KAGRA Program Advisory Board Report

Response to the External Review Report

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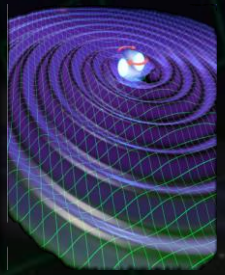

To Do by PAB

- Action items
  - Ask subsystems for updated information.
  - Summarize and discuss about the management part in SEO.

- Presentation file
  - Update the structure :
    Short summary part to be presented
    + Full information as reference.

Review Report

- We receive 16page-report in the end of April.

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From: R. Adhikari, M. Landry, G. Losurdo, H. Lück, and M. Zucker (corresponding)

Re: Committee report on the **Third External Review of the KAGRA Project**, held April 2014 at I.C.R.R. in Kashiwa, Chiba Prefecture, Japan

1 Introduction

The committee visited I.C.R.R. in Kashiwa from 2 to 4 April, 2014 to review the KAGRA program and to offer guidance from an external perspective. The charge was as follows:

- Confirm detailed design/development status of each subsystem
- Identify potential problems with each subsystem
- Recommend to the management whether to proceed to the next development phase
- Produce a report describing recommendation and action items

As in previous reviews, our hosts were frank and open, especially highlighting problems and concerns for which they sought advice. Our report is provided entirely for the benefit of the KAGRA System Engineering Office (SEO), to share or act upon as they may choose.

1.1 Executive Summary

The context of this meeting differed from that of prior external reviews. According to the Project schedule, the initial room-temperature iKAGRA machine should begin installation within 7 months and be ready to start science observations within 20 months. Furthermore, the bKAGRA cryogenic machine is nominally slated for integration immediately thereafter, with a target of operation in late 2017. As a result, our attention is primarily directed to subsystem readiness and installation planning, rather than technical design.

We were glad to review the team's many accomplishments since the April 2012 review, including completion of the underground tunnels and experimental halls at Kamioka, and the fabrication of all vacuum tubes and chambers. We congratulate the group on these successes, achieved under difficult conditions of limited staff and reduced budget.

Report Structure

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2.4 bKAGRA Design

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1.1 Executive Summary

Executive Summary

- Budget Situation
- Manpower Situation
- Project scope, especially for iKAGRA scope
- Efficient management
  - Proactive assessment of progress
  - Correction of deficiencies
  - Mitigation of risks
  - Reallocation of resources
  - Adjustment of mission priorities
- Lack of effective communication, low morale, and degraded trust ... within the team and KAGRA between levels of management

Executive Summary

- Budget Situation
  - We … were pleased to learn recently that a key Grant-in-Aid for approximately ¥500M has been secured. We hope this can partly address the severe shortages reported in many aspects of the program.
  - Lack of budget resources was again cited as a reason for tacitly accepting certain potentially catastrophic risks into the Project baseline. These include some previously flagged for urgent action (e.g., tunnel safety) as well as new issues (e.g., optic spares, viewports, and high-vacuum pumps).

Executive Summary

- Manpower Situation
  - Insufficient budget and staff resources were also key concerns cited in both prior external reviews. Supplements notwithstanding, presentations to our Committee indicate these problems have in fact grown in severity.

Executive Summary

- Project Scope
  - … the committee detected confusion about the goals, timing and rationale underpinning the top-level Project schedule. The motivation supporting the proposed December 2015 iKAGRA observation run seems particularly nebulous. Due to design limitations, iKAGRA is not expected to substantially advance gravitational wave observational science; indeed, there is no longer a specified goal for its strain sensitivity. At the same time, iKAGRA shares comparatively little technology with the subsequent bKAGRA design, limiting its applicability as a technology demonstrator or prototype.

Executive Summary

- Project Management

  - The above concerns suggest that more efficient management of interferometer system development and scientific planning are required. Improvements can be realized in proactive assessment of progress; correction of deficiencies; mitigation of risks; reallocation of resources; and adjustment of mission priorities, according to new information and changing resources.

  - Lack of effective communication, low morale, and degraded trust … within the team and KAGRA between levels of management.

Top-level Recommendations

- Our primary recommendation is to openly and honestly reassess the Project's available assets, objectives, and priorities, and to collectively develop a revised Project plan from the ground up. This plan should respect known constraints and the views of each contributor.

- Revised Project plan (and any future plan that replaces it) be subjected to continual testing, evaluation, and active adjustment, to insure that Project goals and schedule remain feasible, clearly understood, and shared by all team members.

Executive Summary

要約

- 予算
  - 新たに5億円の予算を獲得したことは良かった. 深刻な状況からの改善を期待する.
  - いくつかの潜在的な致命的リスクの原因として予算不足が挙げられる.
    (例: X-end トンネル, Core Opticsのスペア, ビューポート, 真空ポンプ)
- 人員
  - 予算と人員不足は以前からの重要懸念事項であったが、より深刻化している.

- スコープ
  - 全体スケジュールにおいて、目的・時期・根拠に混乱が見られる.
    2015年のiKAGRA観測の目的が不明. iKAGRAでは科学的な観測は期待できず、
    感度目標も規定されていない. またbKAGRA設計と重なっている部分が少なく、
    技術実証として用いるにも限界がある.
  - SEOとサブシステムリーダーの間でiKAGRAゴールの共通理解がないようだ.
    一方、iKAGRAのスケジュールが困難であることは共通理解としてある.
  - 2015年の観測について別案を求められたが、ボトムアップ案が無いので判断できない.

Executive Summary

要約

- マネジメント
  - 干渉計システム開発と科学方針について, より効率的なマネジメントが必要. 新たな情報と変化するリソースに応じて, 進捗の把握, 予算不足の解消, リスクの解消, リソースの再配分, プロジェクト目標の調整 を行うことで改善するだろう.
  - これらの問題は, チーム内や芽根地面とレベル間での効率的なコミュニケーションの欠如, モラルの低さ, 信頼関係の低下につながっている可能性がある. 定期的な会議があるにもかかわらず, サブシステム/SEO/執行部で重要な情報が共有されて、対処されていないことは明らか.

Executive Summary

要約

- Recommendation
  - 第一の勧告は、プロジェクトで使用可能なリソース, 目的, 優先度を先入観なく正直に評価し、一からプロジェクト計画を見直すことである.
  - 見直された計画は、プロジェクト目標とスケジュールが実現可能であるよう、継続的に評価されて能動的に調整されていくべきである.
  - これらの勧告が効率的に行われるためには, サブシステム, SEO, 執行部のリーダーシップについて再考するのが良いかもしれない. 外部マネジメントコンサルタントに相談するのも役に立つかもしれない.

2.1 Systems Engineering Office

2.1 Systems Engineering Office (1/4)

- We note that the SEO portfolio has evolved away from Systems Engineering (as conventionally defined) to fully encompass most nominal Project Management functions (budget, schedule, safety, public relations, contracting, etc).

- Prompted by interface and schedule incompatibilities highlighted during subsystem presentations, we met with the SEO to investigate its role in coordinating subsystem activities. We found that the current structure and level of interaction within SEO, between SEO and subsystem leaders, and between SEO and executive management has not proven successful.

2.1 Systems Engineering Office (2/4)

- We were told that, in effect, SEO does not currently have the authority or internal decision-making capacity to address subsystem issues, and is therefore regarded as ineffective.

