

JGW-G1301896

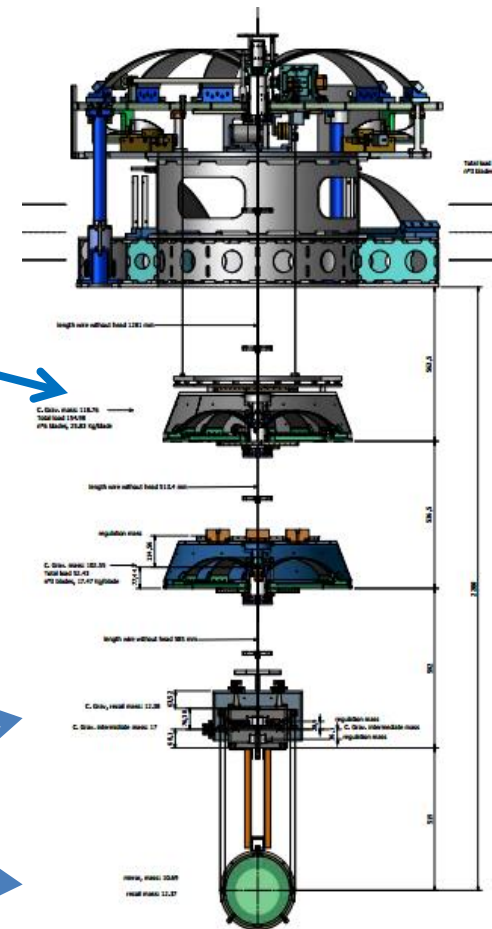
Prototype Test of Vibration Isolation System Current Status & Schedule

ICRR, D2

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Prototype Test of SAS

- **Standard GAS Filter**
@Nikhef & Kashiwa (Jan. 2011~)
- **Pre-Isolator**
@Kashiwa (Aug. 2011~)
- **Payload**
@NAOJ (Aug. 2013~)



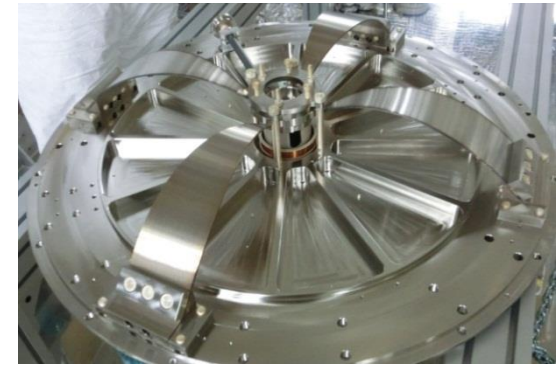
	2011	2012	2013	2014	2015
Standard GAS Filter	■				
Pre-Isolator Mechanics		■			
Pre-Isolator Controls		■	■		
Payload			■	■	
Type-B Full				■	

Current Status

Standard GAS Filter Test

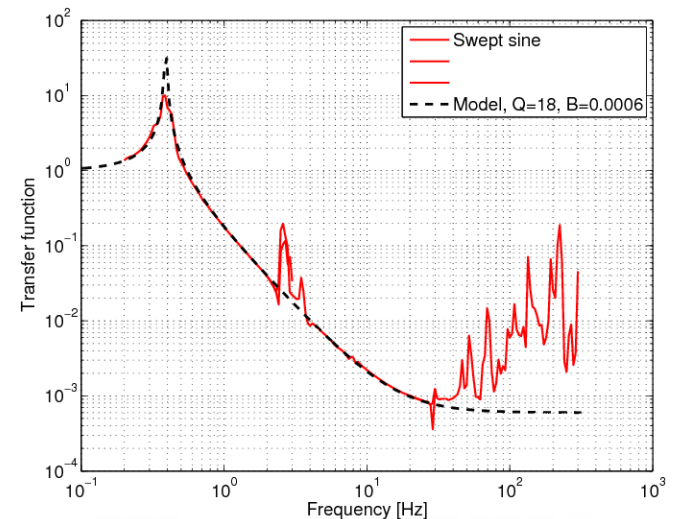
Done at NIKHEF:

- ✓ Tuning of resonant frequencies
- ✓ Measurement of mechanical transfer function



Measurement should be done:

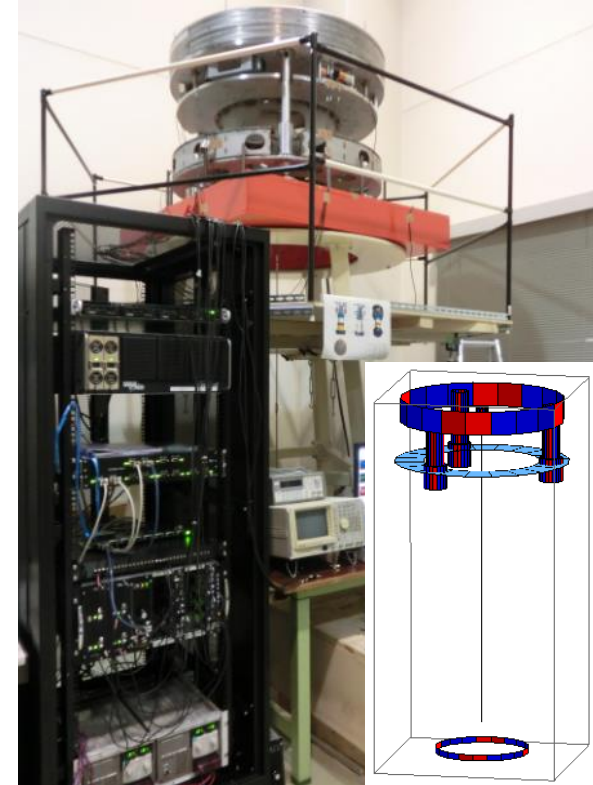
- Tuning of magic wands
(establish the procedure at Kashiwa and apply it to actual equipment in Akeno)



