KAGRA cryogenic payload meeting

19th of Novermber 2013 (Tue) 13:00-16:00
301, Second Research Complex, Kashiwa campus

Attendees: Chen, Hirose, Ishizaki, Koike, Sakakibara, Sekiguchi, Suzuki, Tokoku, Yamamoto
SeeVogh: Ushiba

0. Organization of this meeting

(1)"Reporter" reports the current status and concerns (items whose deadline is close or strategy is not clear and so on).
(2)Today meeting is too long. So, current status report should be short. Daily communication is recommended and only the topic which must be considered by all is discussed.

1.Current status report

An important comment from Eiichi; **"Backup plan" for the worst case must be considered.**

(1-1). Overall design (Hirose)

Important or urgent items

(a)Takanori reported the progress of simulation with local control.He and Eiichi will visit Stanford on the beginning of December to investigate how to optimize the control system (lock acquisition and stable control).

A/I

(a)Takanori or Eiichi ask somebody in LIGO details of the circuit for OSEM.
(b)3 dimention design drawing of Type A is necessary (as soon as possible !): Ryutaro will ask Gianni.

Details

(a)Takanori reported the progress of simulation with local control.(viscous damping on filter 1 and between imtermediate mass and its recoil mass by OSME) Q with damping is also calculated. In almost case, the decay time is shorter than 1 minute, but those of two modes are longer. He is investigating what modes they are.

(b)OSEM noise: Dan asked Takanori. It can be derived from Takanori's simulation. Important point; In adLIGO, OSEM is on only top stage of payload. On the contrary in KAGRA, OSEM is on the intermediate mass. The noise requirement could be serious. The OSEM noise below 0.2 Hz is larger.

(c)The weight for GAS filter: Error should be on the order of kg. Some small masses are necessary to adjust weight.

(1-2). Vertical spring (blade metal spring) (Ishizaki)

Important or urgent items

(a)Although Ishizaki-san explained, Ryutaro will report from the next meeting.
(b)This blade spring will be tested in 1/4 cryostat of Kashiwa.
(c)Manufacture: Probably, Saito-shoten (anyway, outside NAOJ) ?
(d)Material is BeCu.

A/I

(a)The schdule and strategy and so on will be summarized by Ishizaki-san, Ryutaro, Takanori
and Kazuhiro and reported in the next meeting.

Details

(a)Does it take to adjust the spring at room temperature 1 month ? It takes

long time for 1/4 cryostat experiment.

(b)Although there is no drastic progress of material candidate list, we decided the material is BeCu (at least, in CLIO, BeCu vertical springs survive and high Q at cryogenic temperature was reported in refereed journal). If possible, we check other material.

(c)This is other topic, sapphire blade spring. Takanori pointed out that resonant frequency can be 7 Hz when the strength is 100 MPa. According to report from Glasgow, it is 260MPa at least.

(1-3)Material (Suzuki)

Important or urgent items

(a)Mass (Recoil Mass, Intermediate Mass, Intermediate Recoil Mass, Platform) :
Tokoku-san is collecting the information for candidate list. Two kinds of material are necessary; high density material and high electric resistance material. Eddy current damping should be checked. -> A/I

(b)Wire between room and low temperature :
Since it is 4m in length, manufacture and installation are issues.

(c)Wire to suspend Recoil Mass, Intermediate Mass, Intermediate Recoil Mass :
Strength test was reported. Those values of BeCu and W(tungsten) are about 1GPa. Since W has low temperature brittleness, BeCu is better.

A/I

(a)Mass (Recoil Mass, Intermediate Mass, Intermediate Recoil Mass, Platform)
Evaluation of eddy current damping is necessary.
Kazuhiro will ask
(1)Eric Hennes how much he can make his effort for this problem and

whether he can provide files for Finite Element Analysis.
(2)Masaki or Yoichi whether Nishi-kun's file for eddy current damping still remains.