2.1 Systems Engineering Office (3/4)

- We recommend the project consider revising the SEO/management structure so that a single leader is charged with both responsibility and explicit authority for action. Such responsibilities should typically include:
  - Reallocating manpower within and between activities, to address changing priorities
  - Reallocating budget to respond to urgent issues, and also to seize targets of opportunity
  - Adjusting schedules and plans to account for actual and rationally expected future progress
  - Enforcing interface requirements and subsystem performance criteria

2.1 Systems Engineering Office (4/4)

- At the same time, such responsibilities increase the importance of transparency and effective communication between SEO and subsystem group members. It is our belief that making SEO more effective will automatically improve the team's confidence in their leadership. However, to achieve this effect, it is even more essential that executive management visibly and aggressively support SEO decisions.

2.1 Systems Engineering Office

要約

•SEOの役割

- SEOの職務が、慣用的に用いられる 'Systems Engineering' (大部分のプロジェクトマネジメントにおける, 予算・スケジュール・安全・PR・契約など)からずれている.
  結果として、SEOのメンバーが8名に増えている.
- サブシステム発表でインターフェース・スケジュールの不整合があった. サブシステムリーダとSEO, SEOと執行部の間の相互作用が、現状では機能していないとみられる.
- SEOが、現状では権限やサブシステムでの問題に対する決定能力を有していないとのことである.
- SEO/Management構成を再考し, 1人のリーダーが, 以下のものに対して責任と明確な権限を持つようにすべきである:
  * 状況変化に対応するためのマンパワー再配置.
  * 緊急な要件に対する予算の再配分.
  * 進捗に応じたスケジュールとプランの調整.
  * インターフェース要求値とサブシステム性能基準の決定と実行.

  これらには、SEOとサブシステム間の効率的なコミュニケーションが重要である.
  SEOを有効にすることが, チームの自信とリーダーシップを高めるだろう. しかし, EOがSEOの決定を明示的に強く支持することがより本質的である.

2.1 SEO

Answers and Actions

・Revising the SEO/management structure
(single leader is charged with both responsibility and explicit authority for action)
→これらの項目はSEOの業務として認識している．2013年4月からは具体的なプロセスとして，Bottom-upの方針を維持するためchief会議で各subsystemからの要求を議論し，SEOが具体的に策定した案を，Project ManagerがEOで承認してもらう構造となっている．

・Reallocating manpower within and between activities
→Sub-systemのchiefからの要請を聞いて人員の配置を時限的に行なって行きたい．

・Reallocating budget to respond to urgent issues
→SEOがbudget scheduleを作成して進めることにした．予算のsubsystem内での調整はchiefに任せてSEOは執行の確認を行なう．Subsystem間の予算再調整は，chief会議で議論してSEOが策定し，EOで承認してもらうプロセスである．

2.1 SEO

Answers and Actions

・Adjusting schedules and plans to account for actual and rationally expected future progress

→2013年10月から各Subsystem が作成したスケジュールを，SEOで一元化して全体調整を行なっている．Project Manager直属のスケジューラー（2014年度はinstallation scheduler）を置き，各Subsystemと直接調整を行ない始めた．chief会議で議論したiKAGRA，bKAGRAのスコープに沿った調整を進めて行く予定．

・Enforcing interface requirements and subsystem performance criteria

→2013年4月から，chief会議においてinterfaceの各種課題を議題として取り上げ，subsystem間で対策を促している．

・Improvement the team's confidence in their leadership. However, to achieve this effect, it is even more essential that executive management visibly and aggressively support SEO decisions.

→基本的にはchief会議を活用し始めている

→予算や人員配置について権限をどこまで持つかは難しい問題？

2.2 iKAGRA Installation, Integration & Commissioning

2.1 Budget (1/3)

- Certain critical program risks, ..., were attributed to budget deficiency. Examples include emergency egress from the tunnel's X endstation, suitable high vacuum pumps, viewports to admit and extract laser beams, spare optics, and critical staffing. Our committee was persuaded that each represents an imminent threat to the KAGRA mission.
- ... we strongly recommend that whatever the funding situation, KAGRA leadership should always strive above all to mitigate existential threats. This may require realignment of priorities or renegotiation of project scope, in the name of survival. Allowing a profusion of potential "show-stoppers" to persist, with no protective action, virtually guarantees program failure (for one reason or another).

2.1 Budget (2/3)

- We did not recognize any explicit budget allocated for interferometer installation activity. Experience indicates that personnel travel, material transportation, tooling, cleanrooms, gowning, rigging, safety, quality assurance, staff training, and other ancillary expenses incurred during an installation phase are significant. We recommend development and allocation of an installation budget respecting these requirements.

2.1 Budget (3/3)

•… The lack of contingency budget allows even minor issues with delivered equipment to hold the entire program hostage. We recommend that ongoing efforts to remedy budget deficiencies also strive to set aside reasonable and proportionate contingency funds. We further recommend that the project adopt an organized and efficient "Change Control" process to apply these contingency funds judiciously, as unforeseen issues arise.

2.1 Budget

要約

- **予算状況**
  - いくつかのプログラム上のリスクは**予算不足に起因**している.
    (X-end トンネル, 真空ポンプ, ビューポート,予備の鏡など)
  - 追加予算獲得の努力を続けることを応援する. 一方、予算状況に関わらず, リーダーは、**プロジェクトスコープの再交渉**など、全てのリスク要因を解決すべく努力するべきである. **能動的な対応をすることなくプロジェクトの致命的な失敗の可能性を見逃しておくことは、確実にプロジェクト失敗につながる**.

- **予算配分**
  - 干渉計インストール作業のための予算が明示的には配分されていない.
  - コミッショニング時の複雑さから、不整合は事前には不透明である. Contingency 予算がないことで, 小さな問題ですらプログラム全体に影響を及ぼす.
    予算不足解消のための努力と合わせて、Contingency**予算を確保すべき**である.
    また, **組織的で効率的な**'Change control' process**を採用すべき**である.

2.1 Budget

Answers and Actions

Comments by Somiya-san + Ohashi-san

[Comments summary]

(1) Contingency (2) Installation activity (3) Vacuum pumps

[Response]

(0) First of all, we will do our best to get additional budget to compensate the deficit for KAGRA construction.

(1) After the review, we obtained $5M research grant. It will be mainly used to hire people and to transport researchers, but some fraction of the grant can be regarded as a contingency.

(2) CRY people plan to save some part of their budget and use it for the installation cost. Many other subsystems, however, have no money assigned for the installation. Moreover some of the installation tools/instruments have been cut off in the saving plan. It is certainly an issue to be solved.

(3) -> Saito-san issue

2.2.2 Inst. and Commiss. Plan (3/3)

•… The lack of contingency budget allows even minor issues with delivered equipment to hold the entire program hostage. We recommend that ongoing efforts to remedy budget deficiencies also strive to set aside reasonable and proportionate contingency funds. We further recommend that the project adopt an organized and efficient "Change Control" process to apply these contingency funds judiciously, as unforeseen issues arise.