Pre-Isolator Prototype Tests

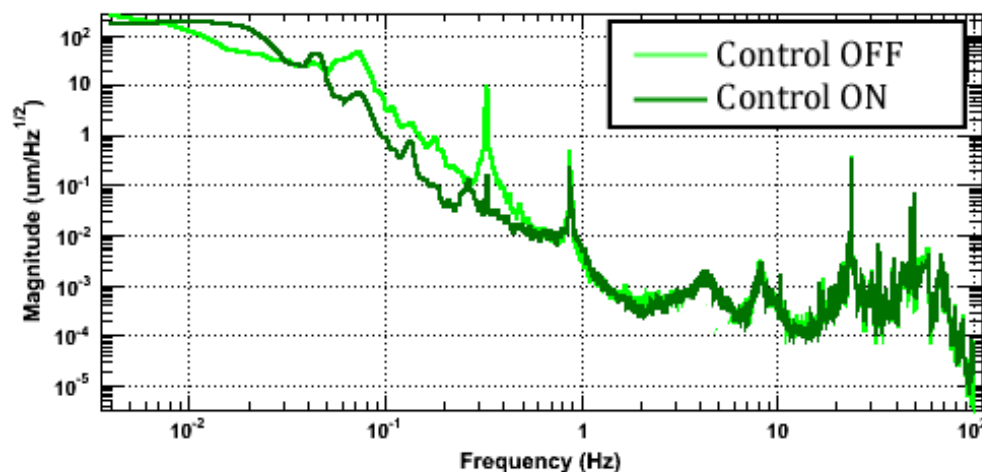
Done at Kashiwa:

- ✓ Tuning of GAS & IP resonant frequencies
- ✓ Digital (standalone) system setup
- ✓ IP control in 3 DoFs with LVDT and geophone
- ✓ DC control of IP with stepper motors



Test should be done:

- ❑ Torsion mode damping



Problems in Pre-isolator Prototypes

❑ Easily broken stepper motor drivers

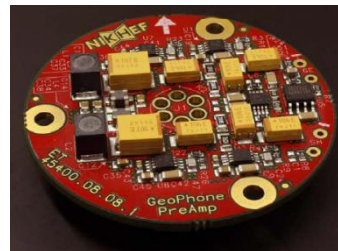
(circuits used in TAMA, manufactured >10 years ago)

→ New driver should be designed soon...

❑ Low frequency (<0.1 Hz) noise of geophone preamp circuits

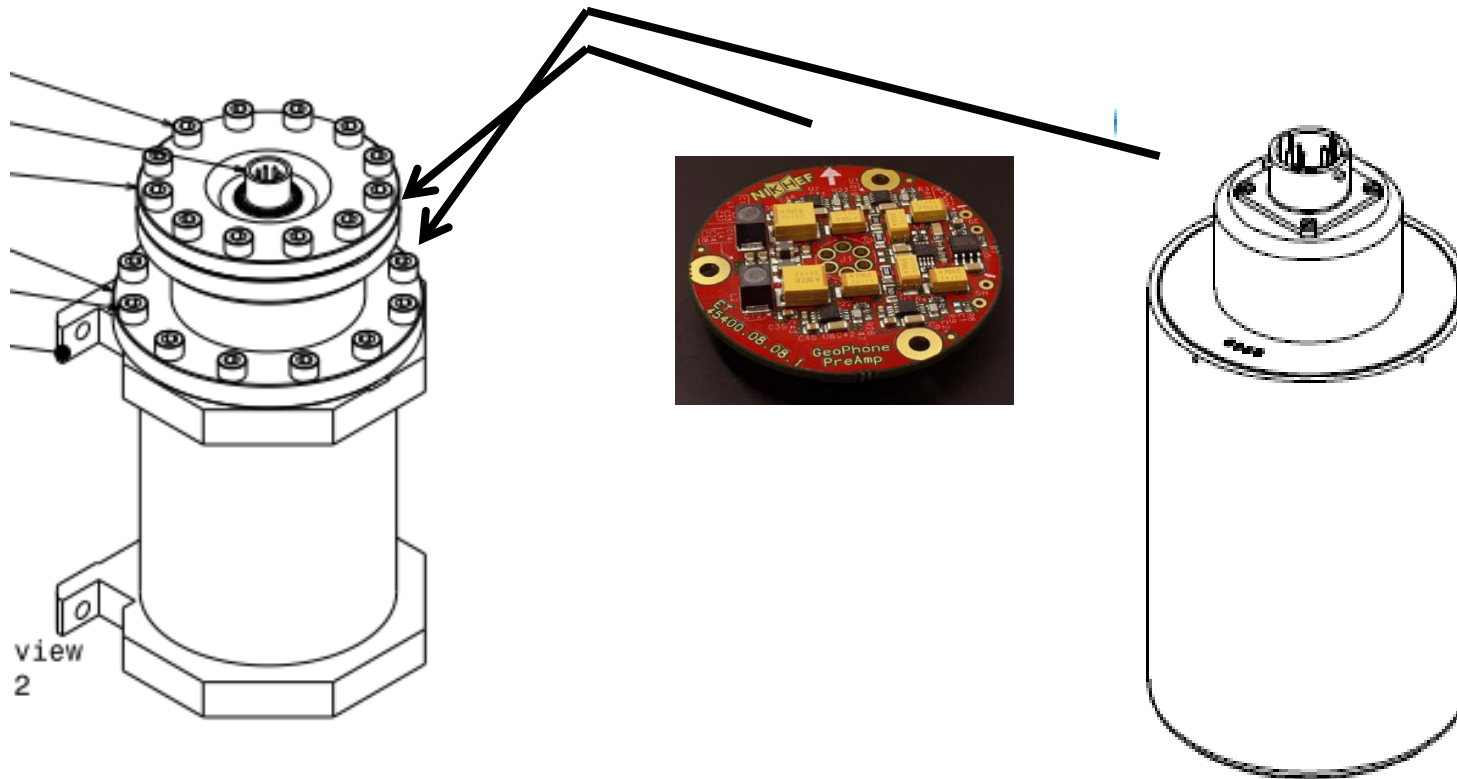
(thermo-electromotive effect coupled with temperature fluctuation)

