2nd J-PARC MUSAC committee meeting
Held at the KEK laboratory, Feb 19Th 2004

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Executive summary:

The concepts of the MSL facility are now on a firm footing and many components are ready for tendering as soon as the budgets are made available. The facility has only one production target from which initially two and later four muon beamlines will be derived.

The muon facilities are being integrated with the neutron ones with a goal of making more efficient use of common infrastructure and eventually allowing more synergies between the two communities. The production target modules, proton beam transport and associated support services are at the detailing stages. The current plans are based on established technologies and are being reviewed for operational constraints (alignment, replacement, repairs etc…). The graphite production target itself is pushing on existing technologies and some concerns have been uncovered regarding its long term stability due to material modification under intense radiation (shrinkages) . However the committee feels that this is not a problem for the initial operation at the lower beam current and that back up solutions exist for the longer term should the static target not prove stable at high power.

The user community is starting to develop the new kind of spectrometers that could use the full pulsed muon intensities that will be produced at J-PARC. Plans for new ultraslow muon beams are being developed that will create unique opportunities.

Due to a shortage of funding for experimental facilities, it is proposed to set a strategy that will encourage externally funded equipment to be brought at J-PARC by experimental teams (be it Japanese or foreign).In return some (to be specified) priority beam allocation could be granted. The committee agrees that this is a viable strategy which has been used at other muon, neutron or light sources but it recommends that the J-PARC management defines minimal standards that such equipment would need to meet as well as what support will be provided by J-PARC for groups wanting to use these facilities. A contractual arrangement could be signed between the parties as is done for the Collaborative Research Group at the ILL.

Finally the committee agrees that a strategy for allowing Japanese physicists improved access to muon beamtime in the interim period between the end of the KEK-PS operation and the start of the J-PARC operation is crucial to maintaining the expertise in the Japanese community. The resolution of such demand will have to done at the laboratory management level.

Response to recommendations from 1st MuSAC meeting:

In its first report the MuSAC committee had formulated three basic recommendations:

-The issue surrounding the lack of funds for completing the shielding around the muon production target has been resolved by JEARI allocating supplementary funds.

-The user community has started to work on specific concepts for new instruments for J-PARC MSL with the capability of making full use of the very intense pulse muon beams to be available in 2007.

-The committee noted that better coordination was happening between the muon and neutron facility developers.

MuSAC04 report:

The second meeting of the Muon Science Advisory Committee (MUSAC) was held at the KEK laboratory on February 19Th 2004 to address the following charge as presented in appendix A:

1. Intermediate review of J-PARC.MSL Construction plan.
2. Evaluation of the first phase experimental program.

The composition of the committee for this meeting is given in Appendix B and the meeting agenda in Appendix C.

The meeting was followed by a meeting of the Executive Council of the International Society for MuSR Spectroscopy (ISMS) and hence two members from the executive participated in the MUSAC deliberation as observers.

After the welcome greetings from the Director of KEK-IMMS, Dr. A. Koma and from the director of the J-PARC project, Dr. S Nagamiya, the committee heard a status report on the J-PARC project construction including an overview, a report on the status of the Rapid Cycling Synchrotron accelerator and its injection Linac, a presentation of the development of the Materials and life science Facility and its proton beam transport line. It is clear that despite some delays and funding cash flow limitation, the project is moving ahead at full speed and that the first beams from the 3GeV booster should be available to users by the end of 2007 . This aggressive schedule has been bought by the developers and dictates when the experimental facilities have to ready. The Linac achieved a major milestone in Nov 03 when 30 mA were accelerated at 20 MeV. The reduction of the Linac injection energy from 400MeV to 180 MeV will not affect much the beam quality at the muon production target but the beam intensity will be reduced initially to .6 Mwatts from .7Mwatts. This was followed by more detailed presentations of MSL facility components.

After lunch the committee was given on overview of recent developments and future plans at muon facilities around the world to place the J-PARC effort in perspective. This was followed by a description of experimental projects envisaged at JPARC.MSL and of the development of a strategy for access funding for the experimental program outside of the J-PARC construction and operating budget.