2.2.2 Inst. and Commiss. Plan

要約

- **状況評価**
  - サブシステムの状況から、12-20か月でiKAGRA観測を行うためには**障害は高い**.
  - プロジェクト計画は、非常に高い要求をする'top-down'計画のようである. リソースを基準にしたものではない. '**希望的計画**'に見える.
  - サブシステム間、サブシステム-SEO間で**ミスコミュニケーション**があるようだ. 一般的な原因を特定することは難しいが、**不整合に対してopenに取り組む**ことが解決策であろう.
  - **人と物品の安全に対する備え**が示されていない. 安全管理、危機分析と監督、安全教育をスケジュールと予算に含めるべきである.
  - **品質評価**(Quality Assurance)**についての議論が無かった**. スペックに合致しているか確認することはプロジェクト成功の鍵である. 移動後の確認も必要である. プロジェクトは、最終的なサブシステム試験に対して、責任と時間を割り当てるべきである.

2.2.2 Inst. and Commiss. Plan

要約

・体制
- SEOが、サブシステムのスケジュールに対する準備状況と進捗を1か月単位(もしくはより高頻度) でレビューする役割を持ち、リソースの移動やマイルストーンの再設定を行う権限を持つべきである.
- iKAGRAのインストール計画が、サブタスクに明確に分けられていない. ボトムアップ解析によって本当のクリティカルパスを特定し、並列作業のマネジメントを行うべきである.
- SEOのインストール担当者が神岡サイトに既に移動しているというのは良い.
一方、サブシステムチームが現地を訪れるのは、納入と設置だけのようである.
稼働まで長期間滞在できるよう努力すべきである.
- 現地サイトにいないSEOメンバーも、遠隔ミーティングなどでインストール活動に密接に関わることを提案する.

2.2.2 Inst. and Commiss. Plan

要約

- 計画遂行
  - 光学-機械系レイアウトを作成し、保守すべきである. それによってインターフェースが明確になる
  - 一般的な 'Stop work' 方針を定めるべきである.
  - 外部業者を活用することが強く求められる. ただし彼らはクリーン環境近くでの作業に慣れていないことが多い. トレーニングと監督を行うことが必要.
  - クリーン物品のインストールがその他の'汚い'作業の横で行われる計画になっており、汚染のリスクがある. それらの時期を切り分ける場合、スケジュールの遅れが予想される. C. Torrie (CIT) に相談することを助言する.
  - 各サブシステムは、真空中への安全・クリーン・正確なインストール手順を作り、示すべきである. 手順についてのチェックリストを欠かしてはいけない. 事前にそれらの計画を立てておくことで、リソースの干渉を避けることができる.

2.2 I&C

Answers and Actions

・Resource-loaded internal working schedule, including schedule contingency, based on realistic bottom-up estimates and constraints as they currently exist.
➔ぜひやるべきだと思いますが、まずは梶田さんの了解が必要です。個人的には、内部スケジュールと外部スケジュールは整合性がとれているべきだと思いますが、これは敷居が高そうです。

・We recommend the SEO group be charged with reviewing subsystem readiness and progress against this internal schedule at monthly intervals (or more frequently), and be empowered to move resources or revise milestone dates as facts and events may dictate.
➔内部スケジュールを作るのならもちろんそれを参照してこのように進めていくべきです。しかし、マイルストーンの更新の権限については梶田さんの了解が必要です。

・True critical path(s) be identified in the above bottom-up analysis, and that parallel tasks be managed to establish and preserve any available safety margins.
➔そのようにするべきです。

2.2 I&C

Answers and Actions

•Creation and maintenance of an integrated opto-mechanical layout.

➔野口さんを雇用しました。そのように進めていきます。

•Personnel and equipment safety

➔これは黒田さんと大石さんがやっているのでは？

•Global "stop work" policy, affording every participant both the ability and the duty to assert safety concerns.

➔これももちろんやるべきです。

•Plan should allow explicit provisions for training and close supervision of contractors while working in or around clean lab environments.

➔もちろんですね。

•Clean installation alongside "dirty" deployment of chambers, heavy lifting, installation traffic, etc.

➔C. Torrieに相談します。

2.2 I&C

Answers and Actions

・Each subsystem develop and propose for review a detailed installation plan to ensure safe, clean and accurate deployment of detector payloads into vacuum chambers. Checklists should be included to ensure steps are not missed and that tests are performed in the correct order.

➔そのようにすべきです。

・Retain subsystem design, installation and commissioning crews in long-term residency on site, well into the operation phase.

➔たぶんそのようにすることになっているのだと思います。これ以外にもコミッショニングではシフトシステムを設けようとしています。

・Explicit responsibility for quality assurance.

➔もちろんそのようにすべきだと思います。

・SEO members on site remain closely coupled to installation activities

➔毎日は無理だとしてもなるべくそのようにします。

2.3 iKAGRA Subsystem Readiness

2.3.1 VAC (1/2)

- We were very impressed to hear of the progress in fabrication of the beamtubes and chambers. We were not asked to review these components in detail, but understand that they have so far met expectations, and are staged for installation when the tunnel has been prepared.

- The committee considers it essential to operate iKAGRA in a high vacuum (molecular flow) regime. Operation under viscous conditions (e.g., at the proposed pressure of 100 mbar) is not feasible; for example, acoustic coupling and bulk index effects would likely preclude cavity resonance.

2.3.1 VAC (2/2)

- Should funding for the baseline pumping system continue to be withheld, we suggest considering several alternatives:
  - Procure pumps in two or more phases, delaying full installation along the arms. … Adding two more at the tube midpoints (six total) would further reduce the integrated gas column density by a factor of four, although iKAGRA may not require this additional step.
  - Attempt to recover ownership, or secure extended loan, of the pumps deployed by the VAC installation contractor for leak checking, after this task is retired.
  - Borrow pumps from international partners or from other KAGRA-affiliated installations (e.g., TAMA).

2.3.1 VAC

Answers and Actions

•We are making effort to get more pumping systems for iKagra still now. We think we can prepare 6sets of TMP in this year and vacuum pressure of iKAGRA will be capable of 10^-4 Pa after 500 hour pumping.

2.3.2 TUN/FCL (1/3)

- We applaud the timely completion of the tunnels. This is a great accomplishment of the KAGRA team and its industrial partners.
- We remain gravely concerned by the lack of emergency egress from the X end station, as well as its consequences with regard to ventilation, anthropogenic noise, and future equipment mobility. We urge the team to place increased priority on resolving this problem.
- We join the team in their hope that new funding will permit construction of a staff/assembly/workshop space near the corner station. …

2.3.2 TUN/FCL (2/3)

- We recommend a comprehensive survey of shipping, receiving, inspection, vacuum preprocessing, clean assembly, and clean storage for each subsystem, time-phased according to the desired delivery and integration sequence...
- With completion of the tunnels, we recommend a thorough seismic and acoustic survey of all stations to establish background noise levels.
- We share the team's concerns regarding noise from flowing ground water. Both the unexpected volume and the imposed restriction on one of the original drain points, which forces additional pumping, indicate noise may be significantly higher than originally estimated.

2.3.2 TUN/FCL (3/3)

- Similarly, we recommend early investigation of the noise contributed by air ventilation system, and exploration of means to suppress or mitigate such noise during science operations.

2.3.2 TUN/FCL

Answers and Actions

- (1) Lack of emergency egress from the X end station

We think much of this risk always. At present, excavating escape mine road from the outside to the X end station is the most desired method, but we need to reconsider the position of the entrance. We continue to think about not only the escape mine road but also other method.