Details

(a)Mass (Recoil Mass, Intermediate Mass, Intermediate Recoil Mass, Platform) :
Tokoku-san is collecting the information for candidate list. Two kinds of material are necessary; high density (at least, 4 g/cc, maybe 8g/cc. If its electric resistance is about 10^(-6)ohm m (about 100 times larger than that of Cu and Al), it is fine.) material and high electric resistance material (>10^(-6) ohm m) even if the density is small. Eddy current damping should be checked. -> A/I

(b)Wire between room and low temperature : Since it is 4m in length, manufacture and installation are issues. The cross section of this wire could be larger than the requirement of strength. Otherwise passive damping can not work well (if this wire is not so thick, cryogenic payload is well isolated from passive damper). In the case of Virgo, sensors are installed for active damping of yaw modes. It implies sensors which work at cryogenic temperature are necessary in KAGRA. Twisted bolfur lines suspended Crab resonator. For them, the hole whose diameter is about 50 mm is necessary.
Installation of cryo duct for this wire is also an issue.

(c)Wire to suspend Recoil Mass, Intermediate Mass, Intermediate Recoil Mass :
Strength test was reported. Those values of BeCu and W(tungsten) are about 1GPa. Since W has low temperature brittleness, BeCu is better. Suzuki-san also reported the strength test for Crab and pointed out that Bolfur has magnetism.

(1-4)Control(Chen)

Important and urgent issues

(a)Stepping motor
This stepping motor is to control the angle of intermediate mass and platform suspended by a wire. The first candidate is phytron. Since delivery time is long (2.5 months), at first, pico motor will be used to develop the apparatus for performance test. Dan and Gerald from Hannover will proceed. Some kinds of stage moved by stepping motor will be prepared -> A/I. The number of motors is 24 in total.

(b)Displacement sensor and actuators (between Intermediate Mass and Intermediate Recoil Mass) :
First of all, we will check whether LED and PD work at cryogenic temperature. The experiment has already been started. The candidate list must be made as soon as possible. After these tests, OSEM will be checked. Eiichi pointed out there are a lot of reports about OSEM in LIGO document server.

A/I

(a)Dan will ask Takashi whether picomotor can survive at cryogenic temperature.
(b)Dan look for design drawing of stage for Type B and commercial stage.
(c)Kazuhiro considers schedule again.
(d)Kazuhiro consult Ryutaro (procurement of OSEM).
(e)Suzuki-san ? check whether thrust bearing can work at cryogenic temperature.
(f)Some concerns; out gas, noise by 10m long line (according to Dan's experiment in Toshiba, it does not matter), must the window of photo diode be removed ?

Details

(a)Stepping motor
This stepping motor is to control the angle of intermediate mass and platform suspended by a wire. The size is about 100mm. It moves 1 or 2kg weight. The first and second candidates are phytron and ALM, respectively. ALM is large. Since delivery time is long (2.5 months), at first, pico motor

will be used to develop the apparatus for test at room temperature. Dan and Gerald from Hannover will proceed. Some kinds of stage moved by stepping motor are necessary. We must (1) make the stage (copy of that of TypeB, it takes a few weeks, maybe) or (2)look for commercial products. The number of motors is 24 in total. (Each intermediate mass and platform has 3 motors for pitch, yaw, roll adjustment). Total cost is several million yen ? If stepping motor is not installed in radiation shield, the design of filter 3 must be changed.

(b)Displacement sensor and actuators (between Intermediate Mass and Intermediate Recoil Mass) :
First of all, we will check whether LED and PD work at cryogenic temperature. The experiment has already started. The candidate list must be made as soon as possible. After these tests, OSEM will be checked. The noise above 10 Hz must be investigated. Low frequency fluctuation might be an issue. Eiichi pointed out there are a lot of reports about OSEM in LIGO document server. Some concerns; out gas, noise by 10m long line (according to Dan's experiment in Toshiba, it does not matter), must the window of photo diode be removed ?

2.Other

New idea about heat link from Koike-san; No extention bar from cryocooler unit. Heat link itself runs along radiation shield. It will be suspended thin wires, for example.