

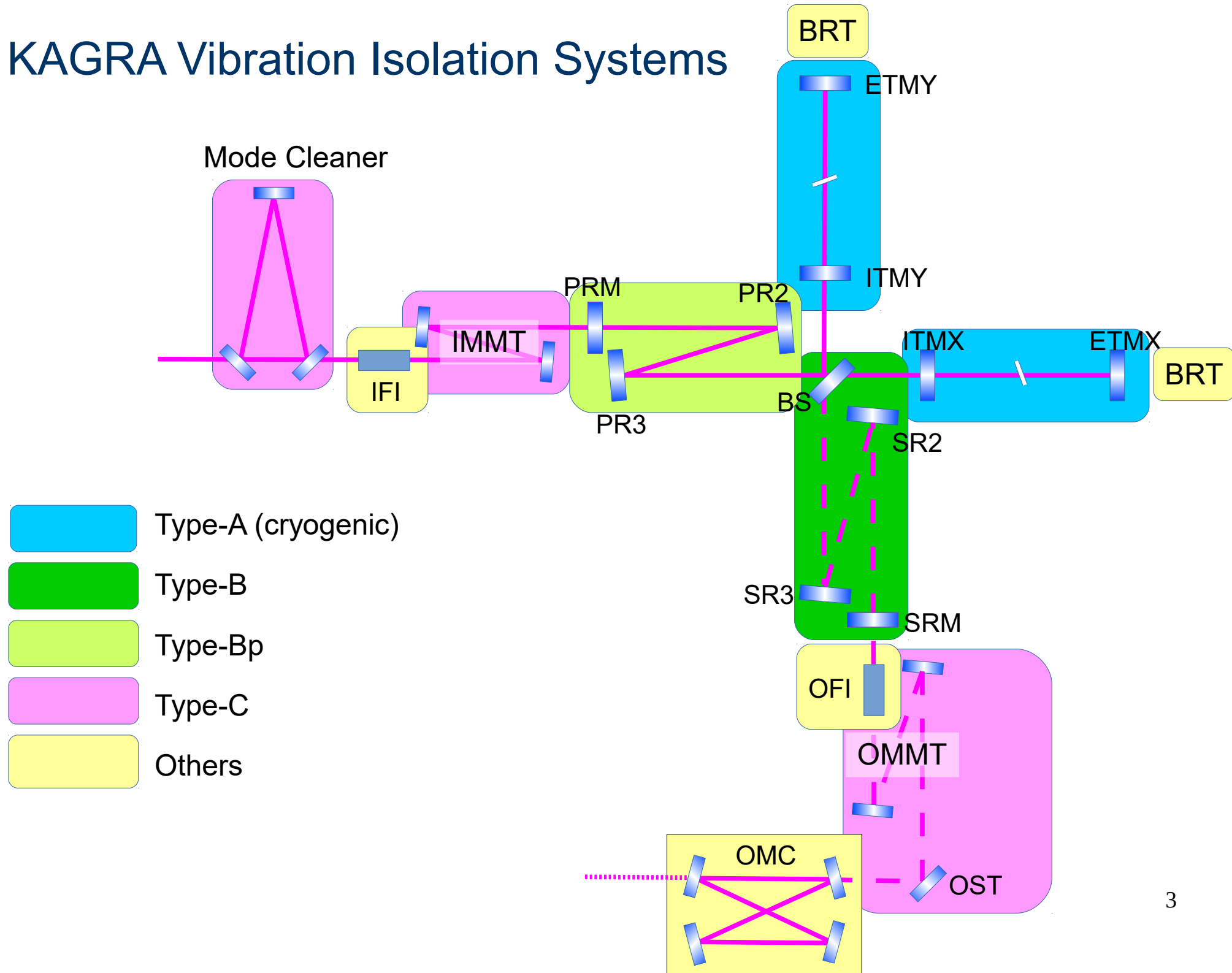
# bKAGRA

# Vibration Isolation Systems

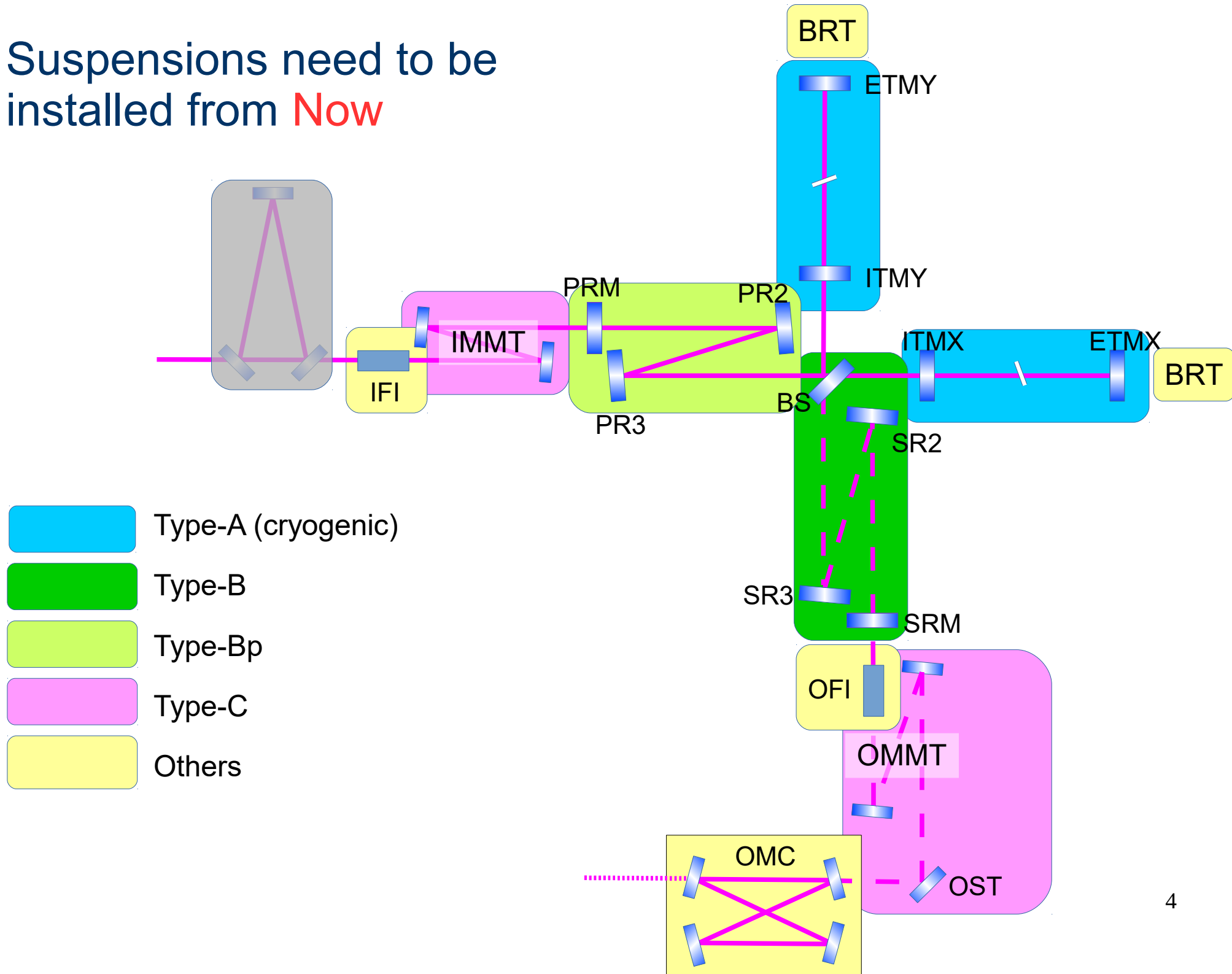
2016/6/21@PAB  
Y. Aso (NAOJ)