- (2) Construction of a staff/assembly/workshop space near the corner station.

We agree our work spaces are limited. We will construct a small house in front of new Atotsu mine entrance. This house will be used for washing vacuum parts. We also prepare staff area of 165m^2 between the mine road and the center experiment room.

2.3.2 TUN/FCL

Answers and Actions

•(3) Comprehensive survey of shipping, receiving, inspection, vacuum pre-processing, clean assembly, and clean storage for each subsystem, time-phased according to the desired delivery and integration sequence.

We agree this importance and we have started combining the site construction schedule by the industrial companies and the schedule of installation work done by us as the first step.

•(4) Thorough seismic and acoustic survey of all stations to establish background noise levels.

We have already prepared an instrument set for seismic measurement. We will find a chance to do measurements without disturbed by the site construction works.

2.3.2 TUN/FCL

Answers and Actions

- (5) Noise from flowing ground water.

We think much of how to drain water in the tunnels. At present, water in the X arm tunnel will be drain through the bypass tunnel between the X arm tunnel and New Atotsu mine road. Thus, the center experiment rooms will avoid flowing water. We wish to make a hole before the Y end station for drainage of the Y arm tunnel and we are negotiating with Kmaioka mining company now.

2.3.2 TUN/FCL

Answers and Actions

•(6) Early investigation of the noise contributed by air ventilation system, and exploration of means to suppress or mitigate such noise during science operations.

We have no idea about the noise from the air ventilation through the whole tunnel (not outer-air introduction ducts). We also prepared several walls between the X (Y) arm and X end (Y end, corner) stations mainly to keep cleanness in each station. These walls are expected to contribute stop the air flow in 3km arm. However, several air flow routes are left in each arm because small ducts connect the main water evacuation duct, which is buried just below the X(Y) 3km arm floor, with soughs that is aligned along the edge of the 3km arm floor. Anyway, we will measure any sound noise in many places in the KAGRA tunnel.

2.3.3 MIR (1/1)

- We are concerned that dependence on a single complement of optics, with no procurement of spares, places the entire program at unacceptable risk. … We urge the team to develop a coherent risk management plan and, wherever feasible, procure adequate interchangeable spares.

- For example, we suggest that obtaining one further iLIGO ITM and ETM, and reconfiguring the ITM wedge as done previously, could provide a spare for each of the most critical cavity optics at minimal additional cost. We recommend exploring this option with LIGO.

2.3.3 MIR

Answers and Actions

- 1) Spare optics

iKAGRA Test Masses: As for iKAGRA test masses, we have two spare ETMs already. These are ETM03 and SPETM06 that were donated from the LIGO lab a while ago. As suggested, we would like to have spare ITMs as well if we are able to obtain iLIGO's ITM-type optics. Cost of polishing the backsurface and AR coating per optic will be reasonable, so it is definitely worth taking this action as soon as possible.

2.3.3 MIR

Answers and Actions

- 1) Spare optics

Beam Splitter: We are having two beam splitters. We provided two substrates from the beginning to make sure that the final beam-splitter could meet the requirements. In other words, one was for both checking the substrate's quality such as thermal stability after annealing and trying their techniques in polishing/coating. Although they are still working on the second one at the moment, luckily, the first one has been already delivered with a good quality which meets most of our requirements. In the final product, they will try both to compensate substrate's inhomogeneity and to minimize the power in the transmitted wavefront at 45 degrees. Although they did not do the same thing for the delivered one, it can be used as a spare one not to cause a major delay in the project. Probably, it will take several months at least to have a new substrate, so it will be necessary to obtain a new substrate as soon as possible. Considering the clipping issue that recently appeared in aLIGO, we also might need to consider having larger size in diameter.

2.3.3 MIR

Answers and Actions

- 1) Spare optics

Recycling optics: We made transmission spheres for all PRM/SRM, PR3/SR3, and PR2/SR2. Since we have several AGC (Asahi Glass Corporation) glasses, it would be nice to have three spare optics. Currently, we polished PR3, PR2, SR3, and SR2 and these will be coated this year. Possibility of having spares simply depends on whether we have an enough budget for them.

bKAGRA sapphire mirrors: With the current plan, we will obtain eight substrates in total and choose four of them to fabricate two ITMs and two ETMs. Especially, crystals with smaller absorption will be selected for ITMs. We understand preparing each spare ITM and ETM will be necessary, but we also know it will not be easy with the current budget situation.

Other optics: Although optics such as mode cleaner, mode matching telescope are not currently planned to have spares, we understand we had better have at least one for each optic. This really depends on the budget and consensus how we distribute it among expenditures in the project.

2.3.3 MIR

Answers and Actions

- 2) Simulation

As for full interferometer optical configuration, we hope LIGO's new tool, FOGPrime13 developed by Hiroaki Yamamoto will do the job. Starting with a single cavity (both Fabry-Perot and triangle configuration), we will move on to iKAGRA and bKAGRA optical configuration to see effects of various imperfection on the dark port wavefront quality. This should help us finalizing the specification of sapphire optics such as figure error, profile of AR surface to compensate inhomogeneity of the substrate. We also expect to learn degree of importance in each optic quality to the dark port. We also strongly feel we will have to pursue both mechanical and thermal analysis using FEA techniques.

2.3.3 MIR

Answers and Actions

•3) BRDF measurement

Currently, we are doing coating R&D on sapphire substrate. The final product includes 200mm ETM-like-coated optic and several 1-inch witness samples. We are planning to characterize these optics, and one of them is BRDF measurement. We should be able to learn the level and feedback to the design of the mirror.

•4) Compensation plate

Although there was no internal discussion so far, it is likely this option would not come in the early stage of bKAGRA. But, we think as least we need investigate possible degradation of the performance by doing various simulations addressed above.

2.3.3 MIR

Answers and Actions

Comments by Somiya-san

[Comments summary]

(1) Spare silica mirrors

(2) Simulation (?)

(3) BRDF

(4) TCS

[Response]

(1)(3) -> Ando-san's answer will be good.

(2) Is there such a question in the report??

The simulation has been done with FINESSE as a part of the work of OMC.

(4) Simulation results tell us 1% RoC error is tolerable and TCS will not be needed for TMs. As for the BS, the intensity is about a half of aLIGO and the TCS is hopefully unnecessary. A simulation will be performed by FFT and FINESSE soon.

2.3.4 VIS (1/3)

- The effort appears substantially understaffed, putting the delivery schedule at risk and amplifying likelihood of unforeseen problems due to insufficient pre-installation testing…

- Without further action we are not confident that vibration isolation platforms will be ready in the required time frame. Some possible remedies to consider include:
  - Temporarily redirect efforts currently dedicated to later project phases, …
  - Exploit existing collaborative programs to invite isolation experts from LIGO, Virgo and GEO to accelerate VIS delivery and commissioning..

2.3.4 VIS (2/3)

- The time and effort to procure, process and test vacuum-compatible wiring has proven surprisingly long for Advanced Virgo and aLIGO… VIS should begin specification and procurement of in-vacuum cabling as soon as possible….

- A complete instantiation of each type of VIS structure required in iKAGRA should be completed and tested as soon as possible to verify compliance with isolation models, and to develop an integration and test program template for commissioning on site.