→ Need temperature stabilization with an envelope



Vacuum Envelope for Geophone

- Preamplifier and geophone are equipped inside



Payload Prototype Tests

Done at NAOJ:

- ✓ Assembly test of TM suspension
- ✓ Order components for OSEM driver

Test should be done:

- ☐ OSEM calibration
- ☐ Assembly of RM, IM, IRM suspension
- ☐ Mechanical TF check
- ☐ Active control with OSEM

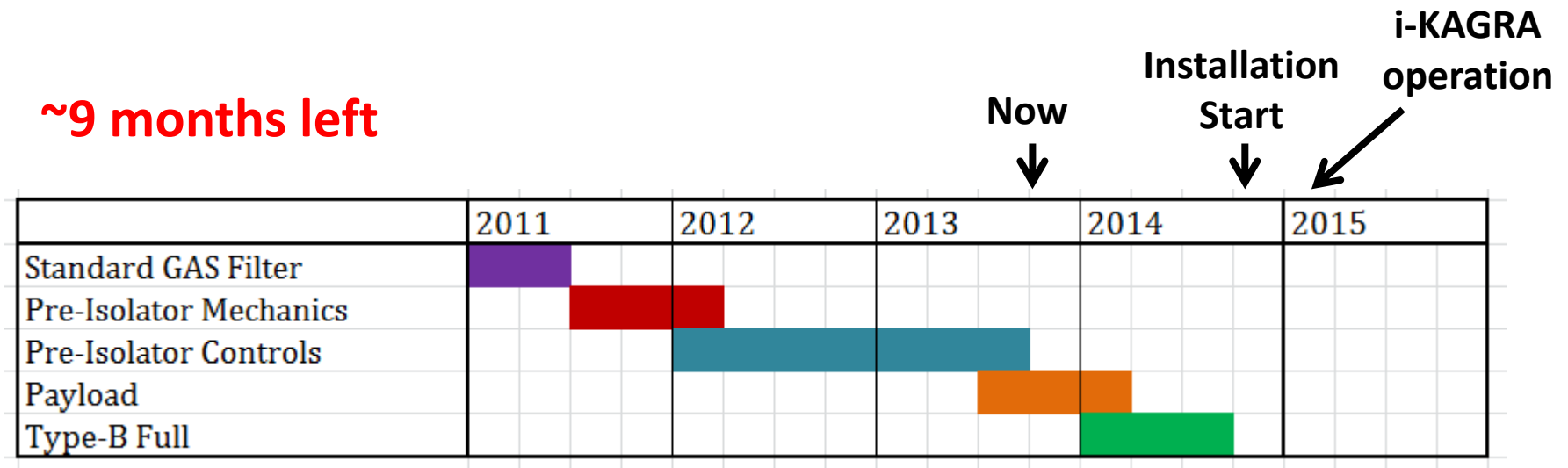


Test Plan for Full Type-B Prototype

Important Schedule

- Pre-isolator and its control system will be delivered to NAOJ this month. (on 10/22-23)
- Installation of the actual vibration isolation system for i-KAGRA will start in the middle of FSY 2014 (~ Oct. 2014).