The committee presented its preliminary conclusions at an oral close out session attended by the director of the J-PARC project.

General remarks:

The committee noted with interest a definite change of perception in the user community which is now focusing in getting ready to exploit the muon facilities which are being developed since the J-PARC MSL facility is now moving forward with a good expectation that beams will start to be available in 2008. The committee was very pleased to note the creation of a muon user group as part of the JEARI material science division . It is not too early to consider operational requirements as they affect the design and construction of the facility.

Review of the J-PARC.MSL construction plan:

There has been excellent progress on the conceptual design of the facility to the point that engineering contracts will be let for a large fraction of the systems as the budgets become available. The main building infrastructure will be available at the end of 2005 and installation will start then. In this intense design phase the committee noted an increased level of cooperation between the develpers of the neutron and muon facilities on one hand and across the J-PARC project as a whole. However more can be done for such subsystems as the proton beamlines, proton beam monitoring devices, remote handling tools and concepts, production targets, etc…

Many of the conceptual designs rely very heavily on simulation tools. The program of systematic prototyping and testing must continue and be expanded to validate the calculations and take into account fabrication imperfections. Such testing and quality assurance must be included at all levels but in particular in the development and construction of reliable production target where failure will lead possible considerable downtime for both meson and neutron users.

The facility group is aware of the challenges ahead and has good connection with experts at facilities with similar environments.

Much of the discussion centered around the design of the muon production target itself. The reference design is based on an edge cooled static graphite disc. It is noted that the very large intensity target at PSI and LAMPF relied on rotating wheel to distribute the heat load and radiation damage. Such a system is more complex to operate and less flexible but has proven to be very reliable. The static disc solution is shown to meet the requirements in principle but the issue of shrinkage under radiation exposure may lead to heat transfer impedance which could affect adversely the cooling effectiveness of the copper envelope and lead to failure of the graphite disc. The effect has been observe at PSI and other facilities but is difficult to quantify as it is graphite dependant. In any case the committee feels that for initial operation at lower current the disc solution will work and that there is time to continue R/D on high powered targets . A fall back position exists if needed by using a rotating system.

The proton beam transport system is now well defined and matches the emittances expected from the 3 GeV Rapid Cycling Synchrotron. A simulation of the muon fluxes from the proposed target configuration using the calculated proton beam envelop has been developed and predicts fluxes of 3.0 *10^7/s in a 40mm diameter spot for surface muons, 1.6*10*^{7}/s for positive decay muons. The work is shifting towards the optimization of the secondary channel optics.
Remote handling considerations have moved forward very well and good integration with neutron facility developer's concepts is happening. Sharing of the flask transport system and of the handling area is envisaged. Very good concepts exist and are transferred to engineering experts for detailed designs. Air handling and radiation controls are developed in collaboration with the neutron facility and a good integration of the building lay out was presented .

Budget: The current budget allocated to the MSL facility was 12.2 OKU Yen in the first phase initially distributed as follows: 5.05 OKU Y for the target and scraper assembly, 5.7 OKU Y for the shielding and 1.5 OKU Y for the primary beam line. A revised estimate was presented which takes into account the reduction of the number of muon production targets from 2 to 1, the increase cost for the primary beamline assigned to MSL and infrastructure costs which were not included in the building cost . Initial secondary beamline costs will add to the shortfall bringing the total missing funding to 8.1 OKU Y. A solution to this funding problem is expected as part of the KEK laboratory Commitment to the muon program. Assuming such solution the remaining budget shortage will be for the basic instruments for the experiments. Outside funding source are to be considered for that part.

The committee compared the above cost estimates to typical cost for muon facilities at PSI, RAL and TRIUMF and concluded that they were in the same bulk part but with large error bars due to different manpower costs accounting.

