

## KAGRA Cryo payload meeting

8th of September 2015 (Tue) 13:30-18:30

111, second research complex, Kashiwa campus

Attendees(ICRR): Akutsu, Craig, Hagiwara, Kumar, Kume, Miyamoto, Shoda, Suzuki, Takahashi, Tanaka, Tomaru, Yamamoto, Zeidler

Polycom : Aso, Barton, Hayama

## Cryo-integration meeting

### (1) Schedule : Slow DAQ test at KAGRA site

This DAQ should be test in iKAGRA. CRY intends to check whether DAQ and some thermometers work and joins the preparation of Yoichi and Kazuhiro (H) et al. on next month. CRY must summarize connectors by this preparation (#231).

Takayuki shows schematic view of Slow DAQ. Yoichi pointed out that some parts look strange. Takayuki asks Osamu to correct it later. (#232)

CRY is interested with how to observe output of thermometer from outside mine and in front of cryostat. In the former case, we can check via ICRR VPN (We must investigate how to access from KEK(#233)). In the latter case, there are the local monitors. One of local monitor is near BS. Other ones are near end cryostats (mainly for CRY and VAC. They close gate valves when some accidents happen). We need more similar systems around top of Type A. Fortunately, number of channel is not so large, we can use some ports of the digital system by DGS (sampling rate is extremely high. But we can change data storage sampling rate) for Type A.

Cables (about 20m length, where they are put (along wall, ceiling, ...), ) must be taken care of.(#231)

### (2) Schedule : Cryo duct

Torisha will deliver two cryo ducts (for end cryostat on the Beam Reducing Telescope side). The first one will arrive on March and the next one will on April or May. So, the first and second one can be test on middle of February and March (or April), respectively (Inhomogeneous SolBlack

could be an issue). AOS consider what point must be checked.(#234)

### (3) Surveying

Recent survey suggests that the cryostat moves largely. In order to monitor this motion, Takayuki installed pendulum (top at 2<sup>nd</sup> floor, mass is above top flange of Y front cryostat). He found that mass goes down ! The wire becomes longer. Then this wire will be replaced by metal one later.

### (4) Wide angle baffle

We discuss the cooling test of wide angle baffle. Unfortunately, 1/4 cryostat is not enough large. So, we cannot install payload and baffle at the same time. But we can install only baffle.

Simon is now summarizing his evaluation of effect of magnetism of black coating on the baffle. His report is coming soon and SolBlack can be used (although magnetism is larger than that of DLC). So, the size of baffle could be smaller.

We must consider the gap (or no gap ?) between the baffle and recoil mass. Hagiwara-san sends (to NAOJ) or uploads CAD of cryo payload and Type A later.

AOS would like to check black coating on low magnetism stainless steel (NSSC-130S from Nippon Steel and Sumitomo Metal)(#235). After this meeting, the test pieces of NSSC-130S are sent to NAOJ from KEK (thanks for Nakamoto-san and Suzuki-san).

### (5) Control and damping

Control and damping for not only cryo payload but also Type A must be considered. So, we have the meeting at NAOJ on the next Tuesday.

Ayaka (Shoda) pointed out that LED's are not identical and current must always be checked for calibration.

## **AI**

(#023)Baffle design : Mirror can observe the frame of hole of radiation shield for laser beam. It is an issue of scattered light. We also consider how to reduce the size of baffle. Other concerns are as follows; whether heat path on baffle is necessary ?, deformation under gravity, in the case of SolBlack .... We must consider the structure between baffle and hole for laser beam on radiation shield.-> Simon starts the investigation.-> Tomotada emphasized

that the first priority is to fix the problem of magnetism of black coating. Asahi precision is investigating how to reduce the magnetism of SolBlack. The requirement of magnetism must be clear soon. The design of the recoil mass should be released soon (almost it has already been written). The space for baffle in shield must be taken care of. The suspension for baffle will be design.

(#074)Suzuki-san discusses protection strategy for mirror and shield in SEO meeting.

(#086)Vertical drift by thermal shrink.

(#087)Monitor system for top of the cryo duct on the ceiling of radiation shield. (only for installation ?, where (from bottom filter side)?, monitor system for wire to suspend bottom filter (there are appropriate view ports.)) Optical view port ? -> Takayuki put screw holes on the top plate.