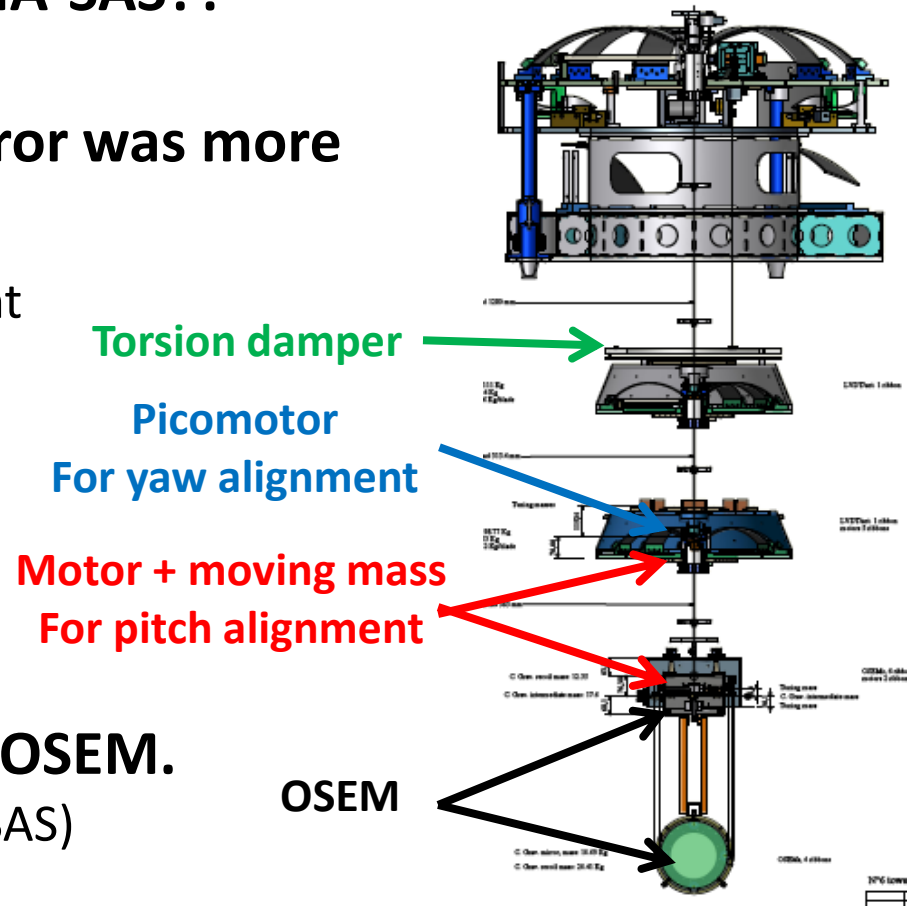
~9 months left



What We Learned from TAMA-SAS ??

& What is New from TAMA-SAS??

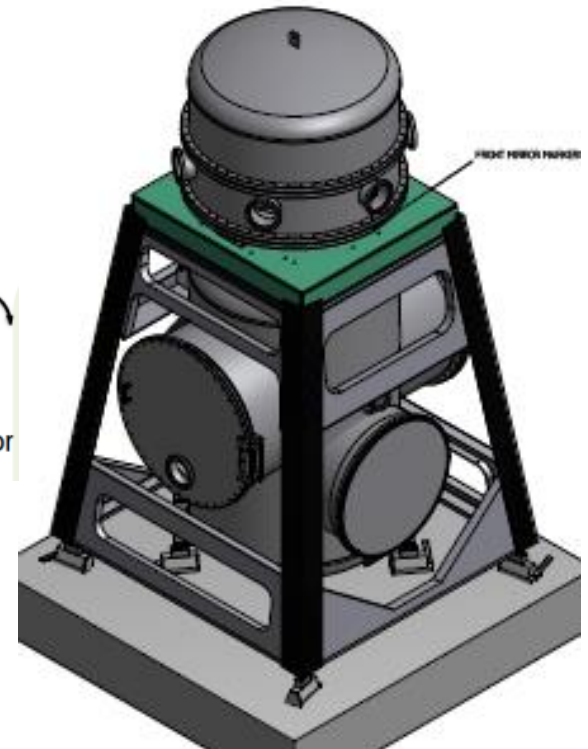
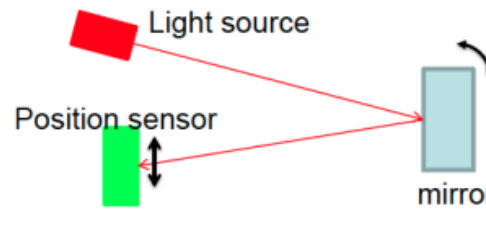
- **Angular fluctuation of the mirror was more critical in TAMA.**
 - Need tools to adjust DC alignment
 - Need dampers for torsion modes
 - Effect from electrical cabling
- **Actively controlled stage with OSEM.**
(c.f. eddy current damping in TAMA-SAS)
 - More flexibility, more complexity



We should spend much time for testing these items.

Main Action Item for Full Type-B Test

- Measure angular fluctuation of the mirror with an optical lever.
 - Check DC alignment adjustment
 - Check efficiency of torsion mode damping
 - Establish control scheme with OSEMs

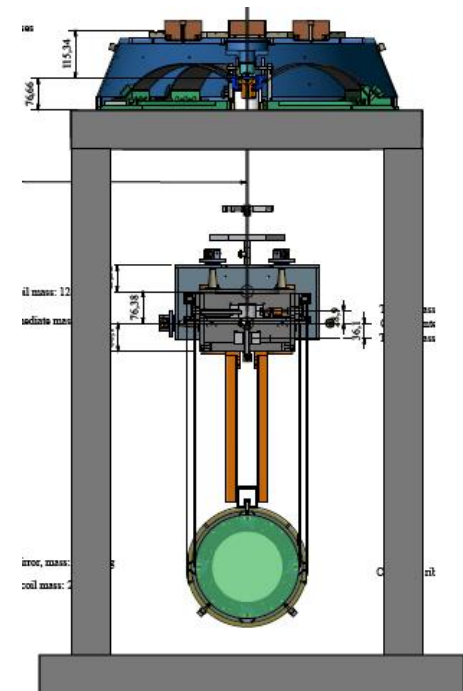


- Length sensing: Michelson interferometer from ground?? (TBD)

Action Items (1)

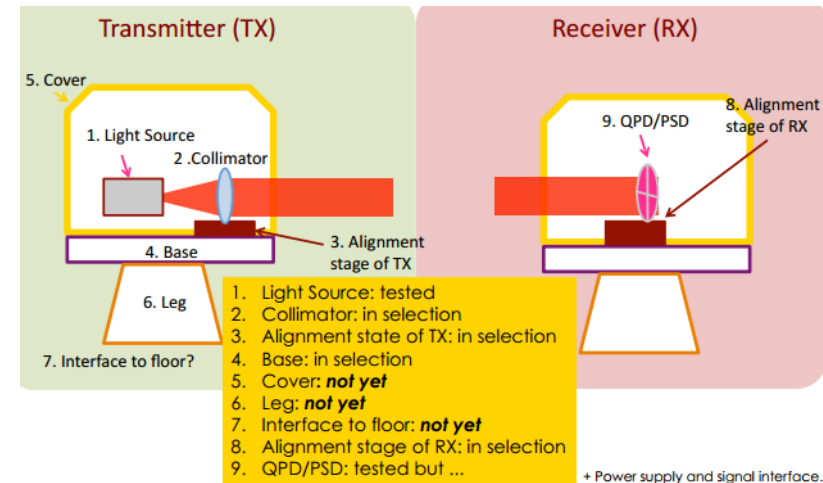
- **Payload Test @20m Lab, NAOJ**

- Tuning bottom GAS filter
- OSEM test & calibration
- Check motors for mirror alignment
- Check mechanical transfer functions with OSEMs
- Control test with OSEMs