Progress towards first phase experimental program:

INSTRUMENT DEVELOPMENT:

RF Muon spin control apparatus by Kadono-san: Dr. Kadono presented a design for a spectrometer that would make full use of the very high pulsed muon beam at J-PARC-MSL. The design is based on time differential Rf $\pi/2$ pulse muon spin resonance .Building on past experience with spin echo technics, prototype experiments at KEK have demonstrated the feasibility of this technics. This could be coupled to a large segmentated detector as described by Shimomura-san.

Both designs represent considerable new advances in MuSR spectrometer technology and could form the basis for funding proposals to Japanese Agencies. This places the MuSR community in Japan at the forefront of detector development and would also be of interest to the world community at large.

HENCE THE PRESIDENT OF THE ISMS OFFERED TO ORGANIZE A DEDICATED WORKSHOP ON INSTRUMENTATION FOR FUTURE MUSR EXPERIMENTS AND ON THE COORDINATION OF INSTRUMENTS ACROSS MUSR FACILITIES WORLD WIDE.

SLOW MUON PRODUCTION:

The production of slow muon by a resonant ionization technique is viewed as the most promising way of achieving high fluxes of slow muon with very sharp time structure. The excellent phase space characteristic of such beams would allow the development of microbeams in the future and hence attract the users with small thin samples.

MUON CATALYZED FUSION:

Important new information is coming along regarding the importance of the initial molecular state on the fusion rate. The main effort is carried out by the RIKEN-RAL collaboration using facilities at KEK,ISIS and TRIUMF. The focus has been on D+D fusion while the Dubna effort is on TT fusion . In both cases, theoretical support provided by the Mucatex group in Moscow will be essential. The Japanese group is leading the experimental effort at the moment and will be relying on getting access to high fluxes of high energy negative muons which can be expected at J-PARC. The key issue is to understand if the control of the initial molecular state is important and to extend the experiments into the high temperature high pressure regime.

INTENSE HIGH ENERGY MUON BEAMS FROM KAON DECAY:

The committee heard a new proposal to develop intense 150 Mev muon beams based upon Kaon decay at rest. The 3GeV proton energy of the RCS is adequate and would provide half of the maximum possible Kaon production useful for this purpose. (The optimal production occurs at 10-12 GeV).These higher energy beams would have high luminosity due to their well localized origin on the surface of the production target. They could be used for interesting new application like muon radiography and could form one of the core projects discussed in the next section.

Core funding issues:

The committee received a proposal to encourage user groups to seek funding for developing core facilities to be located at the muon source. User groups who would provide specific instruments or beam line components would be given some preferential treatment in beam time allocation. It is proposed that for a number of " α " years, the group providing a major instrument/beamline would have a dedicated fraction of the beamtime " β " available on that line. The committee compared the proposed scheme with those in place at neutron user facilities worldwide(ILL, PSI, ISIS, LANSCE, SNS, KEK,Jeari), at synchrotron light sources and other muon sources. The proposal of Dr. Nagamine is not far from the concept of Collaborative Research Groups at ILL. See Appendix D.

The MuSAC committee endorses the general concept of Core User Groups as proposed by Prof. K. Nagamine as an important way to provide funds and manpower for the development of unique MuSR instruments at JPARC. However, MuSAC would like to hear from key representatives of the muon user community at our next meeting before deciding on recommended contractual details between the Core User Groups and JPARC operations. These details include the fraction of beam time allocated to the Core Users, how this time is allocated (PAC review?) and types of user support provided by J-PARC. A modified MuSAC committee could be charged with evaluating the merit of any core proposals being put forward by users.

In parallel, the management of J-PARC should quickly establish the ground rules for generating such proposals and their evaluation. It should also establish soon the minimal technical standards which should be imposed site wide for all instruments contributed to the facility.

In regard to the latter, we recommend that J-PARC strongly consider providing common muon/neutron support for such things as software, cryogenics, electronics, data acquisition, etc.
These matters were discussed by the International Advisory Committee at their March 04 meeting and in their recommendations to management as well.
Integration of the neutron and muon programs is viewed as a crucial step towards efficient and effective use of the J-PARC MSL facilities. In particular commonality of , for example, user support, cryogenics , electronics, data acquisition software support and protocols should be explored at the earliest opportunity.