(#090)Suzuki-san and Takayuki prepare the flange at the top of cryostat to separate cryostat from room temperature part. This flange must have ears for installation.-> Hagiwara-san wrote design.

(#095)Takayuki will check the size of door of radiation shield as the upper limit of size of items in shield.

(#102) Takanori (and somebody) summarizes the requirement of optical lever and so on (motivation and design, wavelength, budget ...).-> CRY is charge of the optical levers near cryostats !

(#113)Takayuki checks how to remove the optical window of the radiation shield.-> Direction of shutter must be checked.

(#116) Design for jigs to fix and summarize cables along SAS and cryopayload chain.

(#134) Tomotada must fix which new cryoduct or Toshiba one will be used for BS side.

(#135) Measurement of scattering distribution and specular reflectivity of SolBlack on Electro-chemical buffing (ECB) on A6xxx.

(#140) Suzuki-san consider shift at KAGRA site (before assembly).

(#142) Suzuki-san and Kimura-san discuss the assembly schedule of clean booths.

(#144) We must check whether there is the contradiction between setting base-pin and wall painting.

(#145) We decide concrete requirement for measurement and alignment accuracy.

(#148) Takayuki and Koike-san simulate the internal mode of the platform.

(#153) Since the ETM has wedge (0.2degree +/-0.1 degree), the angle between duct shield behind ETM and optical axis cannot be zero. Tomotada will summarize details (angle, which side, and so on ...) and tell Kimura-san later.->We discussed (17 Sep 2014) and CRY group have no preference of the direction of the wedge direction (if the the ray is on the horizontal plane).-> We discuss again (21 Oct 2014). Kimura-san circulated e-mail that day. We must decide the direction of this duct by 24<sup>th</sup> of Oct. We discussed and agreed as follow; the duct is on the narrow side. However, we must check some details.(#165)(#166)(#167).

(#160) Takayuki later prepares wiki to write idea about clean booth and so on.

(#162)We add two level markers in Y end. At least, one markers must be seen everywhere

(#164)We must decide the requirement for magnetism of SolBlack (Barkhausen effect).

(#166) It is necessary to check the ACTUAL size of tunnel and rooms around Beam Reducing Telescope(whether crane can be near wall and so on). ->(#207)

(#168)In order to record the progress of installation, interval recorders (for example, [http://www.kingjim.co.jp/sp/recolo\\_ir7/index.html](http://www.kingjim.co.jp/sp/recolo_ir7/index.html)) will be purchased by Takayuki.

(#169) We must take care of the budget (truck for the heads on the sides of cryostat, front room, payload assembly room, office room for shift, rack)

(#171) One Pfeiffer full range gauge is purchased to monitor the pressure in main vacuum chamber of cryostat.

(#172) CRY is responsible for interlock of Gate Valve. It takes one minute to close valve.

(#173)Development of software to show real time status -> Kazuhiro Hayama will develop.

(#174) Dummy recoil mass : Some parts will be done by some companies. The other parts will be made by Terashima-san. Suzuki-san organizes.

(#175) Border lines between subgroups must be discussed.

(#178) Air circulation system for 2<sup>nd</sup> floor is absolutely necessary.

(#179) Collaboration between KEK and NAOJ is necessary.-> Tomotada pointed out that the deadline of the submission for joint research with NAOJ

is on the 23<sup>rd</sup> of Jan. It is better to consult with Raffaele or Yoichi in advance.

(#181) Takayuki looks for cart at golf courses.

(#189) At X-end, there are four hooks. But three of them cannot be used because of falling water. This problem must be fixed.

(#199) Takayuki asks Yoichi reconsideration about requirement for the aperture of the recoil mass (If the aperture is large, coil magnet actuator should be smaller. It is not so easy).

(#200) Simple clean booth for front cryostats before October 2016 and the clean booth at the top of Type A must be considered by CRY and VIS, respectively.

(#204) Dropbox to share the latest CAD drawing (VIS and CRY) is prepared. The memo which describes the contents of CAD is necessary. The link to dropbox is on the KAGRA wiki.

(#205) The procedure of exchange of dummy load for Type A and cryo payload should be considered. Some devices to support and move payload (in vertical) are necessary.

(#206) Thermometers near GAS filters are necessary (not only for DetChar, but also VIS itself)

(#207) Vacuum chamber for BRT : Since there is no drawing, the cylinder whose diameter is 1.2m and height is 2m will be written in design drawings.