2.3.4 VIS (3/3)

- The integration schedule does not currently appear to reflect the time required to characterize each completed assembly and to verify compliance with model and template expectations. This activity requires the attention of the most highly skilled team members, and also stands in series with subsequent installation steps.
- Vacuum preparation and clean pre-assembly is currently shown happening in three or more locations. We urge the team explore ways to mitigate shipping damage and recontamination as early as possible; in some cases, assembly on site may be the only safe option …

2.3.4 VIS

Answers and Actions

- Understaffing issue

The understaffed problem will be settled by employing additional staffs under the new JSPS budge. Though the manpowers were decentralized (NAOJ and ICRR), they concentrate to NAOJ now.

- Temporarily redirect efforts

Some procurements, assembly, and installation related to Type-A system will be postponed to the bKAGRA phase. The resources in VIS will concentrate to the works on iKAGRA.

- Exploit existing collaborative programs to invite isolation experts

NIKEF group is committing to the production of inverted pendulums as well as GAS filter development strongly now. E. Majorana in Virgo and J. Kissel in LIGO are giving us very useful advices. We plan to invite K. Arai in LIGO for Type-C system.

2.3.4 VIS

Answers and Actions

•In-vacuum cable

We made initial specification using Kapton flat cable and PEEK connectors (JGW-T1100499). However, the Kapton flat cable was not soft enough to ignore its elasticity. We could find a FETP flat cable made by Gore, and measured its outgassing ratio. The ratio was less than Kapton's one. There were electrical problems still in the normal flat cables not twisted and not shielded. We will employ a FETP twist-pair-shield cable referring V. Dattilo's report (VIR-0405A-12). The FETP cable has been already designed for KAGRA by Gore.

•Full system test

In our strategies, the full prototype test in TAMA was the most important task to instantiate the main VIS. Now the test for the payload part is very delay. We must finish the payload test as soon as possible, and go to the full prototype test. NIKHEF group is helping the task strongly.

2.3.4 VIS

Answers and Actions

- Integeration schedule

The schedule braked down more is necessary. The process to verify compliance should/would be clear. The highly skilled members are very limited.

- Shipping damage and recontamination

Assembly of the pre-isolators and the filter chain would be moved from Akeno observatory to Kamioka site. A clean booth capable to enclose the full Type-B system will be prepared in the site.

2.3.5 GIF (1/1)

- We are excited to see the long-term prospects of GIF to improve the robustness and low frequency sensitivity of bKAGRA.
- Given the conditions noted above, we suggest that SEO may consider temporarily delaying the phasing of GIF and reassigning resources to bridge urgent manpower shortages in other iKAGRA subsystems…
- The intention to install only two broadband seismometers, at tunnel locations far from the test masses, is puzzling…. We recommend that at least one additional sensor should be procured, and the instruments then deployed locally within the corner and end stations.

2.3.5 GIF

Answers and Actions

- Delaying the phasing of GIF

GIF subgroup is in charge of both the construction of the laser strainmeter and the arrangement of Environmental-Monitor sensors. According to the suggestion, we consider more effort on the latter role (EM sensor arrangement) to contribute to rapid start-up of iKAGRA rather than direct manpower reassignment to other subgroups because GIF manpower is already poor and the reassignment will have little impact on the iKAGRA progress. As for the laser strainmeter, we start with minimum configuration, and as the precursory observation its knowledge will be made use of iKAGRA operation.

- Number and position of seismometers

We proposed minimum number of broadband seismometers mainly because of the budget problem. We accept the recommendation within the limited budget, and will prepare three seismometers for the corner and end stations. To reduce the cost, 120-sec seismometers, including reuses of vibration sensors in CRY, will be used instead of 240-sec because the noise performance is similar and can be used for feed-forward configuration while their cost is less than half.

2.3.6 IOO (1/1)

- We are concerned by severe understaffing in this category. … We suggest the program consider temporarily reassigning or reprioritizing staff assigned to components with later bKAGRA installation horizons, to insure the iKAGRA components are ready according to schedule.

- As for MIR, the lack of spare optics in IOO threatens to halt the project at a most critical integration stage. We strongly recommend procuring spare optics of each type that is not available instantly from stock as a standard catalog item.

2.3.6 IOO

Answers and Actions

・Additional Staffing

SEOからは特推での特任助教の雇用をリクエストしたのですが厳しそうです。例えば廣瀬さんかSaschaにインストレーションの間だけ100％入射光学系をやってもらうことは可能でしょうか？

・Spare Optics

現在、中野君や麻生君に必要な物品のリストをまとめてもらったところで、そのうちCLIOやTAMAからどれがもらえるかの検討・交渉中です。それらが分かり次第、必要な金額をSEOに提出します。その際一応スペアも含めた方がよいかと思いますが、予算措置の実現は厳しい状況かと推測します。

2.3.7 LAS (1/1)

- We endorse the proposed use of the existing laser adapted from LIGO. Because power requirements for iKAGRA are expected to be modest, even further simplification (for example, to just an NPRO oscillator) should be considered. This may permit refocusing of effort on other subsystems considered higher in risk.

2.3.7 LAS

Answers and Actions

-

2.3.8 MIF (1/3)

- iKAGRA commissioning currently appears to be limited by the anticipated late delivery of the beamsplitter isolation system, which delays the first exploration of cavity locking on the 3km baseline. If this linkage persists, we suggest the team explore compensating for the missing beamsplitter by insertion of a dummy optic, or manipulation of the input telescope alignment. This may enable earlier full-baseline locking studies using the X arm.

2.3.8 MIF (2/3)

- We strongly support the team's initiative toward exploiting the iKAGRA experiment as much as possible to reduce risks, train the commissioning team, and shorten commissioning time for bKAGRA. … (some technical suggestions)

- Another possibly useful test could be enabled by introduction of a mode-stabilizing telescope modification to iKAGRA. This would allow end-to-end exploration of the complex DRMI length and alignment controls needed for bKAGRA, reducing future commissioning risk.

2.3.8 MIF (3/3)

- We suggest the team may consider implementation of a digital power stabilization servo, to enable lower-noise readout of interferometer degrees of freedom. This can similarly act as a proof of principle or pathfinder for future bKAGRA power stabilization.

- We suggest that the intended "pop-up" beam targets, to be inserted into the beamtube apertures, may not be required; indeed, they may introduce unnecessary risk (e.g., leakage or mechanical malfunction)….

2.3.8 MIF

Answers and Actions

•For each suggestions

* The suggested earlier test of X-arm locking without BS (by tweaking the input telescope alignment) is certainly something we should try if we find a time slot to do it.

* The suggested list of possible tests to be performed with iKAGRA is very helpful. We will try as many of them as possible.

* Although it is not in the default plan for the iKAGRA IOO, we are thinking about implementing a simple form of power stabilization in iKAGRA. Whether it will be digital or analog depends on the readiness of the DGS at the time.

* We will certainly reconsider the installation of the beam targets. Removing them will also be a non-negligible cost saving.

2.3.9 AOS (1/3)

- We reviewed iKAGRA plans for only three AOS components; viewports, optical levers, and stray light control. We observed that the development status on all three remains at a conceptual level; design, fabrication, testing and installation status appears inconsistent with the proposed iKAGRA schedule. Indeed, current staff effort allocated to AOS was characterized as "less than one third" of that required.
- It was reported that insufficient budget has been provided to furnish optical quality viewports for interferometer beam input and output. Since the interferometer cannot function without these, we presume the conclusion is mistaken. We recommend SEO resolve the discrepancy and clarify the plan to procure these critical, long-leadtime components.