# VIS Overview

# KAGRA Vibration Isolation Systems

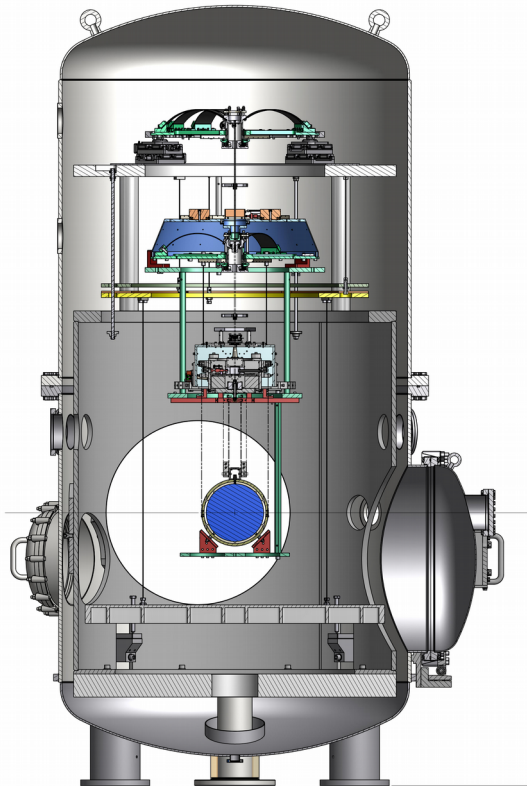


# Suspensions need to be installed from **Now**

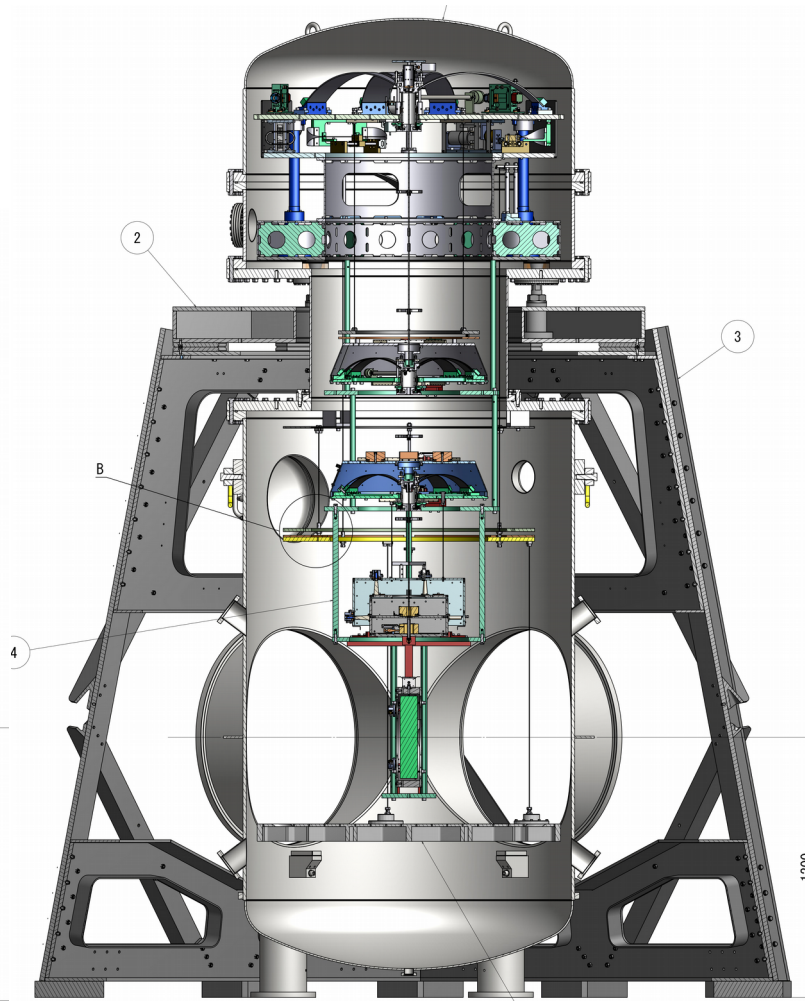


# Three types of large suspensions

Type-Bp



Type-B



Type-A

# Other vibration isolation systems

- MC (TAMA suspensions, installed)
- IMMT (TAMA suspensions)
- Output optics
  - OFI (modified TAMA suspension ?)
  - OMMT (newly built TAMA like suspension)
  - OST (newly built TAMA like suspension)
  - OMC (custom made one)
- BRT
  - Custom made one

# Who is responsible for what ?

## Large suspension systems + IMMT

(Type-A w/o cryo payload, Type-B, Type-Bp, Type-C)

→ VIS subsystem (NAOJ)

## Cryogenic Payload

→ CRY (KEK)

## Beam Reducing Telescope Suspensions

→ AOS (NAOJ)

## Output Optics Suspensions

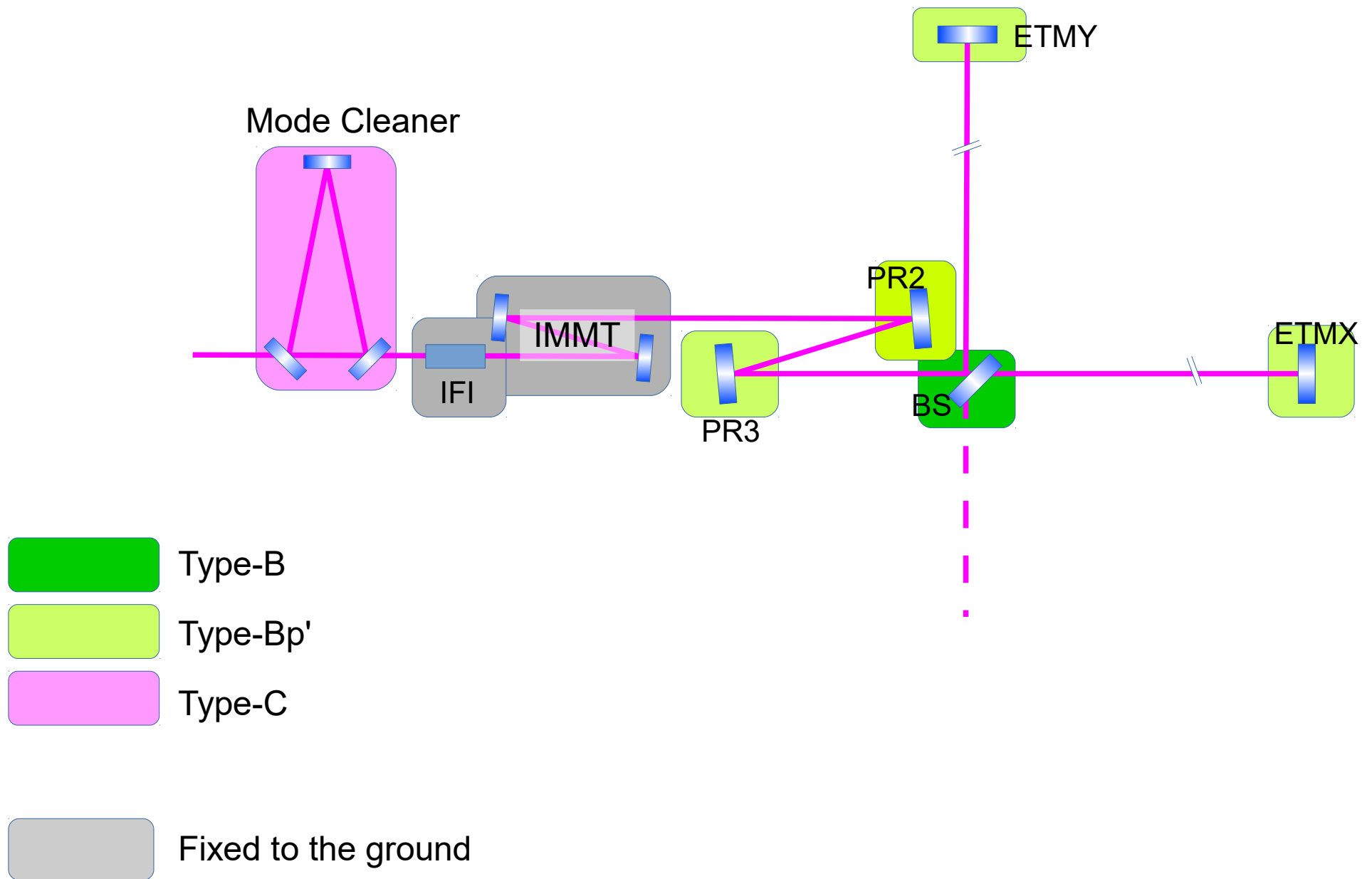
(OFI, OMMT, OST, OMC + IFI?)

→ IOO ?

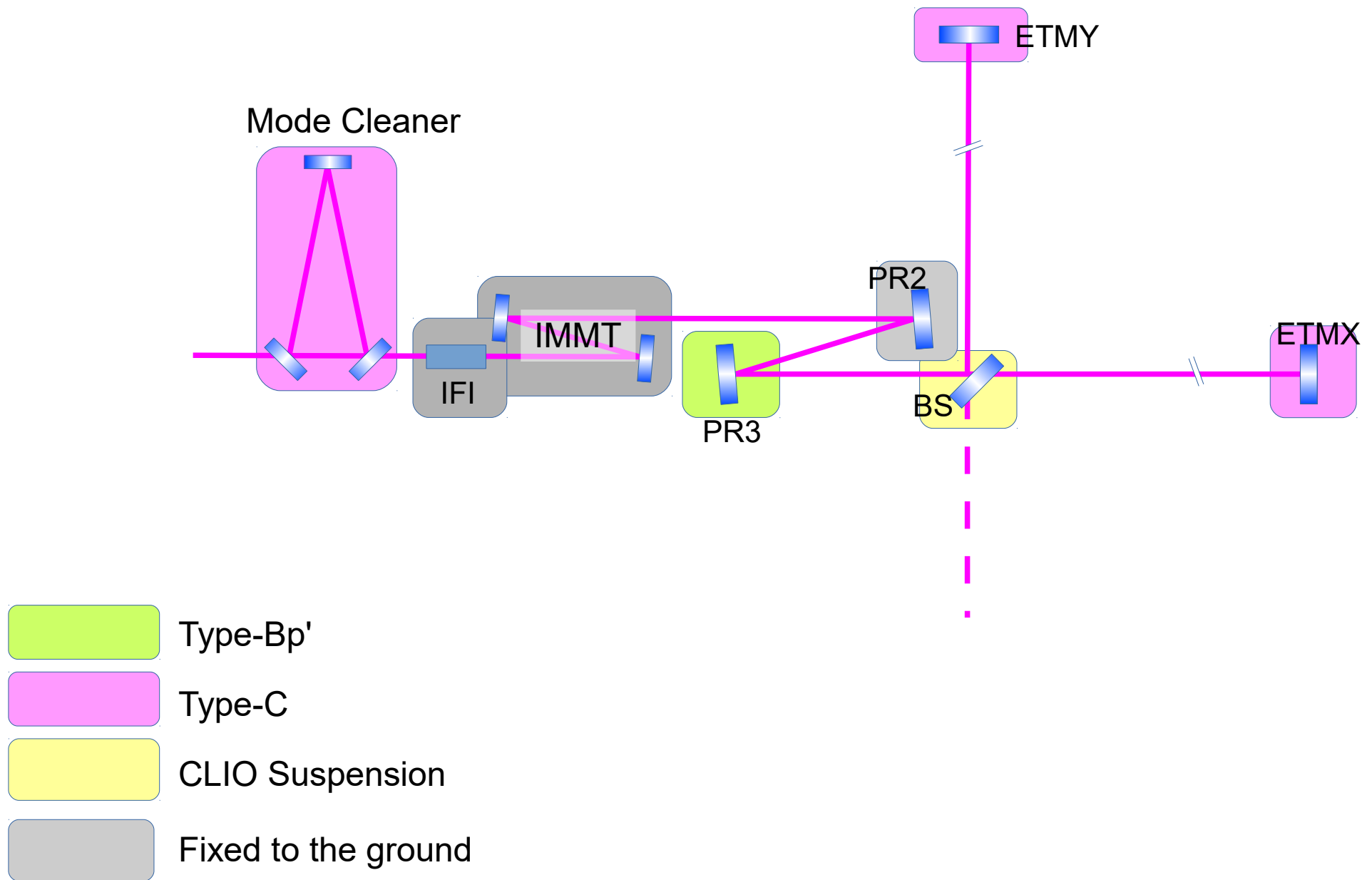
What happened in iKAGRA ?