(#209) Rahul investigates new ideas as follow;

(1) We would like to reduce of weight Recoil mass of marionetta (40kg->20kg).

(2) Recoil mass of intermediate mass (In current design, there is no such mass.)

(3) Rigid connection between recoil mass of marionette and that of intermediate mass (as below photo)

(4) Rigid connection between marionette and intermediate mass.

(#210) We must also consider cables of sensors.

(#213) Since it is not easy to carry something along Y arm, maybe we carry from Mozumi entrance. In this case, some cranes or something similar are necessary at Mozumi entrance (Truck from outside cannot enter the KAGRA site !)

(#218) The acceptable delay of bKAGRA should be considered and discussed.

(#219) 3 dimension measurement system is necessary to check position of ear after bonding. Takayuki proposed table top one (CMM) and looks for it.

(#220)Hagiwara-san introduced new CAD drawing of Type A to vacuum chamber. She thinks that check by VIS is necessary. As first step, her drawing is uploaded in dropbox.

(#221)We observed motion of first floor. So, we must check motion of the second floor. The results of survey on the first and second floors must be connected (via slope or stairs ?). Round connection is better. In any cases, VIS and CRY must consider carefully (not only survey but also installation).

(#222)The largest concern of survey is lack of human resource. Outsourcing could be a solution (budget is an issue). Yoichi tells this issue to SEO.

(#223)We must summarize what we must survey (change of whole tunnel should be measured).

(#224)Requirements and specifications (length, collimation, and so on) of short optical lever for cryo payload should be summarized.

(#225) Bending length of metal fiber should be checked.

(#226) We measure vibration of radiation shield at KAGRA site (X end, probably, June or July 2016).

Ettore said that KAGRA can use Luca's vertical accelerometer and Luca is interested (He can measure).

However, Ettore and Kazuhiro found that sensitivity improvement is necessary (Meas. Sci. Technol. 25 (2014) 015103). Ettore checks noise at cryogenic temperature (electric noise is dominated by thermal noise) and performance at Sardinian mine. Ettore also pointed out that the sensitivity is larger when we increase pump current (in the measurement at Toshiba, this current is as small as possible because they are afraid that current can generate heat).

We keep touch and exchange information before we start measurement.

(#227) We measure vibration of radiation shield at KAGRA site (X end, probably, June or July 2016). Kazuhiro will ask Tatsumi-san the status (He has Dan's horizontal accelerometer now).

(#229)Ettore proposed particle counter is put in clean booth when somebodies work. It gives much information.

(#230)We must take care of weight of screws.

(#231) Preparation of Slow DAQ test at KAGRA site in iKAGRA. CRY intends to check whether DAQ and some thermometers work and joins the preparation of Yoichi and Kazuhiro (H) et al. on next month. CRY must summarize connectors by this preparation. Cables (about 20m length, where

they are put (along wall, ceiling, ...), ) must be taken care of.

(#232) Takayuki asks Osamu to correct schematic view of Slow DAQ later.

(#233) We can check output of thermometer in cryostats via ICRR VPN. We must investigate how to access from KEK.

(#234) Torisha will deliver two cryo ducts (for end cryostat on the Beam Reducing Telescope side). The first one will arrive on March and the next one will on April or May. So, the first and second one can be test on middle of February and March (or April), respectively (Inhomogeneous SolBlack could be an issue). AOS consider what point must be checked.

(#235) AOS checks black coating on low magnetism stainless steel (NSSC-130S from Nippon Steel and Sumitomo Metal).

(#236) Hagiwara-san revised clamp. But so far, bending length of metal wires is not taken into account. Kazuhiro (Y)'s rough evaluation suggest that it could be several mm. Takahiro will check.

(#237) In order to reduce weight, the Marionetta looks delicate. So, Takayuki checks how much the first resonant frequency is.

(#238) Rahul proposed heavier intermediate mass (to reduce recoil loss). The platform weight could be 60 kg weight. If so, intermediate mass can be heavier. Takayuki and Higiwara-san will check later.

(#239) We discuss the small weight for adjustment of weight of each mass. We must consult with VIS.

# Cryo-payload meeting

## 0. Schedule and so on

### Important or urgent items

We discussed design of cryogenic payload.