2.3.9 AOS (2/3)

- A possible contributor to the above confusion may have been the very high price quoted for such viewports, perhaps two to five times the cost for comparable items in LIGO and Virgo. We recommend consulting with international colleagues and/or seeking alternate vendors, to bring viewport costs more in line with expectations.

- AOS staff members attributed delays in optical lever design to a lack of defined requirements, and indicated confusion regarding who is responsible for determining such requirements….

2.3.9 AOS (3/3)

- Similarly, the AOS scope of responsibility for stray light control in iKAGRA appeared to remain largely undefined. This was partly attributed to lack of an integrated optomechanical layout, depicting machine geometry along with beam trajectories. However, at least some confusion also seems to arise from vague definition of the mission. We recommend that SEO and associated subsystems (MIF, IOO, VAC, etc.) establish concrete requirements for iKAGRA stray light control as soon as possible.

2.3.9 AOS

Answers and Actions

-

2.3.10 DGS/AEL (1/5)

- We are pleased to see excellent progress toward providing digital signal infrastructure and subsystem front-end support. Extensive sharing of LIGO architecture has reduced risk and minimized design investment for KAGRA.
- This sharing should also help to broaden the pool of experts for technical support and reduce the chance of obsolescence, for both programs. We recommend continued tight coupling between the LIGO and KAGRA digital electronics groups to avoid unnecessary divergence.

2.3.10 DGS/AEL (2/5)

- While channel and signal properties have been organized and carefully estimated, we did not understand the plans for generating real-time front-end code. VIS, IOO and MIF code presumably need to be created soon; however, prototype opto-mechanical systems are not available for experimentation. DGS may consider adding support for real-time physics plant simulators, to allow initial subsystem code development in the absence of real hardware.

2.3.10 DGS/AEL (3/5)

- The problem of building and testing analog electronics for all subsystems is a source of deep concern. The large number of modules currently expected significantly exceeds the group's capacity, and some groups (e.g., AOS) have not yet articulated all their requirements.
- ... To illustrate this concern we note, for example, that the technician, EE and physicist staff assigned to module fabrication and testing (not including design) appear to be less than 25% of resources assigned to comparable work in aLIGO.

2.3.10 DGS/AEL (4/5)

- The committee is further concerned that, in response to high quoted costs for vendor outsourcing services, the team is actually considering bringing more electronics production in-house, rather than less. The committee suggests pursuing other vendors for electronics fabrication, rather than asking KAGRA team members to engage in this activity.

- Beyond the difficulty in providing an initial complement of functional analog electronics, the committee fears that assigned staff may also be unable to maintain and update these electronics through commissioning and operation….

2.3.10 DGS/AEL (5/5)

- We share the AEL leader's concerns about field connection wiring. Our joint experience is that unreliable connections, poor labeling, and badly chosen cables and routes quickly render complex experiments unstable and impossible to diagnose. Depending upon students and postdocs to run high-performance wiring is a dangerous risk for any experiment larger than a tabletop.

- Each of these concerns leads us to recommend that a) the schedule for AEL be significantly relaxed, and b) additional qualified electronic engineering staff be added, if possible resident at the observatory site.

2.3.10 DGS/AEL

Answers and Actions

- Simulated Plant

The problem is that a very few people are familiar with real-time front-end model not only in DGS members but also in whole KAGRA members. We had referred and modified existing models which was used in 40m or iLIGO for VIS, and will refer current aLIGO model for IFO at the very initial stage of KAGRA until some experts grow up. This can reduce much time for initial implementation of models, and can wait for growing some experts by playing with existing models.

Privately I am very interested in simulated plants. However simulated plants are not actively being discussed even in LIGO. Development of simulated plants is not an easy task and it will be a burden for us.

On the other hand, we are operating the Large Network System which is a test bench for KAGRA digital system and has several real-time front-end PCs working with ADCs/DACs. They can test real-time front-end models for example lsc, asc, suspensions, even if real time hardware does not exist. They can be accessed by remote PCs, so multiple people can contribute the development.

2.3.10 DGS/AEL

Answers and Actions

- Group's capacity for analog electronics

We totally agreed with these comments. We think 25% is a pretty reasonable number, but actually active AEL members are less than 2% of KAGRA's collaborators. Currently we stated asking other new collaborators to share the tasks specially for VIS circuits, but still resources are not enough at all. We will strongly ask SEO to assign more people.

- Cost of vendors and in-house production

At the very beginning, during we were searching good companies, we ordered to some expensive boards or chassis. Currently we are using the company which manufactures probably the lowest cost circuit boards in Japan, and very good U.S. company to make low cost but high quality chassis introduced by LIGO engineers. For fabrication, we found a good company and we are discussing with them to assemble/inspect boards, connectors, cables into chassis. However the cost for such assembling/inspection is not small, and out budget is very tight.

2.3.10 DGS/AEL

Answers and Actions

•Upgrade capacity of circuits

We are referring the existing circuit diagrams only for well updated or well used in LIGO/VIRGO. Even so, modifications or replacements will happen one day during installation/commissioning. We may ask each subsystem to find a source of problem and re-design a new circuits if needed, and then we modify/manufacture. This may reduce our tasks for maintenance.

•Wire connections

Honestly we have no good idea to answer for this question. One way is to ask professional company for such wirings/installations, but the signals from each subsystem are still not well determined and they won't be defined shortly, so the term of wiring/installation lasts for long. We do not have enough budget to keep the company in the mine so long. After all, we are currently thinking to do by ourselves.

2.3.10 DGS/AEL

Answers and Actions

- Relaxing the schedule and additional staff for AEL

Thank you for the comment. We would like to emphasize b). Clearly the number of people working at the site is not enough at all, and it will be more tough once the installation/commissioning starts.

2.3.11 DAS/DMG/DetChar (1/2)

- We are pleased to note that, perhaps alone among the subsystems, the data analysis team is now fully staffed according to plan, with approximately 8 FTE assigned and active.

- The committee applauds the diligence of the group in pursuing the development of GW search algorithms. We strongly encourage increased collaboration and interaction with corresponding LSC and Virgo search groups, to insure that KAGRA efforts complement, reinforce, and extend, rather than simply duplicate, established search pipelines.

2.3.11 DAS/DMG/DetChar (2/2)

- On the other hand, the group has committed little to the critical function of detector characterization, with less than one FTE assigned….

- Finally, the data analysis group asked the Committee's advice in suggesting "scientifically publishable" GW searches that could be based on data from the proposed iKAGRA data run.
The question frankly seems outside the scope of our Committee's charge. We believe that no astrophysically interesting search can be performed using iKAGRA data...

2.3.11 DAS/DMG/DetChar

Answers and Actions

-

2.4 bKAGRA Design

2.4.1 AOS (1/2)

- Design calculations for the cryo duct shield backscattering presumed that its motion is excited only by modeled ambient seismic noise. However, the shield cryocooler, other adjacent equipment, and tunnel ventilation and drainage are actually expected to introduce much greater motion.

- This presents a risk that optical backscatter from the shield may contaminate the bKAGRA noise spectrum. That risk is compounded by the requirement that this shield be installed in the iKAGRA phase, since it is subsequently trapped in place and inaccessible..