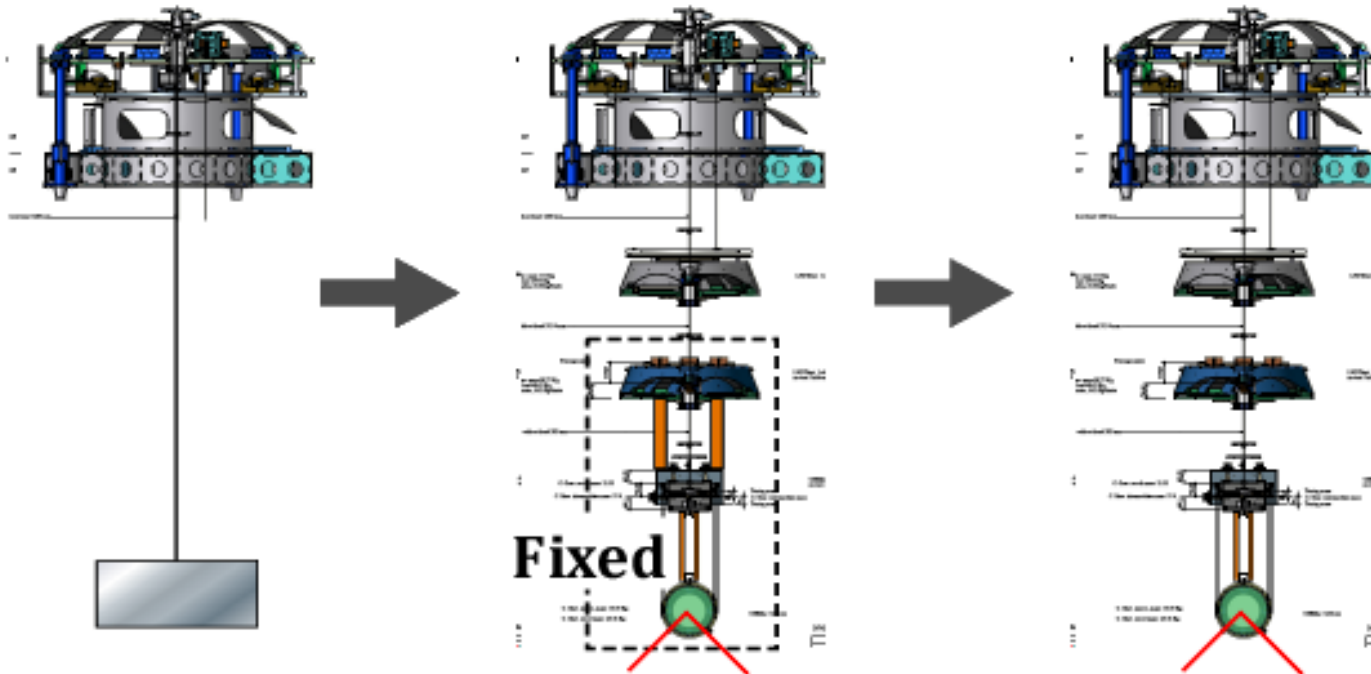
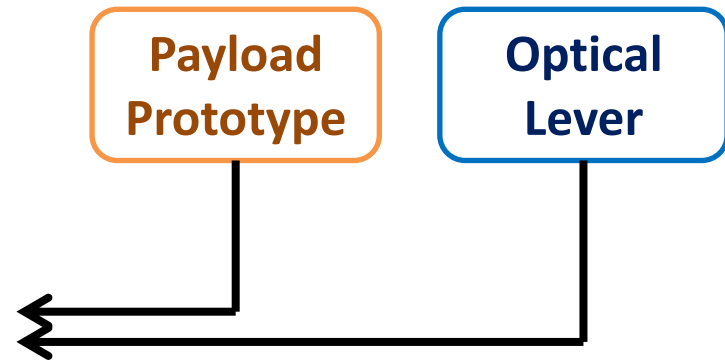
- **Optical Lever Setup @TAMA**

- Designing holders and covers for light source & detector
- Check commercial electric circuit for PSD
- Measure noise level



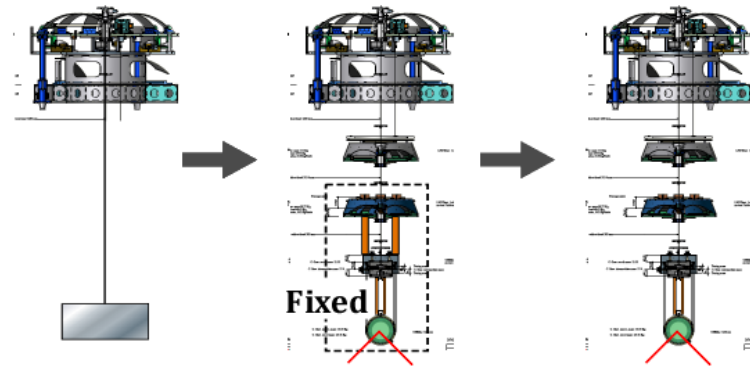
Steps for Type-B Test

1. Pre-isolator Test in Vacuum
2. Full Type-B with Fixed Payload
3. Full Type-B Test



Action Items (2)