#### (1) Clamp point

Hagiwara-san revised clamp. But so far, bending length of metal wires is not taken into account. Kazuhiro (Y)'s rough evaluation suggests that it could be several mm. Takahiro will check. (#236)

#### (2) Sensor

Now, the sensor which consists of Light Emitting Diode and Photo Diode is a unit. We can install and remove this unit. The assembly procedure is simpler.

#### (3) Resonant frequency of Marionetta

In order to reduce weight, the Marionetta looks delicate. So, Takayuki checks how much the first resonant frequency is. (#237)

#### (4) Mass distribution

Rahul proposed heavier intermediate mass (to reduce recoil loss). The platform weight could be 60 kg weight. If so, intermediate mass can be heavier. Takayuki and Higiwara-san will check later. (#238)

We discuss the small weight for adjustment of weight of each mass. Of course, we must consult with VIS (#239). But we guess 10% adjustment is enough. Since the mass is about 20kg, small weight must be a few kg in total.

## 1. Sapphire monolithic suspension (Khalaidovski)

### Important or urgent items



## IMPEX

Kazuhiro has already ordered ears. But discussion about fibers is still in progress. "Concrete value" in quotation is an issue. Today, Ronny and Helene (from IMPEX) discuss. Yesterday, Kazuhiro told Ronny points. Ronny will report soon.

### Full size sapphire suspension prototype assembly

Rahul proceeds with design of frame. He found an appropriate one and we can purchase (Misumi or Kitahara Shouji). Takayuki pointed out that some coating on Al frame is a problem (out gas). But he found Al frame without coating on web site.

Rahul also proceeds with design of fiber holder (it support holder during assembly). He needs some stages (although he tries to reduce number). Later Takayuki show his stock room. Rahul might appropriate stage.

Rahul proposed test of full size sapphire suspension prototype in 1/4 cryostat (KEK) because it is larger than ICRR cryostat. So assembly is easier with less risk. However the initial cooling time is longer (more than two weeks with liquid nitrogen!). So at first we assume that we adopt the cryostat at ICRR and proceed with design. If we find serious problems, prototype moves to KEK. We must take care of Takahiro's schedule.

Kieran are designing the intermediate mass (for full size sapphire suspension prototype). We compare his design with Hagiwara-san's. We discussed. Hagiwara-san will send her drawing and Kieran will revise.

Kieran asked why the sapphire washers are introduced. Rahul explained his simulation. He compared thermal noise by only Cu clamp with thermal noise by Cu clamp and sapphire washers. The former is larger because the deformation in Cu is larger. However, Kieran pointed out that (a)Number of contact area is larger. It suggests that friction is larger. (b)Assembly is

difficult (polished surface could slip). So, at first, we try clamp without sapphire washer.

Rahul is preparing measurement of Q of blade spring with clamp (and sapphire washers).

Takayuki also mentioned that 1/300 gradient must be taken into account (After this meeting, Takayuki changed his mind. 1/300 rad gradient is smaller than tolerance in processing. Thus, in design drawing, this gradient does not appear).

Heat extraction test of actual suspension

Takayuki mentioned that heat extraction test for ACTUAL KAGRA sapphire suspension (otherwise, we cannot know how much mirror temperature is). But it is not easy ... We must consider.(#240)

### One fiber prototype

Hiroki made earthquake stopper and confirmed that he can assemble one fiber prototype with earthquake stopper on the optical table. Now he is assembling one fiber prototype with earthquake stopper in cryostat and preparing thermometer and heater.

Hiroki also must prepare indium bonding. After that, he tries cooling test at first. He checks temperature of mass because the thermometer on mass should be removed in Q measurement.

He is studying ANSYS (supervised by Rahul). Now the simulation of a sapphire fiber (1.6mm in diameter, 350mm in length) with and without a sapphire cubic (6kg in weight) is in progress.

### **AI**

(#020)Kazuhiro summarize the length of sapphire fiber. He must take bending point and adjustment of diameter into account.-> He explained. He will discuss with Sascha.

(#024)Yoichi Aso and Eiichi Hirose prepare the plan and R&D items of optical contact and screw, respectively by Christmas. -> Kazuhiro summarizes points and consults with them.

(#053)Rahul investigates thermal distribution model.

(#083)Details of strength test of sapphire blade spring are considered (also

clamp). Ettore suggested the measurement of resonant frequency of horizontal motion of sapphire blade spring.