2.4.1 AOS (2/2)

- We recommend that the backscatter calculation be revisited using a realistic vibration excitation spectrum (if possible, a representative measured one). We further suggest exploring modifications to allow modest seismic isolation of the shield. Finally, we suggest modifications to the installation plan, or to the vacuum envelope design, to allow access and possible retrofit at a later date.

- We support the simplification of the Transmission Monitor beam reducing telescope by use of only spherical mirrors. K. Kawabe (LHO) can offer other lessons learned in commissioning the aLIGO beam reducing telescopes.

2.4.1 AOS

Answers and Actions

-

2.4.2 MIR (1/3)

- We believe that the current baseline plan to proceed without spare sapphire optics presents an unacceptable risk to the program. We strongly recommend generating and qualifying for use at least one interchangeable spare of each test mass type and configuration, concurrently with the initial fabrication cycle.

- Similarly, other long-lead custom optics such as recycling mirrors, mode matching mirrors, mode cleaner mirrors, Faraday isolators, etc. should be provided with interchangeable spares, according to a conservative engineering risk analysis.

2.4.2 MIR (2/3)

- As presented, the projected effect of wide-angle backscattering presumes it will be limited by measured fine scale microroughness. However, actual realizations of interferometer optics typically exhibit excess Lambertian scattering, due (for example) to point defects or dust. We recommend directly measuring the wide-angle BRDF of sapphire test optics, and perhaps obtaining LIGO and Virgo data obtained from installed cavity mirrors. The scattering noise budget should be revisited with this information.

2.4.2 MIR (3/3)

- We are concerned about the deleterious effects of potential mode mismatch between the bKAGRA arm cavities. We suggest investigating the option to install compensation plates in order to match the mode between the arm cavities, either initially or perhaps as a phased upgrade.

- We suggest that the extensive list of optical modeling tasks required to support bKAGRA design should be assembled, clarified and prioritized. Without a review of these calculations, it is not clear that the sapphire optics' parameters have been correctly specified…

2.4.2 MIR

Answers and Actions

Described together in Section 2.3.3

2.4.3 CRY PAYLOAD (1/3)

- Recent work on attachment losses and other cryogenic suspension technology was very encouraging, and the team has made excellent progress.

- However the research team is now sharply reduced in size, just as more detailed investigations are needed. We are concerned that the schedule presented for finalizing and fabricating the cryogenic payload is unrealistic, given the large remaining uncertainties. Significant R&D is required before a design can be validated with respect to requirements, and this type of research is intrinsically time consuming.

2.4.3 CRY PAYLOAD (2/3)

- We recommend the team continue to pursue economizing alternatives, as they have suggested. For example:
  - Modify (delay) the schedule for bKAGRA cryo payload integration..
  - If this is impossible, deploy a temporary payload arrangement (such as a "cradle‟ or "dead bug") to enable early exploration of cryogenic and systems integration issues, while a final, full-performance solution is developed It should be noted that under current manpower and budget restrictions, the latter approach may prove a distraction, and actually cost more schedule than it saves; this possibility should therefore be considered cautiously.

2.4.3 CRY PAYLOAD (3/3)

- We suggest further review of the proposed cooldown and warming sequences. Speeding up the cycle time will greatly leverage commissioning efficiency. We suggest exploring exchange of simulation software with the LIGO/Cryogenics group; they are also working on cooldown and heat extraction calculations and experiments.

- Given likely burdens of tuning, performance enhancement, and repairs, we suggest that cryogenic cycling times may still render the stated commissioning and operating plans for bKAGRA, such as observing duty cycle, overly optimistic.

2.4.3 CRY PAYLOAD

Answers and Actions

- Overall plan

An employment by a new Grant-in-Aid for scientific research partially stops reducing staff. We continue to pursuit final configuration of a monolithic suspension. If R&D of a critical component stuck, a partial replacement of the component would be considered within the minimum modification.

- Cooling and warming-up time

Speeding up of cooling and warming process is investigated under a new Grant-in-Aid for scientific research. A review will be planed maybe in a start of bKAGRA phase.

End

Appendix
3rd External Review Summary

Previous PAB Report

- In 'Planning of iKAGRA' section of PAB (Nov. 2013)

Recommendations:

We recommend that KAGRA hold an external review of its planning for iKAGRA early in 2014, indicated as a possibility in the opening presentation. The act of preparing for such an external review will help identify necessary tasks and focus the team's attention on preparing for a successful installation and commissioning effort.

→ We had an external review on April 2nd – 4th , 2014.

Three Types of Reviews

- Internal review
  - Review design, schedule, etc. of each subsystem by SEO and other subsystem leaders.
  - (1) Dec. 2010 - Jan. 2011, (2) Dec. 2011 - Jan. 2012
- External review
  - Review design, schedule, etc. of each subsystem by external experts in the GW field.
  - (1) Feb. 2011, (2) Feb. 2012, (3) April 2014.
- Program Advisory Board (PAB)
  - Review management, progress, design, etc. by senior (management) people in the GW and neighboring fields.
  - (1) Jun. 2011, (2) Aug. 2012, (3) Nov. 2013.

Previous External Reviews

- Previous (2nd) External Review (Three days, April, 2012)
  - Scope: Detailed design/development status of subsystems.
  - Reviewers: 7 experts from the GW field.
    Stefan Ballmer, Raffaele Flaminio, Andreas Freise,
    David Ottaway, Roberto Passaquieti, Benno Willke,
    Michael E. Zucker (Chair).
  - Report from review committee on May 4th, 2012.
  - Remote follow-up meeting on Sept. 25th, 2012.
    → KAGRA reported actions on the recommendations.

Scope of This External Reviews

- This (3rd) External Review (Three days, April, 2014)
  - Scope:
    * Primary on Installation/Commissioning plan for iKAGRA (2014-2015). ← Different from previous ones.
    * Important issues in bKAGRA design and plan (2016-).
  - Reviewers: 5 experts from the GW field.
    Rana Adhikari, Mike Landry, Giovanni Losurdo, Harald Lueck, Michael E. Zucker (Chair).
  - The final report expected in a month,
    We will have a follow-up meeting

Review Program

(1) Status of the Project.
Show the status/plan as boundary conditions of discussion.

(2) On-going or fixed Subsystem.
TUN, FCL, VAC, CRY(cryostat), GIF.
Little issues to discuss. Explain at first as premises.

(3) Subsystem which can be critical paths.
IOO, VIS, MIF.
Detailed discussions are expected.

(4) Subsystem which can affect them:
AOS, AEL, DGS, MIR, LAS.

(5) Subsystems for observation.
DMG, DAS, DC.

(6) Topics picked-up from bKAGRA Design.
MIF, AOS, MIR, CRY.