# iKAGRA VIS: Original Plan



# iKAGRA VIS: What happened



# VIS installation took much longer than expected

PR3 was the only large suspension installed

- Tunnel environment
  - Access, limited work time, keeping it clean, etc
- Insufficient preparation
  - Parts missing
  - Not-well-established installation procedure
  - Incorrect drawings
  - Tools missing
- Troubles
  - Cracks in the sapphire prisms
  - Broken OSEM flags
  - Wrong cables
  - Screw galling

Original estimate of installation work duration

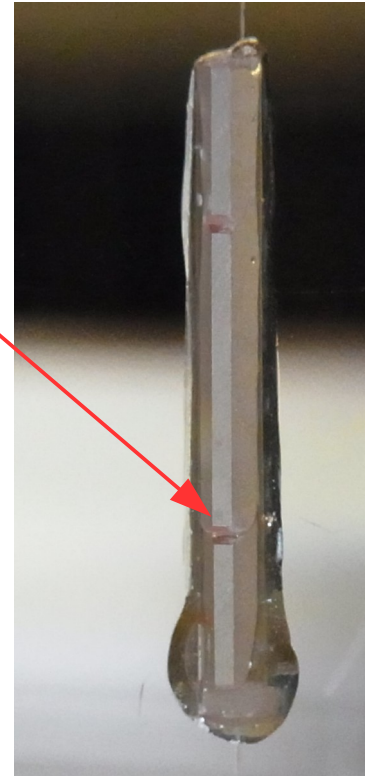
1 month for PR3

Actually happened

3 months for test installation, 1.5 months for the actual installation.

# PR2 wire breaker developed cracks

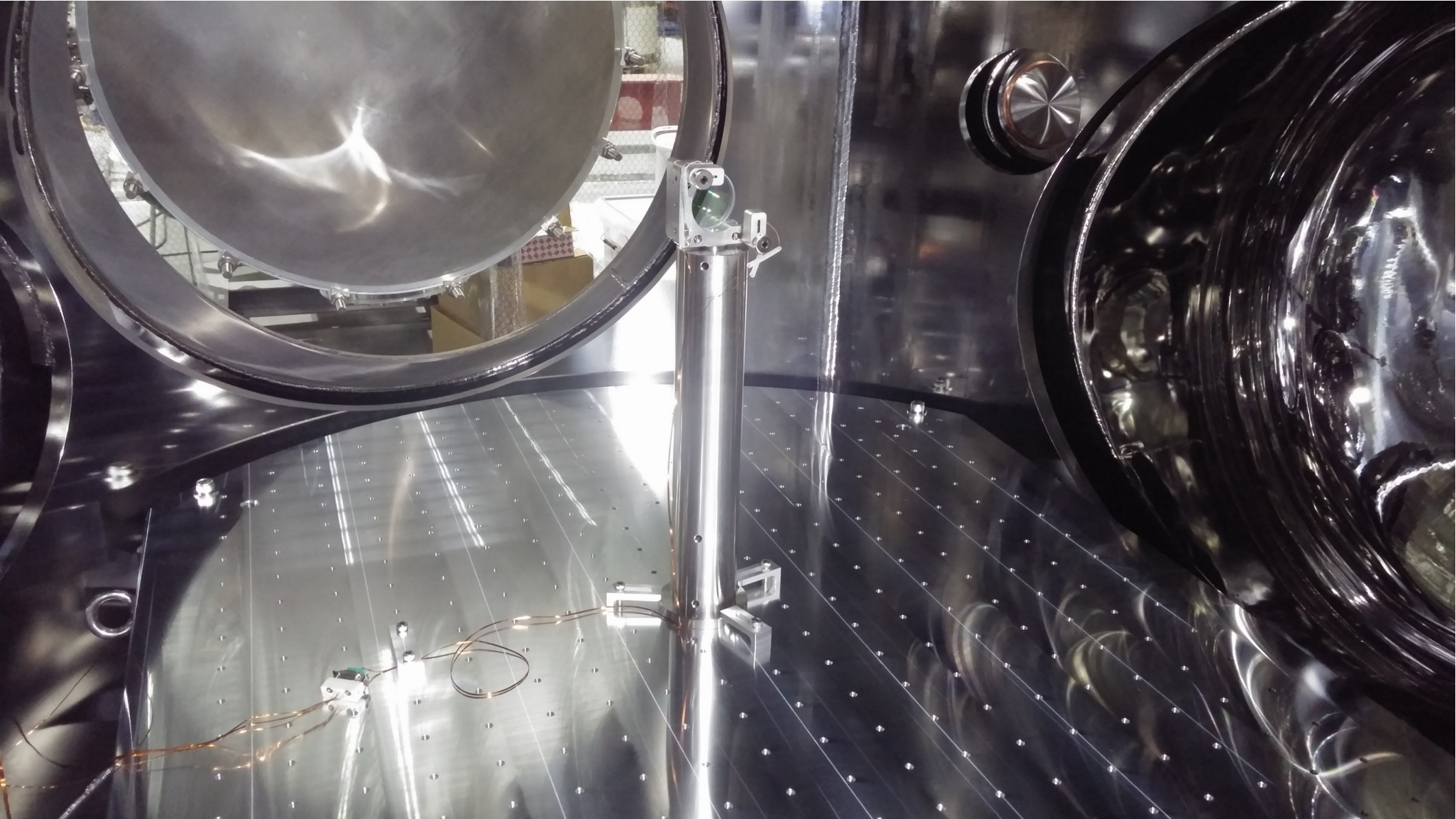
- Small size (2mm height)
- Rough surface finish
- No annealing (!)



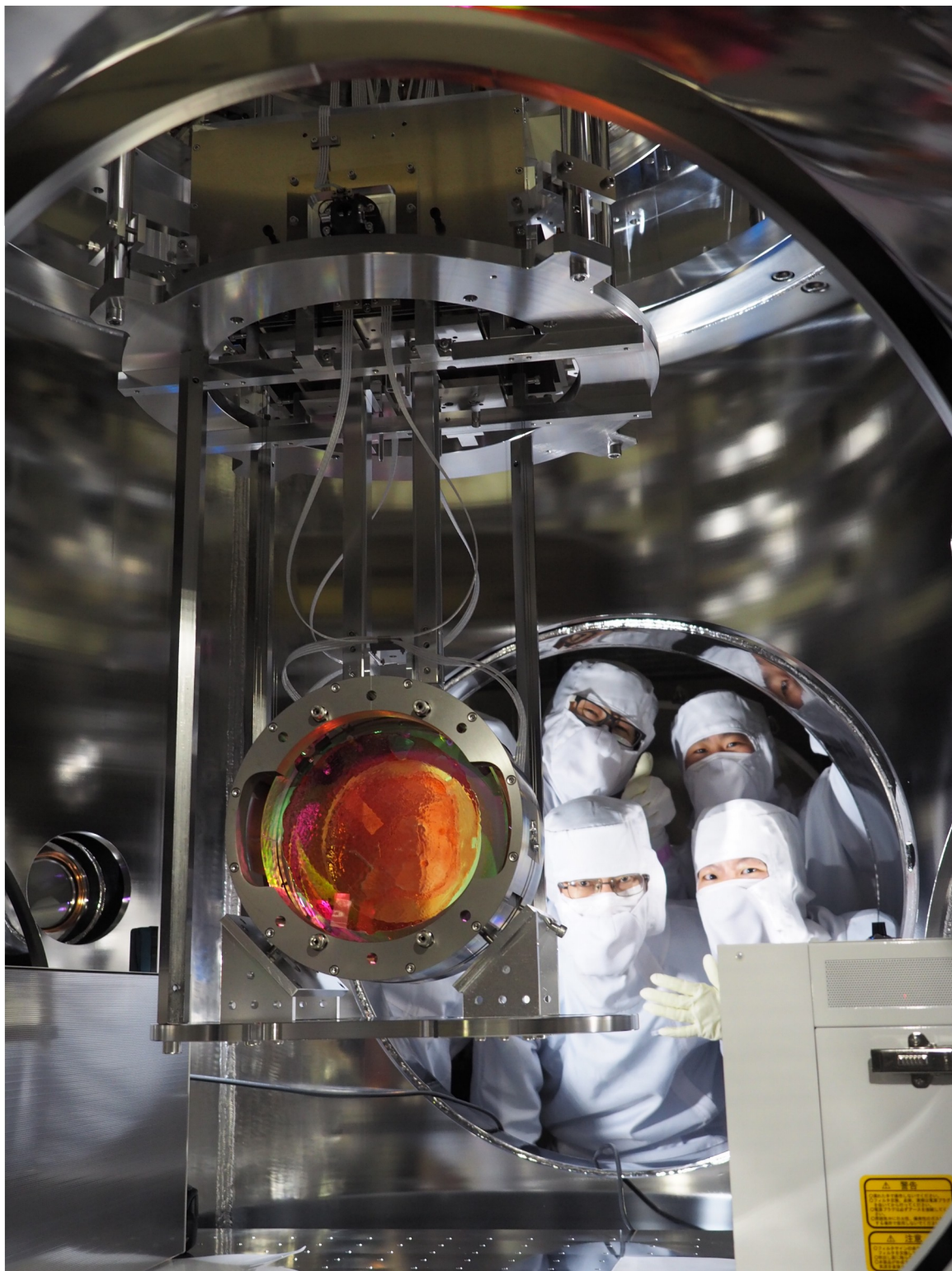
Operation of iKAGRA by the end of 2016 March  
was a strict requirement