- **Pre-isolator Test in Vacuum @TAMA**
 - Re-setup of digital control system
 - Compared with the result of in-air experiment
- **Full Type-B with Fixed Payload @TAMA**
 - Torsion mode damping test
 - Check cabling effects
 - Optical lever working test
- **Full Type-B Test @TAMA**
 - Mechanical TF check with equipped sensors and actuators
 - Apply full control, check DC alignment adjustment



Schedule

- 2013: payload test + sensor preparation
- 2014: Type-B test utilizing TAMA facility

Agatsuma & Joris join from NIKHEF

		Person	Site	2013			2014									
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Moving	Moving Preisolator	ryu, seki	K->NAOJ													
Filter 1	Standard filter magic wand tuning	ono,seki	ICRR													
Frame	Outer Frame modal analysis	Lundock	20m													
OSEM	OSEM test & calibration	fab,seki	20m													
Payload	Payload prototype test	seki	20m													
Op Lev	Optical lever setup & test	aga,seki	TAMA													
Vacuum	Vacuum test	ryu	TAMA													
Preisolator	Preisolator mechanical setup		TAMA													
	Control test in vacuum		TAMA													
Fixed Pay	Installation, cabling		TAMA													
	Torsion damping test		TAMA													
Full Test	Release payload		TAMA													
	Full system test		TAMA													

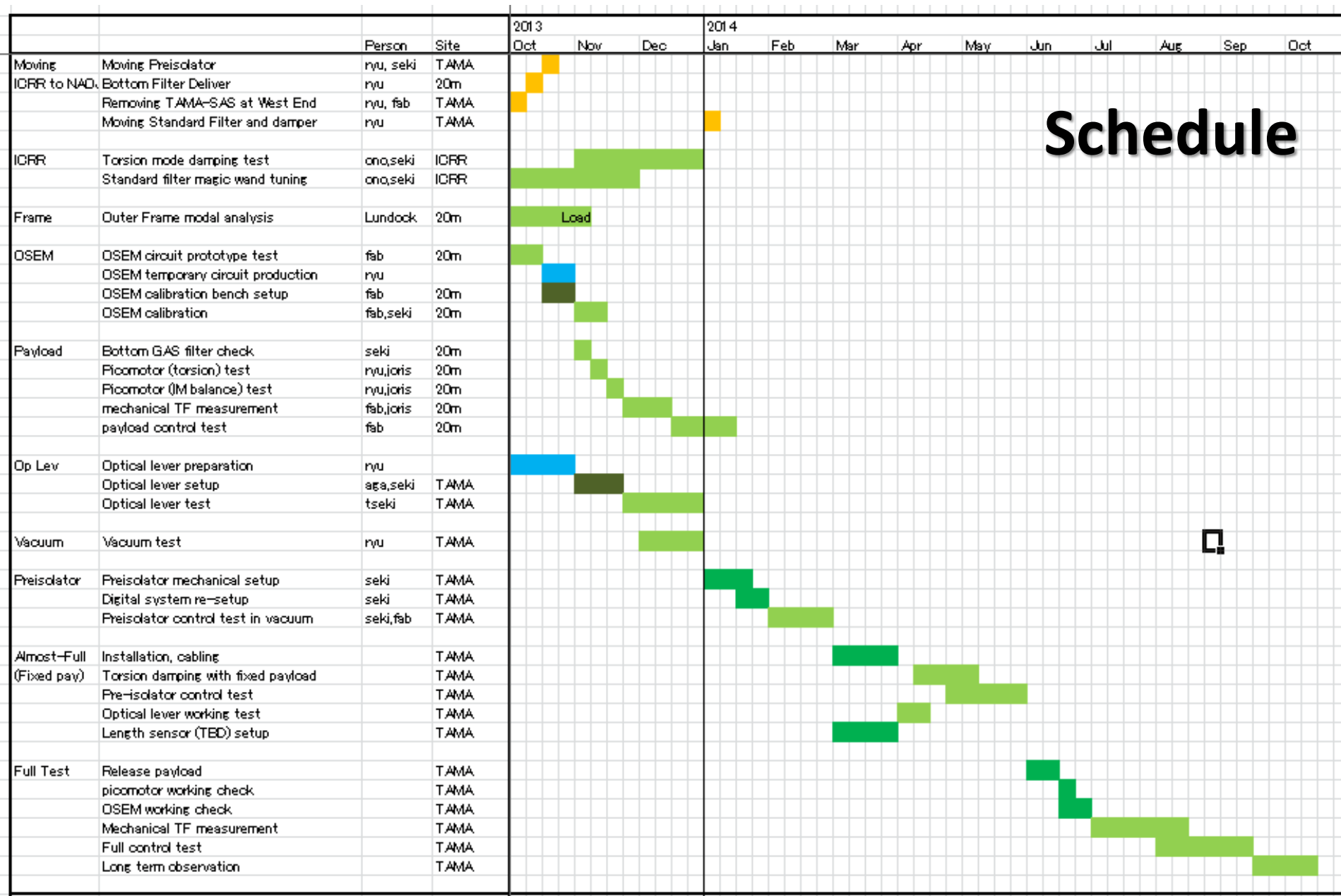
Urgent Tasks

- **OSEM electronic circuit check & OSEM calibration bench setup (~ Oct. 2013)**
- **Design/purchase accessories for optical lever (~ Oct. 2013)**
- **Design stepper motor driver circuit (prototype test: ~Jan. 2014)**