2nd April (Wed)

Time	Title	Speaker
	Project Overview	
10:00 ~ 10:10 (10)	Welcome Address and Introduction	T.Kajita
10:10 ~ 10:30 (20)	Scope of External Review	M.Ando
10:30 ~ 10:40 (10)	Budget Status	M.Ohashi
10:40 ~ 11:00 (20)	Scope/Overall Schedule	K.Somiya/Y.Saito
11:00 ~ 11:30 (30)	Installation and Commissioning Plan	M.Ohashi/S.Kawamura
11:30 ~ 12:00 (30)	TUN/FCL/GIF(env)	T.Uchiyama/S.Miyoki/A.Araya
12:00 ~ 13:00 (60)	Lunch	
	iKAGRA Plan 1	
13:00 ~ 13:30 (30)	VAC/CRY(cryostat)/GIF(vac)	Y.Saito/T.Suzuki/A.Araya
13:30 ~ 14:30 (60)	IOO/LAS	K.Kawamura, N.Mio
14:30 ~ 15:10 (40)	Closed Meeting and Break	
15:10 ~ 15:30 (20)	MIR (Silica Optics)	E.Hirose
15:30 ~ 16:30 (60)	VIS	R.Takahashi
16:30 ~ 17:30 (60)	Closed Meeting	
	Dinner	

3rd April (Thu)

Time	Title	Speaker
	iKAGRA Plan 2	
10:00 ~ 11:00 (60)	MIF (iKAGRA)	Y.Aso
11:00 ~ 11:30 (30)	AOS(oplev, viewport)	T.Akutsu
11:30 ~ 13:00 (90)	Lunch	
13:00 ~ 13:30 (30)	DGS	O.Miyakawa
13:30 ~ 14:00 (30)	AEL	O.Miyakawa
14:00 ~ 15:00 (60)	DMG/DAS/DetChar	N.Kanda, H.Tagoshi, K.Hayama
15:00 ~ 15:30 (30)	Closed Meeting and Break	
15:30 ~ 16:30 (60)	Reserved	
16:30 ~ 17:30 (60)	Closed Meeting	
18:00 ~ 20:00	Banquet at Hassai	

4th April (Fri)

Time	Title	Speaker
	bKAGRA Plan	
10:00 ~ 11:00 (60)	CRY (Suspension)	H.Kimura/K.Yamamoto
10:00 ~ 10:20 (20)	MIF/IOO (bKAGRA)--> *Canceled*	Y.Aso/K.Somiya
11:00 ~ 10:20 (20)	AOS (Baffle, BRT)	T.Akutsu
11:20 ~ 11:40 (20)	MIR (Sapphire)	E.Hirose
12:00 ~ 13:00 (60)	Lunch	
13:00 ~ 15:00 (120)	Closed Meeting	
15:00 ~ 15:30 (30)	Concluding Session	
15:30 ~ 17:00 (90)	Closed Meeting	

What to be Presented by Subsystems

- Scope and boundary condition of the subsystem.
  - Goal of the subsystem, Constraints from overall plan.
  - Boundary condition by available resources (Budget, Manpower, Facility).
- Installation and Commissioning plan.
  - What, When, Where, How to install and to operate.
  - Important milestones and detailed breakdown for reasoning.
- Risk, Backup plans, Options, and Margin.
- Issues on which advises are needed.

Charge of Review Committee

- Confirm installation and commissioning plans for iKAGRA.
- Identify potential problems with each subsystem.
- Recommend to the management on go/no-go for the installation plan.
- Produce a report describing recommendation and action items.
- Check our responses to the recommendations in a remote meeting.

Recommendation Report

- Concluding Session in the evening of the 3rd day.
  KAGRA members will hear the preliminary recommendations by the review committee.

- The final report will be summarized by the committee in a month.

- Follow-up meeting to report actions on recommendations.

Summary

The scope of the external review is originally on installation and commissioning plan for iKAGRA.

However, there were a lot of discussions and comments on project dynamics. The reviewers had strong concerns.

We should seriously take these advices and recommendations into account and make actions to them.

These action will the key of the success of our project!

Actions underway…

- Circulate the report to EO-SEO-Chiefs
  → Summarizing the comments.
- Full survey of the budget situation
  → Reassign more to iKAGRA.
- Bottom-up discussions for the scope
  → ‘’Scope of KAGRA2016’
  in the 3rd-day morning session

3rd External Review of Kagra

Summary of Findings

•KAGRA Program Advisory Board (Nov. 1st, 2014)

Overall

- We are impressed and enthusiastic about the completion of the tunnels. Congratulations!
- Subsystem development has been outstanding
- We share your hope that new funding can be secured

•KAGRA Program Advisory Board (Nov. 1st, 2014)

iKAGRA Plan

- We are concerned that the proposed schedule is not achievable with anticipated resources
- If the iKAGRA data run at end of CY2015 is an absolute priority, the entire team will need to refocus on achieving this goal.
- Otherwise, the schedule and objectives of iKAGRA must be reassessed.

•KAGRA Program Advisory Board (Nov. 1st, 2014)

Budget Concerns

- Several “Show Stoppers” are identified as depending on budget, e.g.,
  - Vacuum pumps, optic spares, viewports, X end escape
- Irrespective of new funding, “show stoppers” should be eliminated
- Resources must be redirected to mitigate such serious threats.

Team Dynamics

- We feel that communication can be improved within the team
- Increased transparency and narrowed focus will help everyone to pull together
- We recognize that conditions are extremely difficult, but see that great advancements have been achieved.
- The team is outstanding in every way except size!

•KAGRA Program Advisory Board (Nov. 1st, 2014)

Acronyms of Subsystems

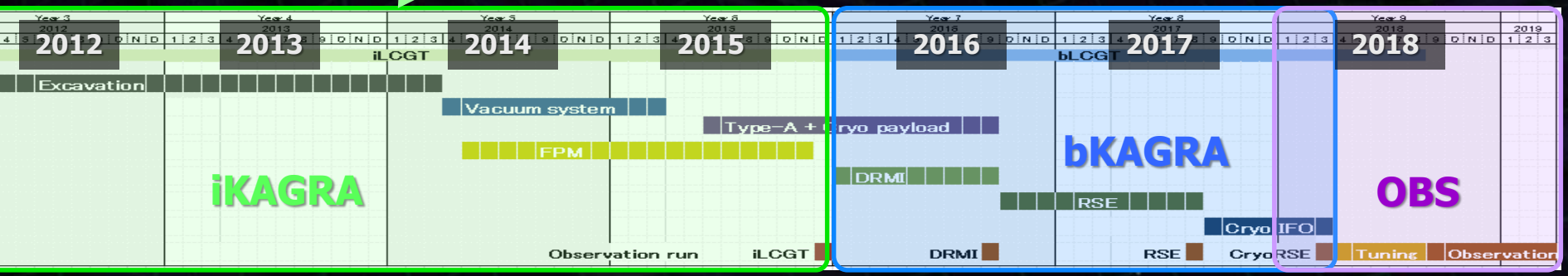
TUN: Tunnel
FCL: Facility
VAC: Vacuum system
CRY: Cryogenic system
VIS: Vibration Isolation

LAS: Laser
MIR: Mirror
MIF: Main interferometer
IOO: Input Output Optics
AOS: Auxiliary Optics

AEL: Analog Electronics
DGS: Digital Electronics
DMG: Data Management
DAS: Data Analysis
DetChar: Detector Characterization
GIF: Geophysics Interferometer

KAGRA Schedule

- **iKAGRA** (2010.10 – 2015.12)
  3-km FPM interferometer
  - Baseline 3km room temp.
  - Operation of total system with simplified IFO and VIS.



- **bKAGRA** (2016.1 – 2018.3)
  Operation with full config.
  - Final IFO+VIS configuration
  - Cryogenic operation.