We also urge the Japanese meson society to support this new and exciting project at J-PARC. A society representing the neutron community already exists. It is recommended that meson users society coordinate with the neutron users to establish a coherent user policy.
The user group should also be expected to provide information on instrument demands in the medium and long term and to this end coordinate with the proposed core users.

Access to muons during the shutdowm of KEK-Muon facility:

Access to muon beams for Japanese users will be crucial to maintain a vibrant program while the J-PARC complex is being built. It is very important to continue the training of young researchers who will form the core of the J-PARC program. Possible relocation at other laboratories should be explored and the management of J-PARC should be negotiating with their counter parts for improved access to muon facilities during the construction period..

Concluding remarks:

It is time to engage the full user community right away and to develop a strategy and a policy for allowing external groups to build experimental stations at the end of the muon beamlines , thereby allowing groups to take advantage of funding opportunities outside of the J-PARC envelope. This policy should apply to other communities around J-PARC (Neutron, pion… users) and be uniformly applied.

Appendix A: Charge to MuSAC04

1. Intermediate Review of J-PARC.MSL Construction Plan

   a. Is Design/Plan correctly done for the following difficult items?

      Target material and structure vs heavy irradiation effect, possible test
      Target-scraper chamber structure
      Primary beam line components; monitor, accelerator-interaction
      Services for beam-line tunnel
      Radiation shielding
      Secondary muon beam lines; effect of target structure
      Other beam-line components
      Near-Future Extension; Super-Omega, etc.

   b. Is financial plan reasonably arranged?

2. Evaluation of the First-Phase experimental programme

   a. Is proposed experimental proposal proposed by the KEK-MSL group sound in terms of physics content and technical feasibility?

      μSR; pulse vs high time-resolution
      μCF (non T)
      Slow μ^+ & microbeam
      Future directions; μCF (with T) ,14 MeV neutron source, muon cooling, etc.

   b. Is "Core-User Plan" correctly arranged for possible domestic as well as international collaborations?

Appendix B: MuSAC committee membership:

Member of 2nd J-PARC.MuSAC

J. Akimitsu	(Aoyama Gakuin Univ.)
S. Ikeda	(KEK)
Y. Ikeda	(JAERI)
M. Iwasaki	(RIKEN)
K. Nagamine	(KEK)
N. Nishida	(Tokyo Inst. Tech.)
Y. Miyake	(KEK)
Y. Yamazaki	(JAERI)
H. Yasuoka	(JAERI)
R. H. Heffner	(Los Alamos Lab.)
C. Petitjean	(Paul Scherrer Inst.)
L. I. Ponomarev	(Kurchatov Inst.)
J. M. Poutissou	(TRIUMF Lab.)

< Guest member >

H. Yokomizo	(JAERI)
P. J. C King	(RAL)
R. Cywinski	(Univ. Leeds)
K. Nishiyama	(KEK)

Appendix C: Agenda of the 2nd meeting of MuSAC, Feb 17-18 2004.

2nd J-PARC.MuSAC

(Rev. '04.02.18)

February 19, 20, '04
KEK bldg. #4

AGENDA

February 19 (Thu) 9:00 – 18:00

0. Opening (9:00 – 9:15)

Greetings	KEK-IMSS Director	A. Koma
	J-PARC Project Director	S. Nagamiya

1. Report of J-PARC Project Construction (9:15 – 10:15)

Overview (15 min)	S. Nagamiya
RCS Accelerator (15 min)	Y. Yamazaki
Materials and Life-Science Facility (20 min)	Y. Ikeda
3NBT Proton Beam Line (10 min)	S. Sakamoto