END

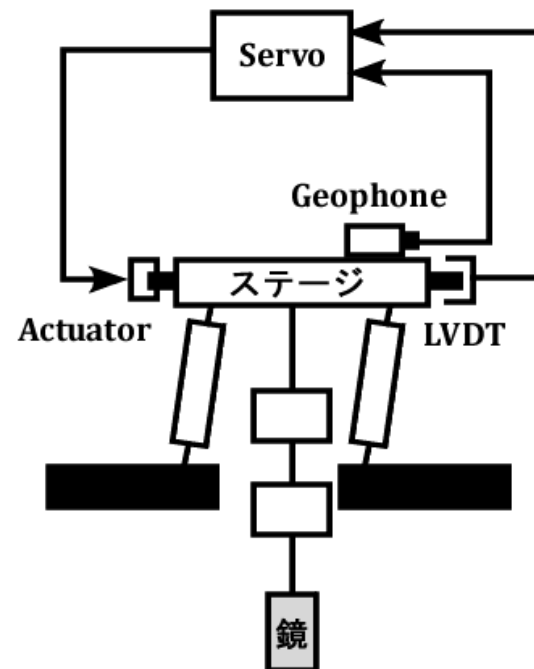
Appendix

Schedule



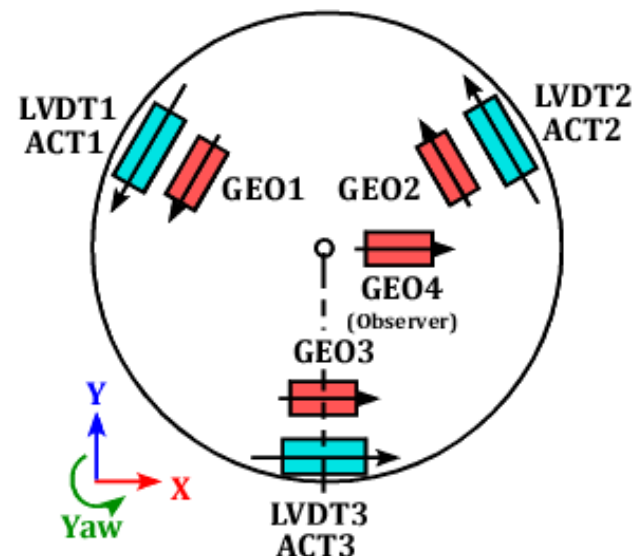
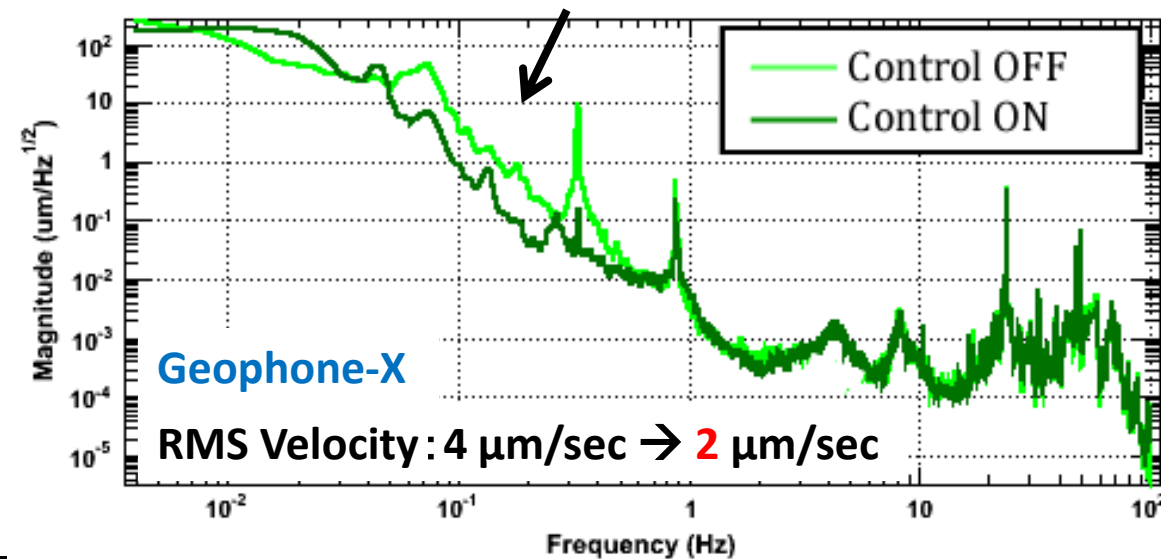
IP Control Test

- 3-DoF motion of the top stage is stabilized with displacement sensor (LVDT) and seismometer (geophone L-4C).