(#104) Dan, Sascha and Kazuhiro make research plan in FY2014 based on Grant-in-Aid for Specially Promoted Research. It includes report of outline of sapphire mirror suspension (final version), purchase plan for fibers, test of connection between mirror and ears, blade spring test, how to assemble.

(#119) Rahul prepares the measurement of mechanical loss on the surface of sapphire fibers.-> Rahul started design.

(#147) The sapphire fiber length must be decided soon. -> Kazuhiro Hayama explained impact of first violin mode(<http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=2825>). The length should be between 300 mm and 350mm.

(#149) Rahul summarizes his result file and their explanation for somebody else and writes short report for the paper.

(#159) Dan and Rahul check the analytical investigation of bending length (<http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=2773>) using Finite Element Method.(#109)

(#163) Cold damping for violin mode and so on.

(#167) Precision in installation: The light transmitted by a sapphire end mirror could not be on the horizontal plane. We must check the requirement of this point.

(#170) 1/300 radian gradient problem must be considered (Since the KAGRA baseline has the 1/300 radian gradient, sapphire mirror must be tilted. The stress in the sapphire fiber must be as small as possible.).

(#175) We will ask IMPEX how to wash sapphire fibers.

(#176) Reconnection of HEM fiber and nail head with Hydroxide Catalysis Bonding (the fiber went from the nail head)

(#177) Ettore found a company which has HEM sapphire. We check the cost and delivery date of HEM fiber.

(#182) Before Dan and Yusuke leave, Hiroki, Takahiro, and Kazuhiro learn how to make Hydroxide Catalysis Bonding, to handle experimental apparatus and ANSYS and so on. Although Dan and Yusuke are busy, we must coordinate our schedule. -> Kazuhiro found many sapphire blocks for practice (Hydroxide Catalysis Bonding). Maybe, Dan and Yusuke have time in the second half of February. Kazuhiro looks for jig to fix the blocks.->Yusuke taught Miyamoto-kun.->\_Miyomoto-kun, Tanaka-kun, and

Kazuhiro made samples under supervision of Dan and Yusuke. Kazuhiro is summarizing the manual.

(#184) Frame and lab jack for full size sapphire suspension prototype: Kazuhiro will check whether the frame and lab jack for 1/2 dummy payload can be used. -> Frame is OK. Maximum load of lab jack must be checked.

(#187) Assembly jigs to support the mirror : Size of sapphire bulk for prototype is slightly different from that of the actual KAGRA mirror. We must prepare it. Kazuhiro will tell Hagiwara-san details later.->Hagiwara-san wrote. Kazuhiro must check.

(#188)Improvement of cryostat with vibration reduction system (H. Tanaka): 350mm fiber should be included. Exchange gas system is necessary.

(#190) Kazuhiro checks the strength (whether it can support 6kg weight or not) of Nitofix for dummy sapphire fiber (photoran straight sapphire fiber and sapphire block with hole from Shinkosha).

(#191) For dummy sapphire fiber (photoran straight sapphire fiber and sapphire block with hole from Shinkosha), the jig to fix the blocks and the fiber before dry must be considered.

(#192) Assembly jigs for full size prototype sapphire suspension is designed and manufactured (We order not only Mechanical Engineering Center of KEK but also mechanical workshop at Institute for Solid State Physics, check and write drawing...).

(#194)Ronny proceeds with thermal resistance measurement inside smaller cryostat. Rahul learns.

(#196)We must practice with larger sample for Hydroxide Catalysis Bonding.

(#197)Application software for CAD should be prepared (one space designer license in KEK will be expired at the end of March 2015).

(#201)Indium contribution calculation by Dan and Rahul is checked.

(#202)We consider whether we make the slit of sapphire blade spring larger.

(#203) Takayuki and Kazuhiro check the stock of sapphire in KEK and ICRR, respectively for sapphire fiber clamp.

(#211)In order to check how Q-values depend on the surface, Kazuhiro later will send the IMPEX monolithic fiber to Takayama-san(National Institute for Fusion Science).

(#216)Jig for ears on mirror during Hydroxide Catalysis Bonding process. The adjustment along direction which is perpendicular to optical axis is difficult. The end of flat cut is not good reference. Moreover, how to put mark

(and remove later) is not an easy issue. Takayuki suggested case around mirror. Hiroki and Kazuhiro are considering.

(#217)Final version of design drawing of end sapphire mirror will be uploaded on KEK wiki.

(#228)We must decide the distance edges of mirror itself and reflective coating.