We needed to do something about it

# Fixed PR2

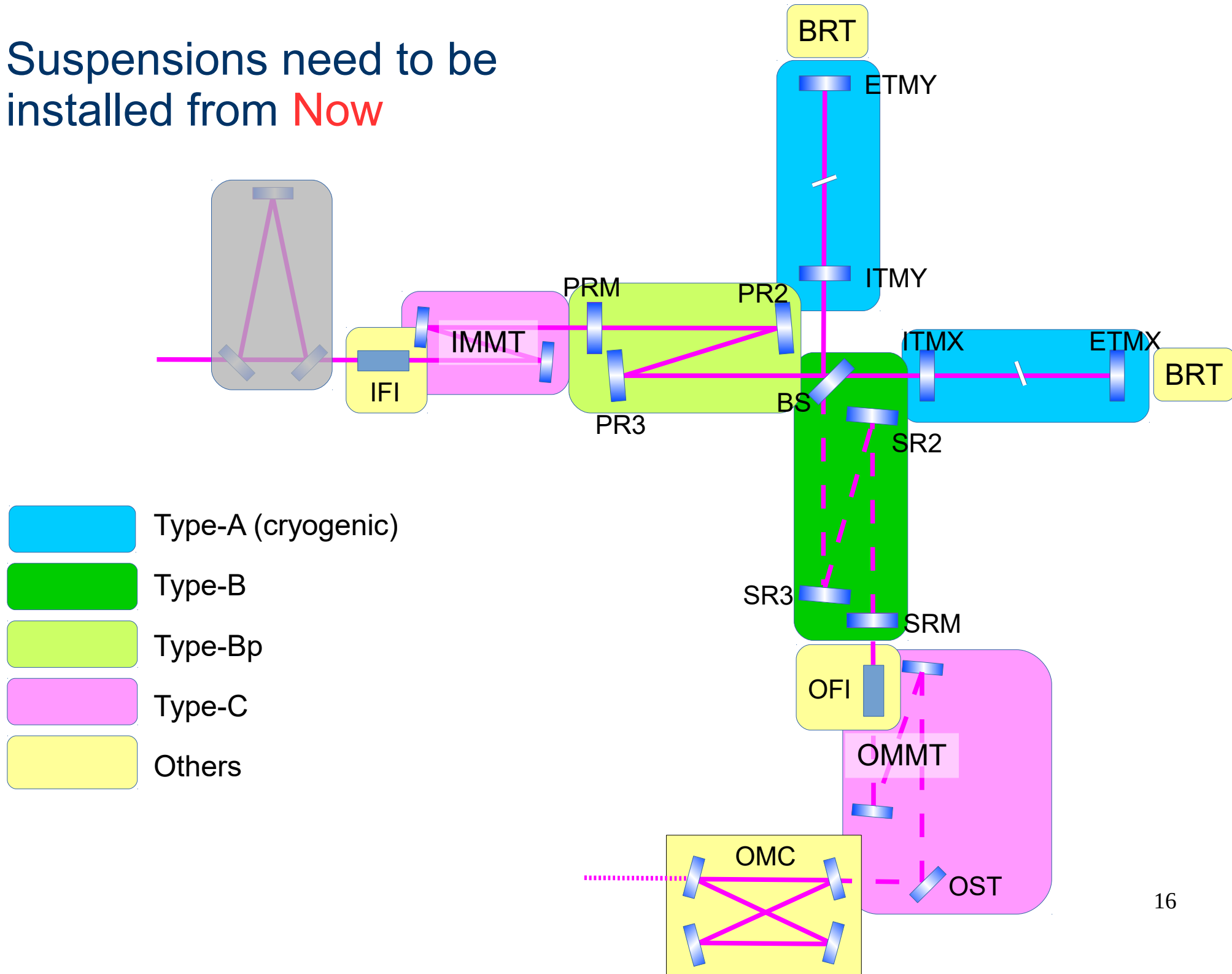






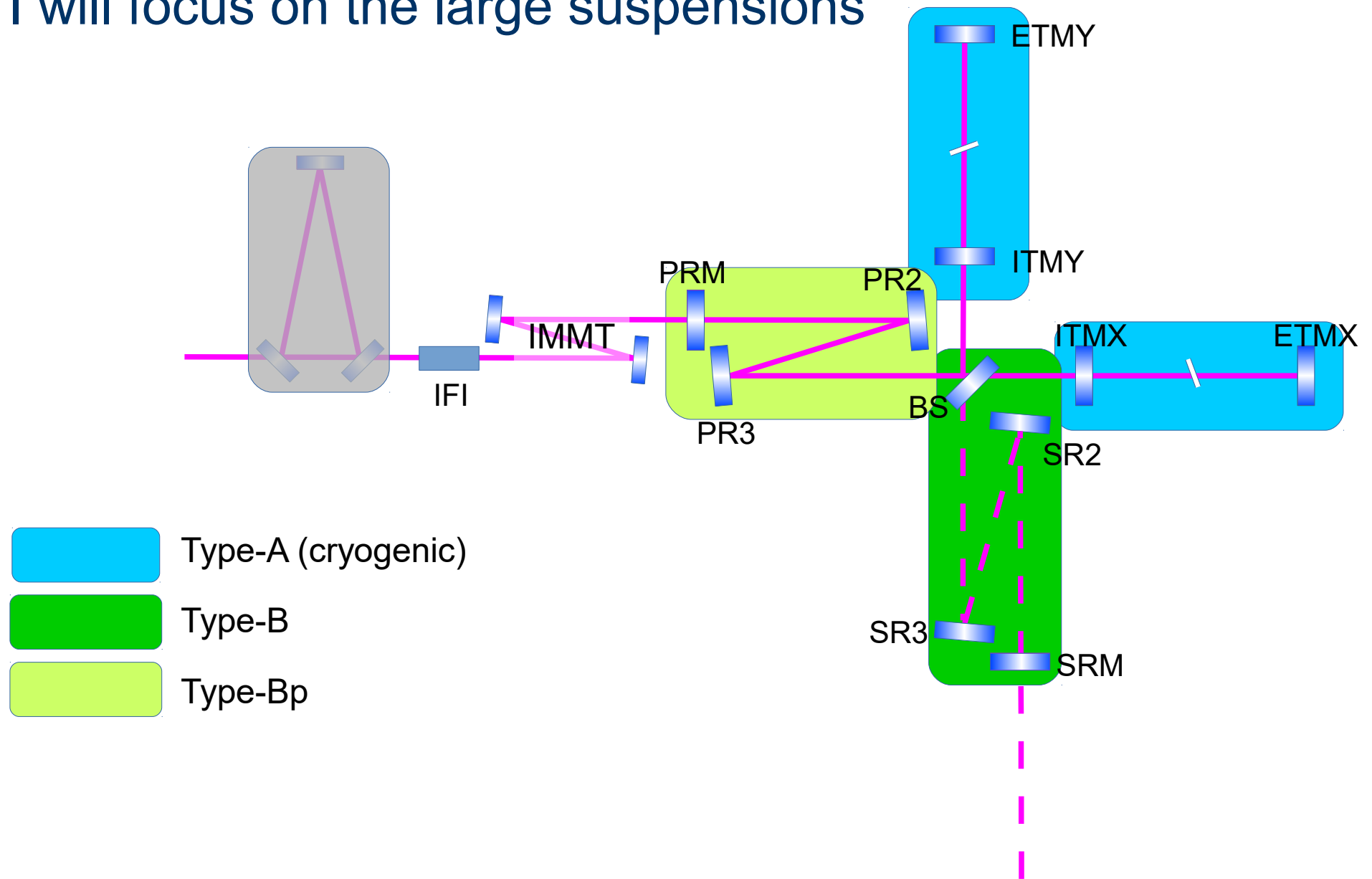
# Plan for bKAGRA

# Suspensions need to be installed from **Now**

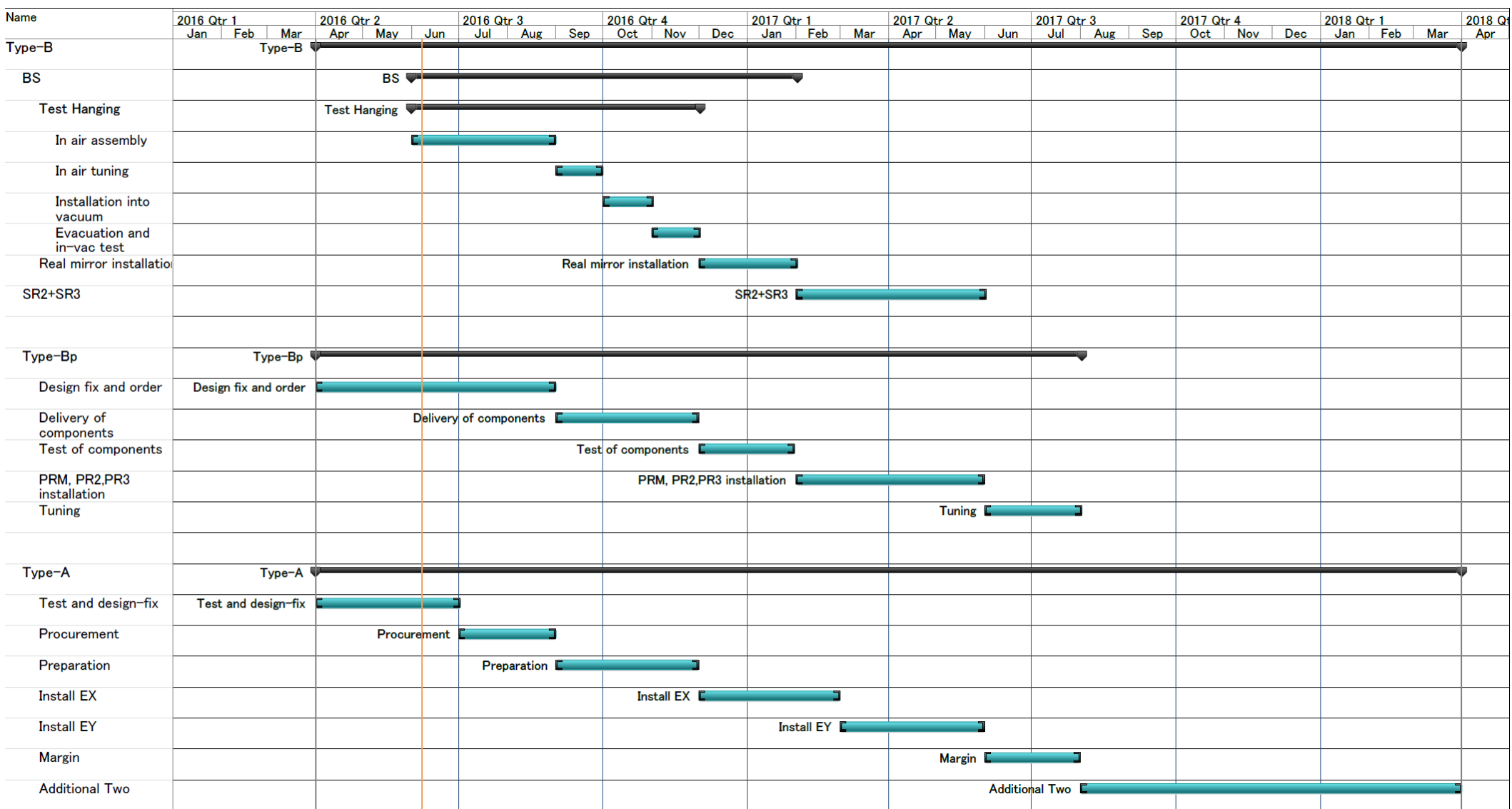




I will focus on the large suspensions



# Overall Schedule



Need to be updated (may take more time ...)

# VIS team organization

## Three teams

Type-A: 1 scientist, 2 engineers, 1 student

Type-B: 2 scientist, 1 engineer

