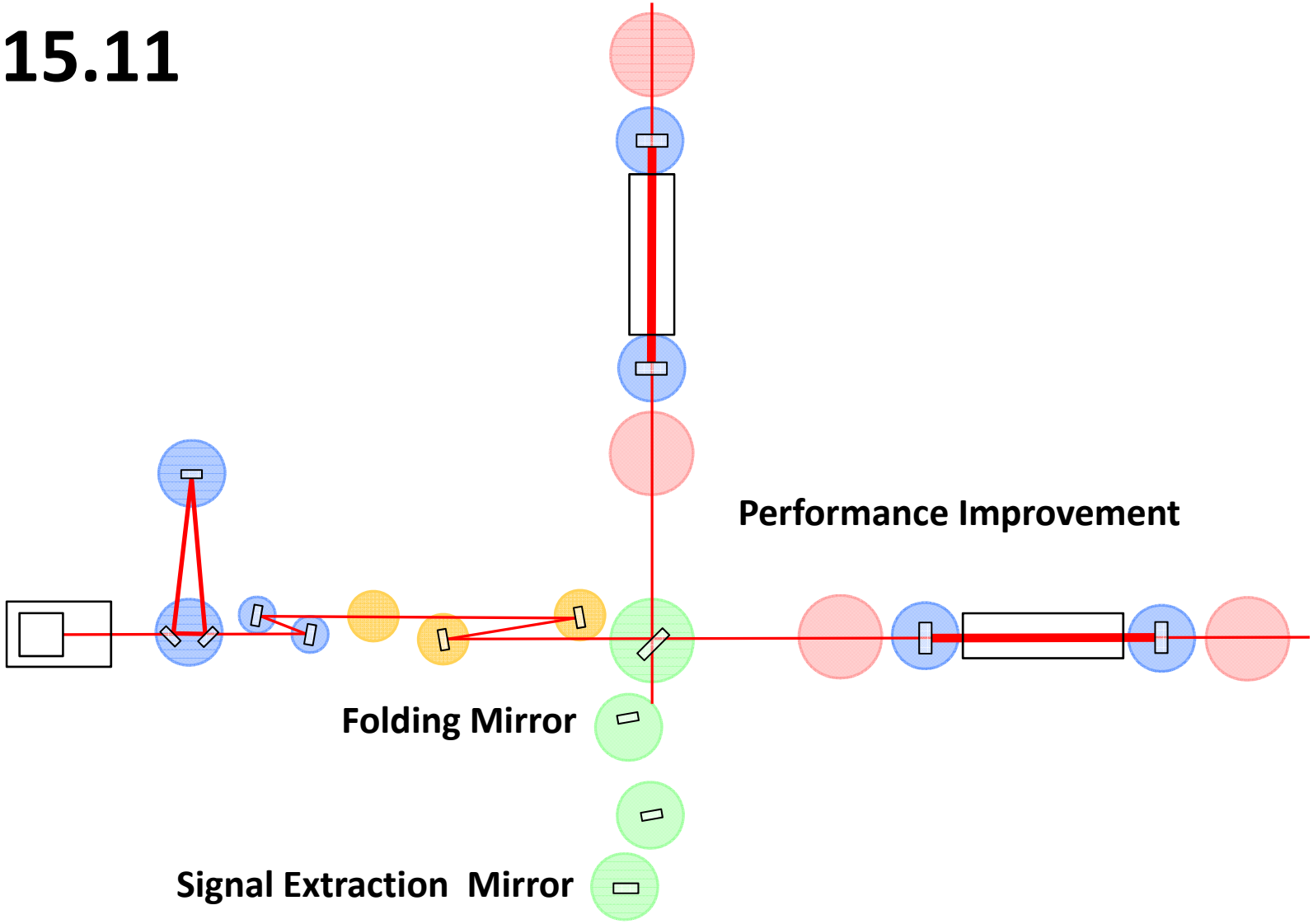
Installation/commissioning schedule

2015.10



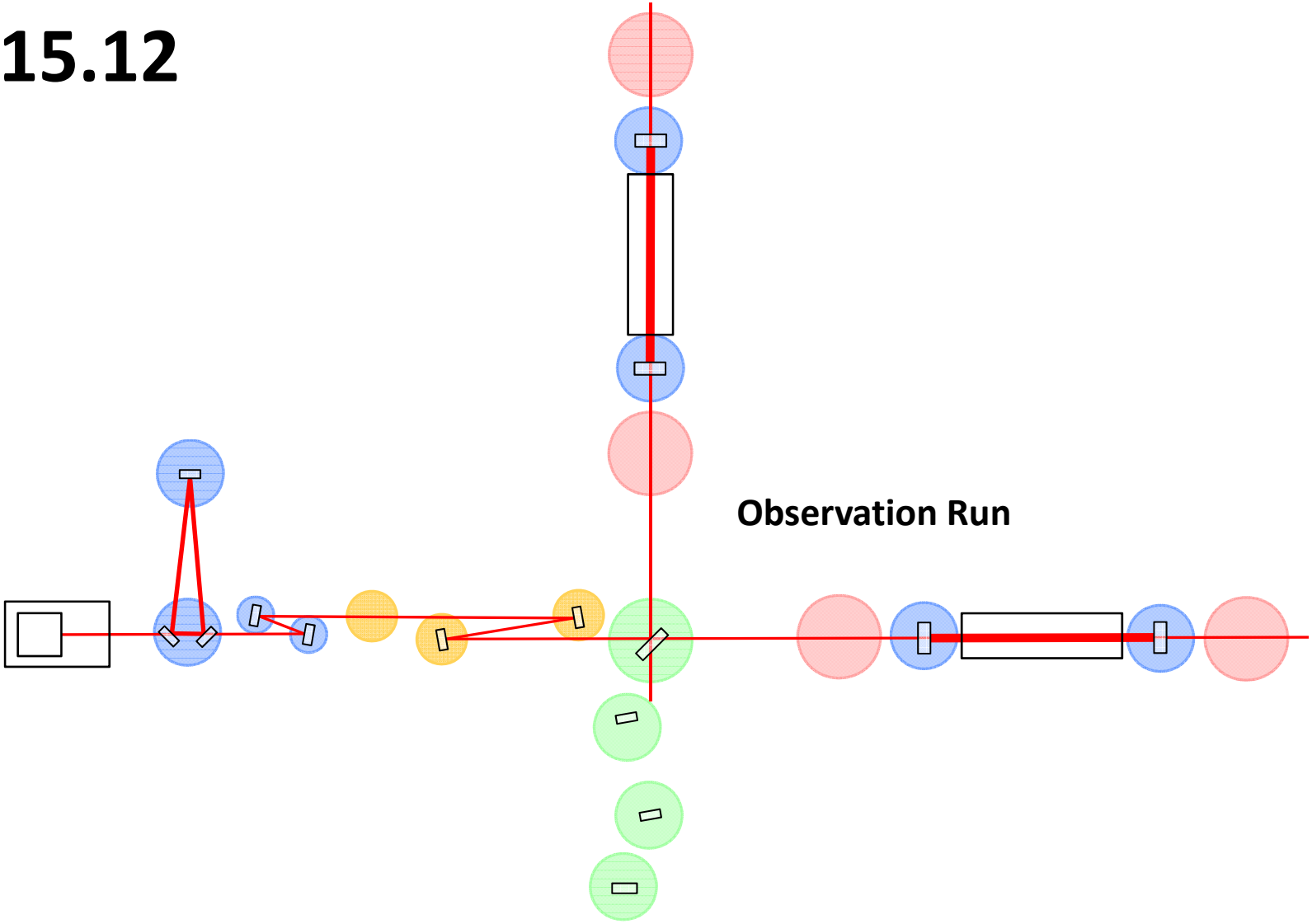
Installation/commissioning schedule

2015.11



Installation/commissioning schedule

2015.12



Then we will move on to bKAGRA.

Summary

- KAGRA has cryogenic and underground GW detector (2.5-generation).
- We plan to build KAGRA in two steps: iKAGRA and bKAGRA.
- We will start installing iKAGRA very soon.
- We plan to start observation run with iKAGRA in December 2015.
- Then we will move on to bKAGRA.