(#240)Takayuki mentioned that heat extraction test for ACTUAL KAGRA sapphire suspension (otherwise, we cannot know how much mirror temperature is). But it is not easy ... We must consider.

## **2. Vertical spring (blade metal spring) (Takahashi)**

### **Important or urgent items**

No news

**AI**

(#046)Kazuhiro Hayama evaluates the amplitude of gravitational wave from pulsars between 10Hz and 20Hz. He will take into account the direction of KAGRA interferometer and pulsars.

(#105)Schedule must be revised (small sample test for material properties investigation and prototype for 1/4 cryostat and thermal compensation system) by Takashi-san and Takayuki Tomaru.

(#106)Takayuki prepares experiment for small sample test for material properties investigation.

(#139) Kazuhiro will summarize the requirement and so on.

(#214)Hagiwara-san checks whether these 12 blade springs (simulated by Takahiro (#208)) can be installed in platform or not.

(#215)Takahiro upload memo about how to design blade spring in GAS (in short what Takanori taught) on KEK wiki.

## **3.Material (Suzuki)**

### **Important or urgent items**

No news.

**A/I**

(#093) Yusuke check where Al samples with clamps for thermal resistance measurement.

(#099) Ti-6Al-4V is the candidate as bar between low and room temperature. Kazuhiro Yamamoto will fix specification and ask company. -> Kume-san and Kazuhiro proceed. -> Kazuhiro will summarize the specification of Ti-6Al-4V bar (shorter one when the cryostat is separated from room temperature part). Hagiwara-san will draw design and Kume-san asks the company. The number is 2 or 3. -> We must consider the details of cryo payload at the same time. It is useful to make test piece with nail head.

(#111) Kazuhiro Yamamoto checks the effect of weight of heat link. For example, their weight can stretch the vertical spring.

(#117) Dan will measure Q and thermal conductivity annealed by Takayuki.

(#118) Yusuke evaluate effect of magnetism using ANSYS in order to check Kazuhiro's calculation (#091).

(#126) Takayuki prepares the annealed tungsten wires for Q and thermal conductivity measurement (by the end of May).

(#212) Kazuhiro proceeds with the procurement of low magnetism stainless steel. He will ask whether the increase of magnetism by processing can be reduced by heat treatment.

#### **4. Control (Chen)**

##### **Important and urgent issues**

Takahiro proceeds with his experiments.

- (1) Tilt adjustment system : He checked relation between displacement of moving mass and angle of Marionetta (and dummy mirror) before and after the tungsten alloy moving mass is replaced by copper alloy mass. The tilt is twice times smaller. It makes sense because density of tungsten alloy is about twice times larger.

When the moving mass is around center, the angle of Marionetta and dummy mirror is almost constant. It looks strange. But we continue experiment.

- (2) Sensor : Takahiro prepares test for new Photo Diode (diameter is larger) and Light Emitting Diode (more diffuse light). This pair will be cooled soon in cryostat. Takayuki has already checked and they work in liquid helium.
- (3) Takahiro practices to make coil. He checks how many we can wind.

## **AI**

(#019) Ryutaro will consult Saito-san on the outgas of board for OSEM.

(#044) Suzuki-san asks Saito-san whether Nitofix is ultra high vacuum compatible.-> Suzuki-san will reserve the out gas measurement system at KEK

(<http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=2101>) for not only Nitofix but also Master bond. For baking, the spacer between magnet and mirror is necessary because baking mirror with glued magnet causes contamination.

(#056) We must decide strategy and schedule for LVDT.-> Takanori is discussing with Ettore and Alessandro.

(#057) Out gas from Photo diode, LED and motor should be checked (Dan and Kazuhiro?).

(#075) Ceramic bearing test

(#120) Measurement or evaluation of 300K radiation through a optical window

(#121) Takayuki asks Hagiwara-san to check CAD about tunnel for optical laver.

(#125) Dan consults Jena people (requirement of moving mass)

(#138) Mitsubishi cable industries can provide polyimide line for coil. Suzuki-san checks out gas.

(#156) We should consider the specification of coil magnet actuator on the sapphire mirror (and coating. If the coating covers the mirror surface perfectly, it could be a problem when the magnets are attached). Diffraction loss must be also considered.

## 5. Heat switch test (Tomaru, Sakakibara)

**Important and urgent issues**

No news.