Type-Bp: 1(+1) scientist, 1 student, (1 engineer)

## Preparation status

### Type-A

- Suspension components are mostly ready
- Installation procedure is being tested
- Some local sensors needs to be added
- Installation will start from Dec. 2016

### Type-B

- Most of the components are ready except for two additional payloads
- Installation procedure is being finalized
- Start the test installation from July

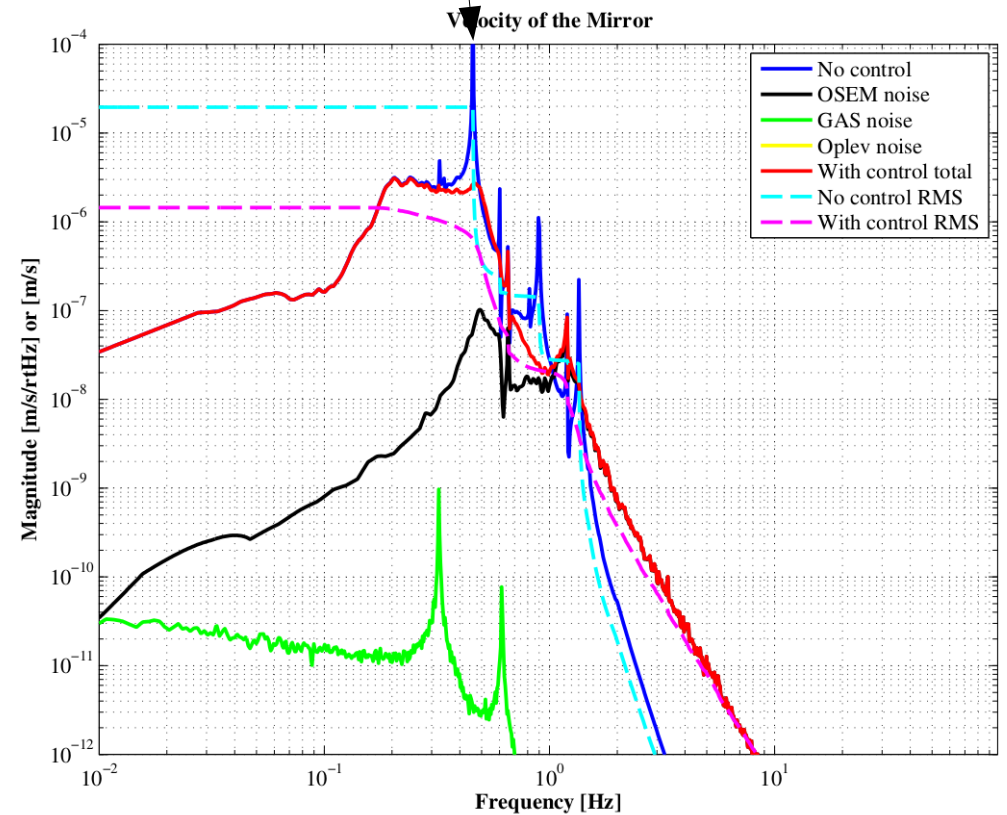
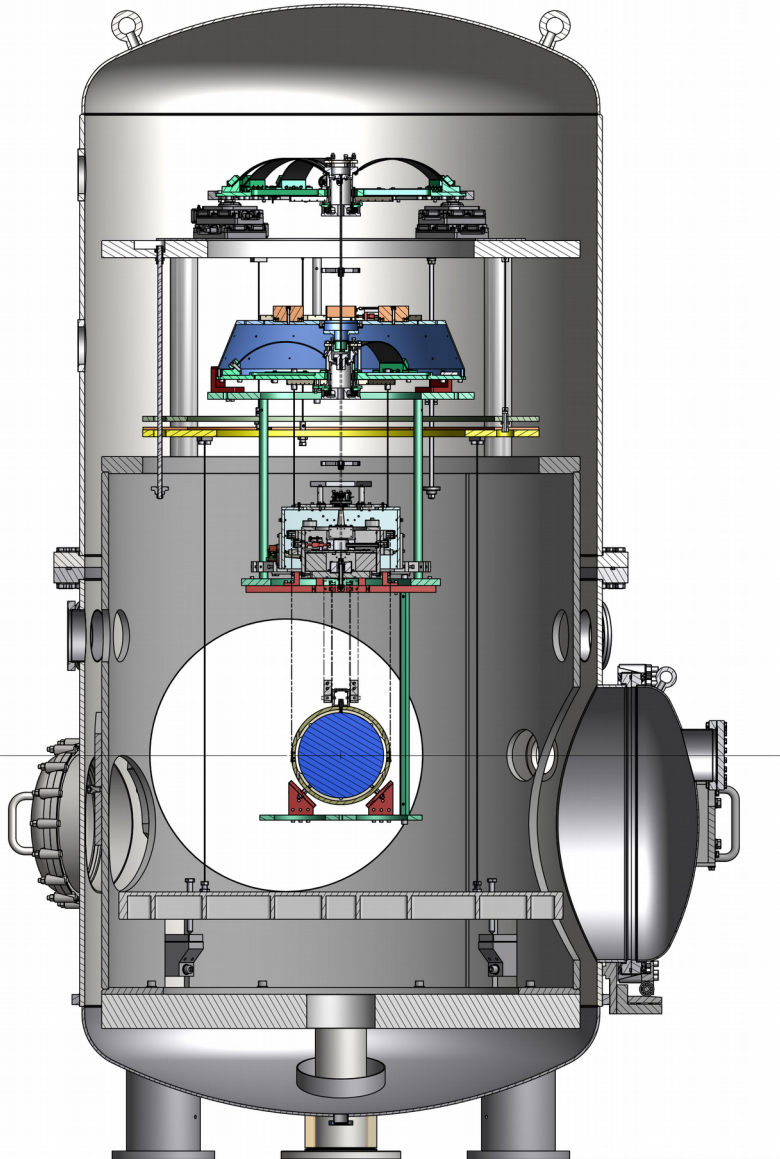
### Type-Bp