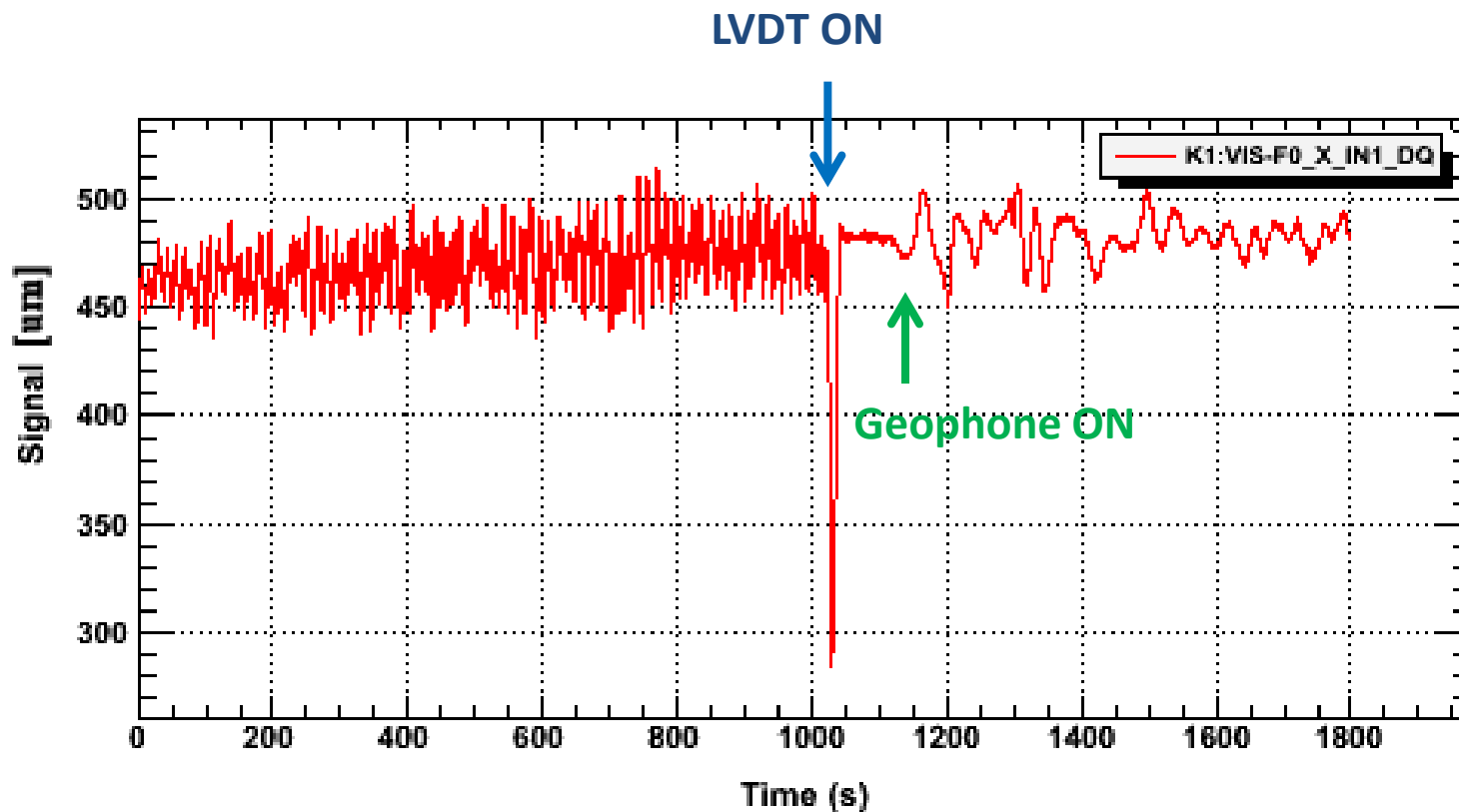
Larger fluctuation below 0.1 Hz

Active isolation, damping



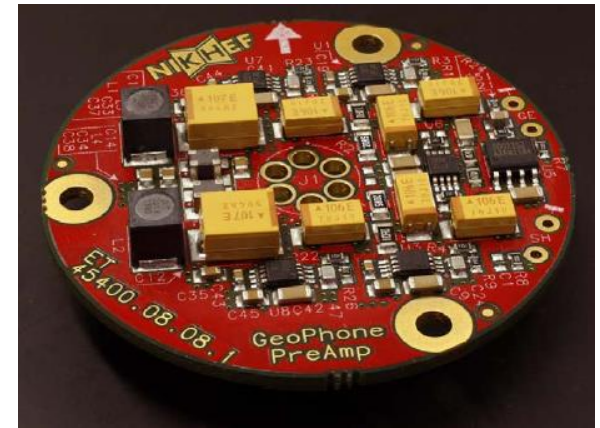
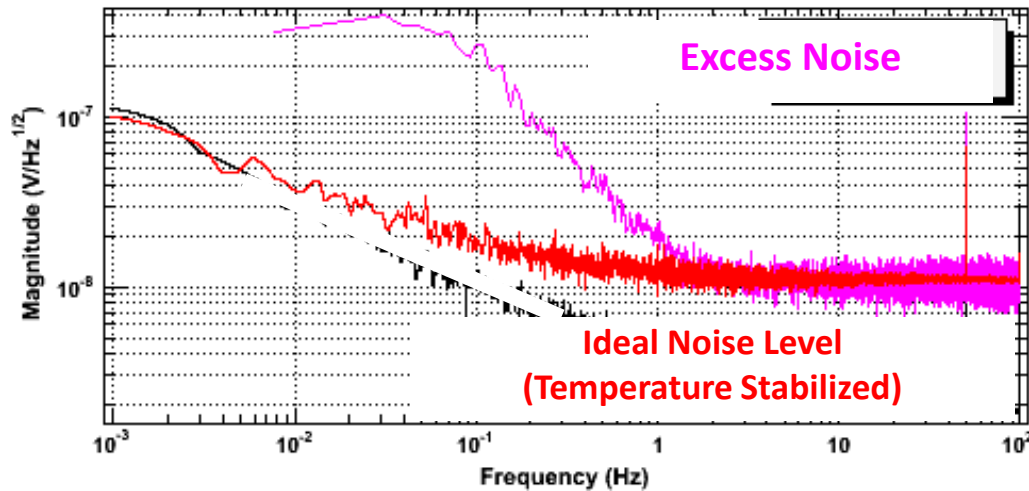
IP Control Test

- 3-DoF motion of the top stage is stabilized with displacement sensor (LVDT) and seismometer (geophone L-4C).



Problems in Pre-isolator Prototypes

- Excess control noise at low frequency (<0.1 Hz) due to electronic noise in geophone preamp circuits



- Possible source: thermoelectromotive effect coupled with temperature fluctuation of the circuit/geophone