2. Report of J-PARC.MSL Facility Construction (10:30 – 12:00)

Overview (30 min)	Y. Miyake
Primary-Line Components, Details (15 min x 2)	N. Kawamura, S. Makimura
Secondary-Line Components (15 min)	K. Shimomura
Comment (15 min)	J. L. Beveridge

------- Lunch -------

3. Review of Present and Future of World-Wide Muon Facility (13:00 – 14:45)

PSI (15 min)	C. Petitjean
TRIUMF (15 min)	J. M. Poutissou
ISIS-RAL (15 min)	P. J. C. King
RIKEN-RAL (15 min)	M. Iwasaki/K. Ishida
Dubna (15 min)	L. I. Ponomarev
KEK-MSL (15 min)	K. Nishiyama

4. Experimental Projects at J-PARC.MSL (15:00 – 17:00)

Proposal of "Core-User" Plan (30 min)	K. Nagamine
μSR Condensed-Matter	
KEK-MSL (20 min/10 min)	R. Kadono / K. Shiomomura
Core User Candidate	(Y. Koike, E. Torikai, J. Sugiyama)
Fundamental Muon Physics, μCF, Others	
KEK-MSL (15 min x 2)	Y. Miyake, N. Kawamura
Core User Candidate (20 min)	(K. Ishida), K. Nagamine

5. Committee Closed Section (17:00 – 17:30)

------- Welcome Party (18:00 –)-------

February 20 (Fri) 9:00 – 14:00

1. Committee Closed Session (9:00 – 12:00)
   1-1. Evaluation and Comments on Construction Status of J-PARC.MSL and Proposed Experimental Program
   1-2. Discussion and Evaluation on "Core User" Plan

------- Lunch -------

J-PARC .MSL Core-User Plan

1) Search Committee

J-PARC MuSAC (Muon Science Advisory Committee) under JAPRC Project Director Prof. Shoji Nagamiya

2) Qualifications of Applicant

Research physicist, outside KEK-MSL, who can satisfy the following two requirements.

a) Propose and, after MuSAC approval, take a leadership role in an advanced muon-science experimental research-project at the J-PARC .MSL with a term of around 5-years
b) Obtain research fund(s) from funding agencies outside the J-PARC main-budget for the following expenses
   i) basic instrumentation required for the proposed experiment
      e.g. μSR spectrometer, set-up for muon catalyzed fusion experiment
   ii) facility support funds needed for the completion of beam channel and associated instrumentation

3) Successful applicants will have

a) Exclusive use of the JPARC-MSL beam time, during α years and β fraction, at the experimental port where proposed experiment will be conducted. The number of α and β will be decided by MuSAC.
b) Strong support from KEK-MSL to encourage the Director of KEK-IMSS (Institute of Materials Structure Science) to accommodate the applicant as a Visiting Professor or Visiting Associate Professor. The final decision will be made by the KEK-IMSS Executive Committee.

Appendix D: A quick survey of the modes of operation at n,m,g, sources

Here is a quick survey of the modes of operation at n,m,g, sources which operate in a user mode:
ISIS: neutron and muons users are treated on the same footing. 2 calls for proposals per year, reviewed by specific panels. Beamtime is scheduled for the next 6 Months. There are no private instruments and no charge for beamtime. (Some agreements are made with specific groups with industrial connections). The laboratory provides support for the operation of the instruments and a contact person for each experiment.

PSI: Neutron and muon users are also treated on the same basis with dedicated Program allocation committees. The schedule is determined on a yearly basis in January for the following 9 months of beam delivery (April-Dec). No beamtime fee. PSI provides supports for instruments and research scientists to help external groups. A coordinator is overseeing the operation
There are no private beamlines except on the light-source.