- Additional sensors/actuators need to be retrofitted to damp some resonances
- Except for the modifications above, most of the suspension components are ready
- Installation will start from Feb. 2017

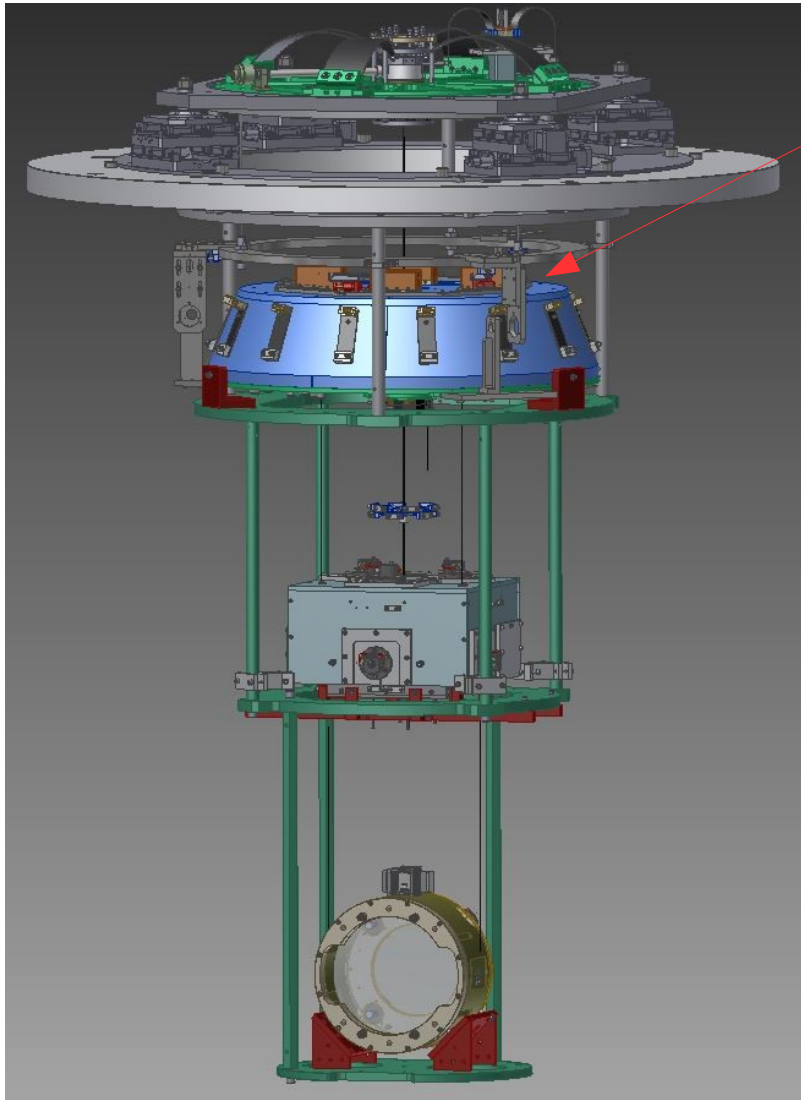
# Technical Issues

# Type-Bp damping issue

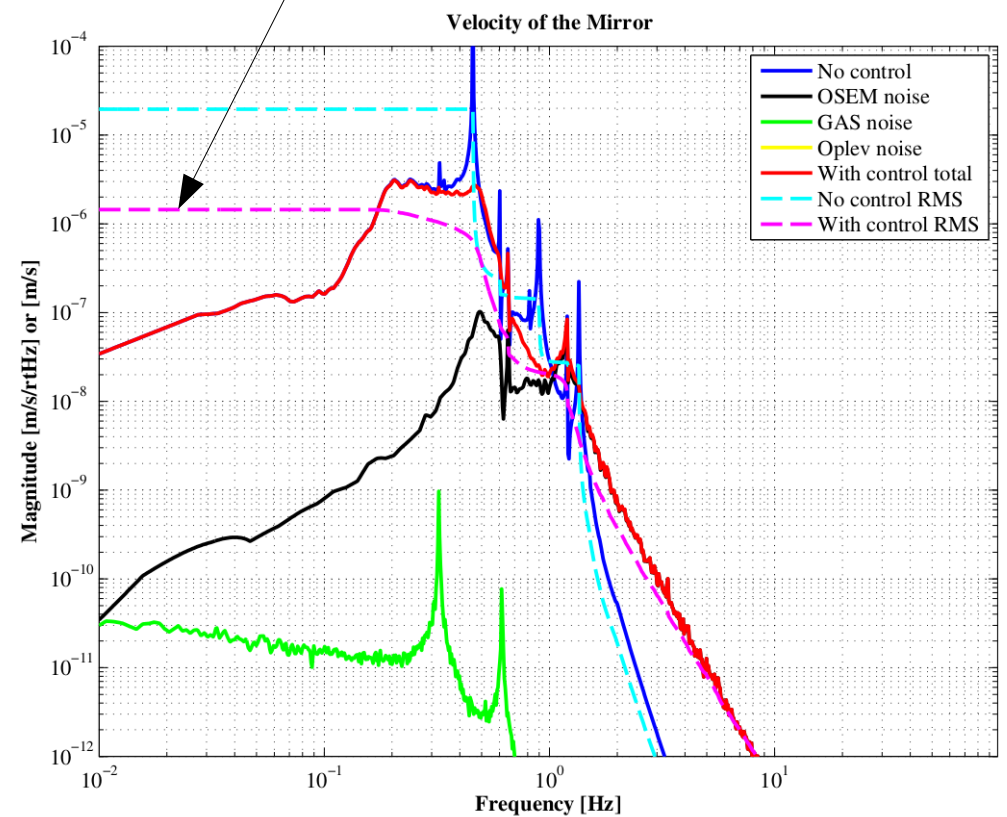
- No inverted pendulum
- A high Q mode survives



# Type-Bp damping issue

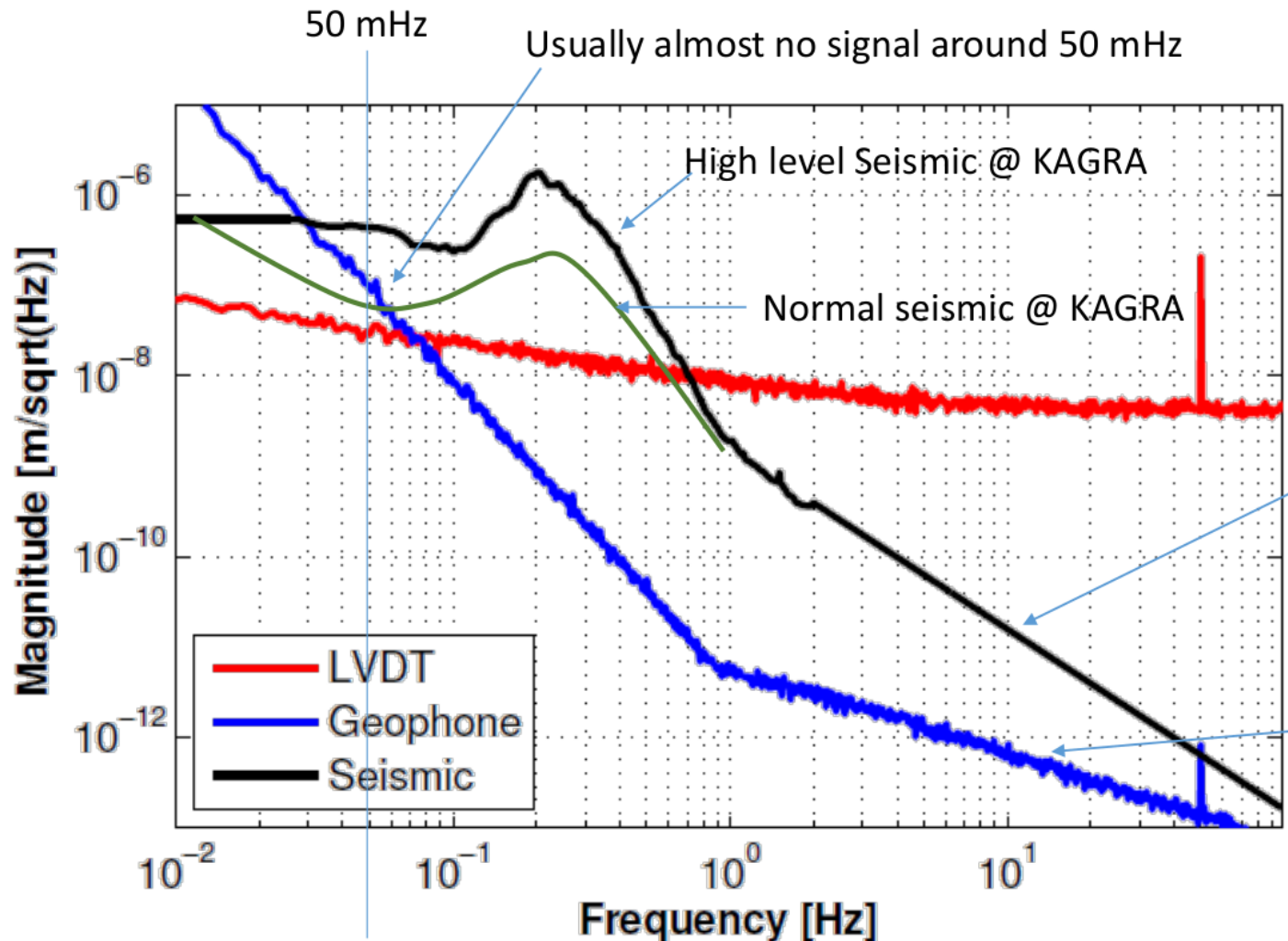


- Additional sensors/actuators
- Active damping on the bottom filter
- Reduced RMS



## Better inertial sensors for the pre-isolators ? (Type-B and Type-A)

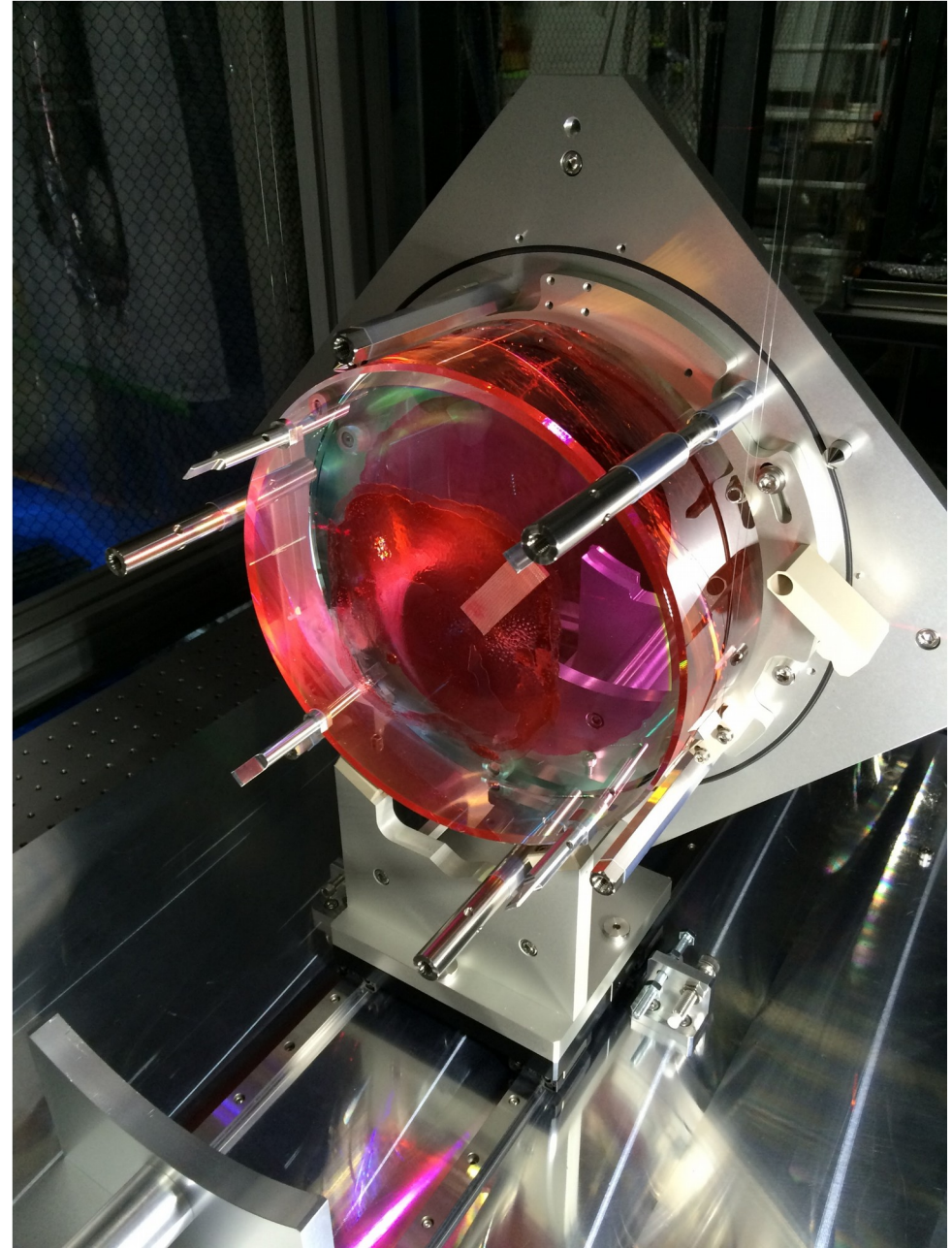
- Original plan: Use Geophones
  - The noise may not be good enough
- Alternative options: Accelerometers (capacitive or LVDT type)
  - TAMA accelerometers (capacitive) for Type-A
  - Sensors for Type-B are under test with BS





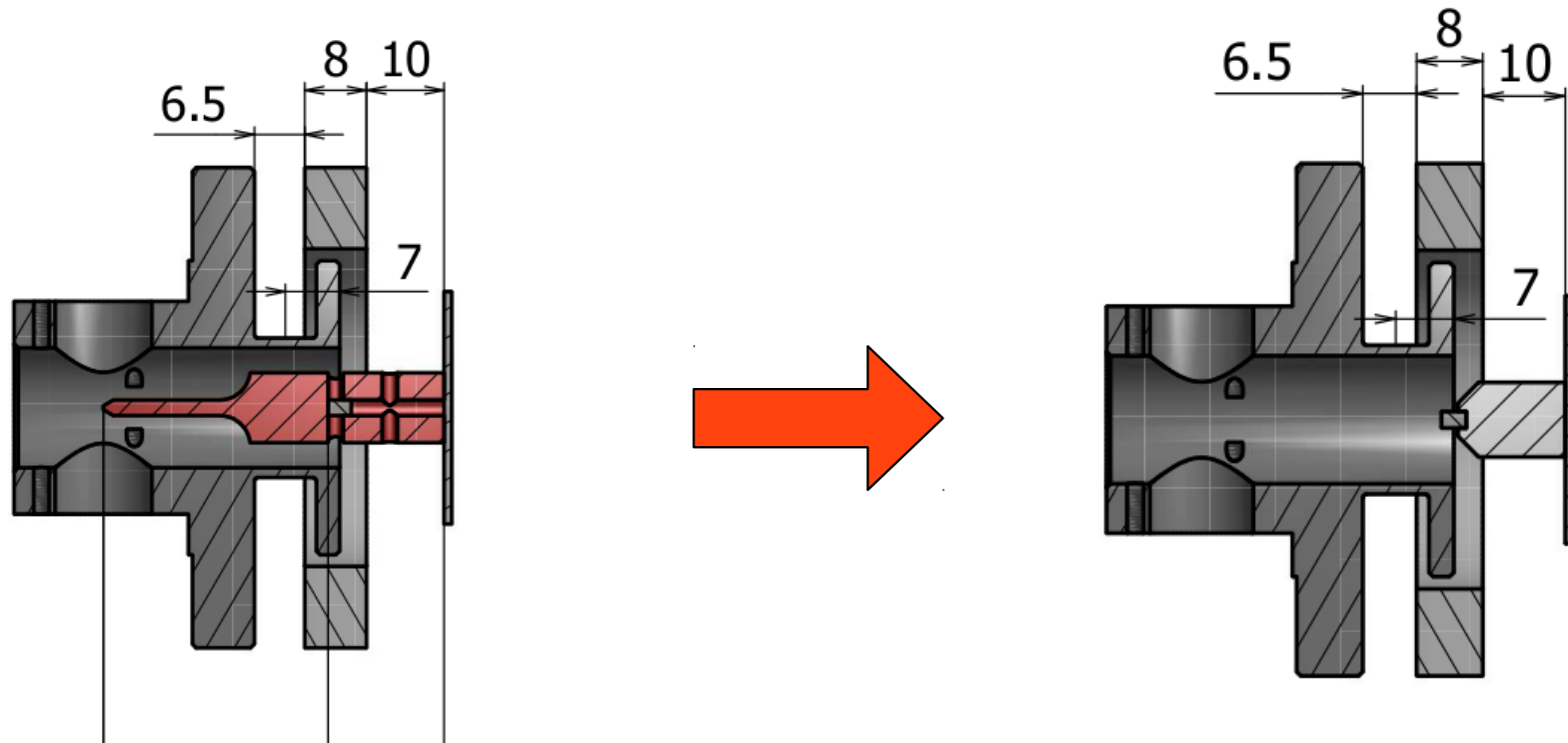
# OSEM flags are huge

- We broke them during the suspension assembly work
- Thermal noise concern  
-> calculation says barely OK