Institut Laue Langevin (ILL): the user program for scientists from the "owner" countries is fully supported by ILL who have dedicated use of 24 instruments.
Proposals are reviewed twice a year and beamtime is scheduled within 6 months for approved experiments. (Beamtime is oversubscribed by factor of 2 or 3).
For the other 35 beamlines, two types of Collaborative Research Groups(CRG) are established:
Type A) Outside users providing an instrument and full technical support. Revenue neutral to ILL. Beamtime is not controlled by ILL. Users external to that group must negotiate access with the CRG.
Type B) Shared beamline for ILL/external users. A fraction of the beamtime is available to the CRG group members without ILL peer-review. The other fraction is allocated through ILL' peer review process. Generally technical support is provided by ILL while scientific support comes from the CRG itself.
These CRG's are controlled by strict contractual arrangements of typically 5 Year duration and the contracts are peer-reviewed after the fact at renewal time.

US LANSCE: there are no private beamlines and no charge for beamtime. All proposals are peer-reviewed. The laboratory provides full support for operating the instruments.

Japan: CRG concepts are used on the neutron facilities with 50 % of the beamtime available to the group and 50% for the users at large . The group allocation is only reviewed as a package once a year while the user fraction goes to the program advisory committee for evaluation and approval twice a year.

TRIUMF: MuSR user facility operation with technical and scientific support provided by special peer-reviewed funding . TRIUMF is providing managerial and some technical support. There is no charge for beamtime but a user common fund (based on beam/instrument usage) is established to provide additional development/improvement funding for the instrumentation. Proposals are peer-reviewed twice a year and no beam privileges are in place.

Executive summary: （MuSAC2 答申の骨子）

ミュオン科学実験施設は、今や強固な基盤技術開発の裏付けの元に概念設計がなされており、数多くの構成機器の入札の準備が整い、予算が認可されるのを待機している状況にある。

ミュオン施設では、１つの生成標的から当面は２本、最終的には４本のミュオンビームラインが引き出される。共通の基盤設備をより有効に使いこなすという観点からいうと、ミュオン施設は、中性子施設と有機的に結合されつつあるといってよい。ひいては、J-PARC 物質生命科学実験施設（MLF）を利用する２つのコミュニティの間により強固な相乗効果をもたらすであろう。生成標的、陽子ビーム輸送系並びにこれらに伴う保守に関しての詳細が検討されている。現行の計画は確立された技術を背景として、アラインメントや交換・修理といった作業に係わる条件の洗い出しがなされている。グラファイト製の生成標的に関しては、これまで培われてきた技術開発を更に押し進めつつあるが、一方で、強い放射線場に於けるグラファイトの物性変化（収縮効果）によって引き起こされる、長期的な安定性に関する課題が明らかになりつつある。しかし、当委員会は、この問題はビーム強度の小さい初期の運転時には問題にならないし、静止標的が大強度では安定でないとしても、長期的には、他の解があるであろうと考える。

ユーザーコミュニティは、J-PARC で得られる大強度のパルスミュオンを検出する事ができる新しいタイプのスペクロトメータの開発を始めている。また新しい超低速ミュオンビームの開発が更に進んで、ユニークな実験環境が作り出されるであろう。実験施設の予算が不足しているので、ユーザー実験グループ（日本人の場合も、外国人の場合もある）が、外部資金により J-PARC 施設に機器を導入する事を奨励する指針が提案されている。その代償として、制約条件はあるにしても、優先的にビーム配分を受ける権利が与えられる。 当委員会は、この方針は、他のミュオン・中性子・放射光源施設でこれまで採用してきた実行可能な方法であると認める。これらの施設を使いたいユーザーグループに対して、J-PARC 側は、どのような装置でなければならないか、またどのようなサポートをするかを決定し、提示しなければならない。ILL 研究所の共同研究グループでなされているように、当事者間で契約書を取り交わすことも考えられる。これらのチームによって提案された実験を、各々の割り当てられた優先期間の開始前と終了時に、専門家による評価を受ける制度を制定することが肝要である。

最後に、当委員会も、KEK-PS 運転終了から J-PARC 運転開始までの間、日本人の研究者がミュオンのビームタイムをより容易に得やすくする事がミュオン科学専門家を保ち、育成する為に必要であると考える。しかし、このような要求は、研究所の執行部によって解決されるべき課題である。