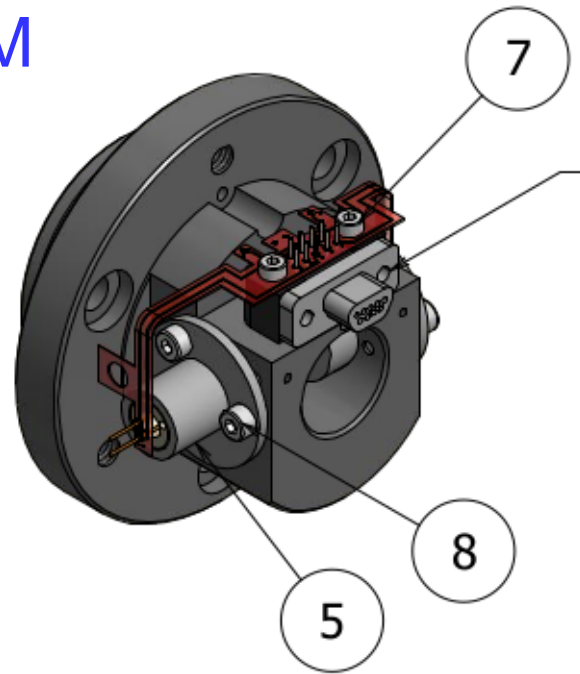


## Decided to remove the flags from the optics

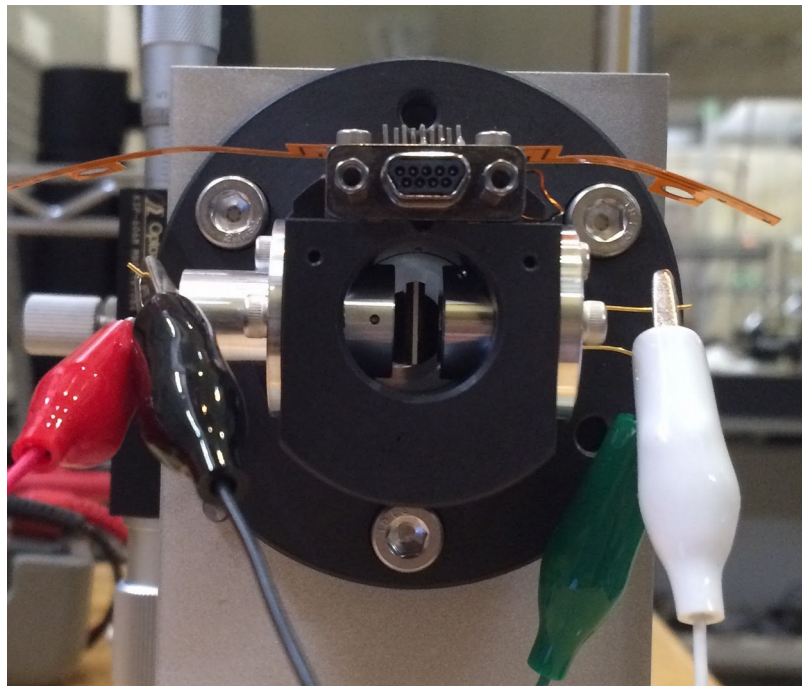


- No sensing. Only actuation.
- Use an optical lever instead
  - Two QPDs at different Gouy phases to sense the longitudinal motion

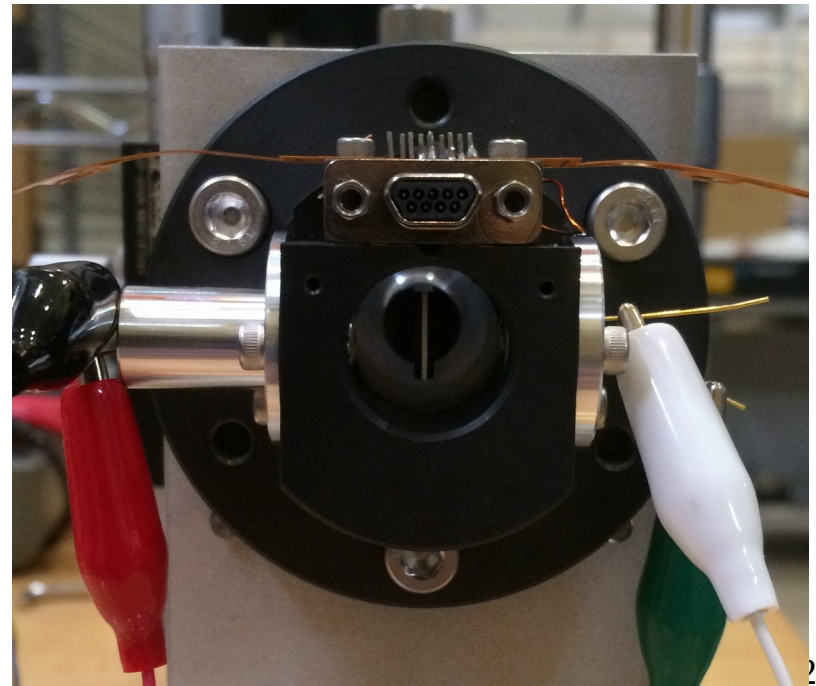
## Wider gap OSEMs for IM



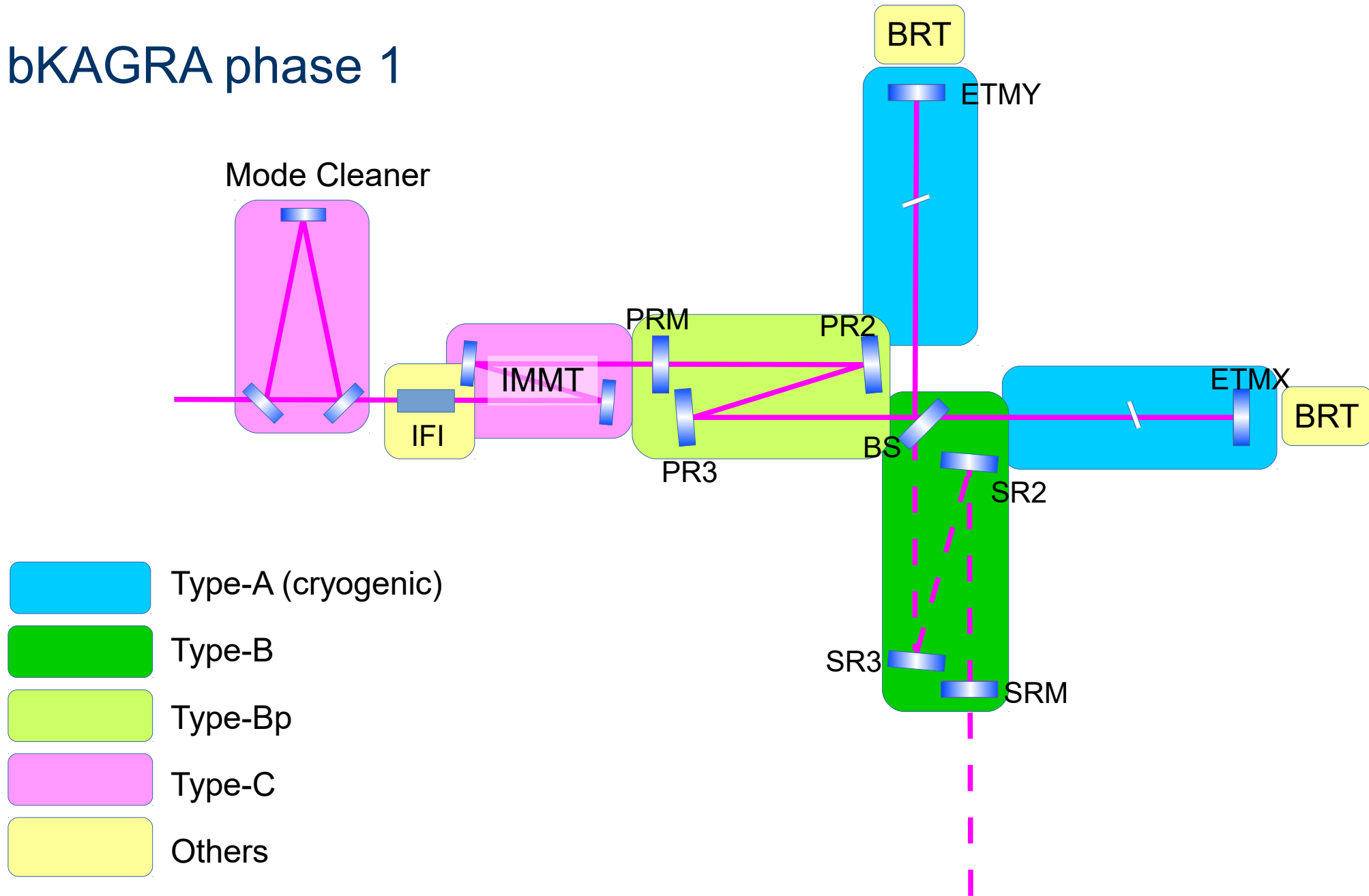
Narrow



Wide



# bKAGRA phase 1



# Before bKAGRA phase 1

