Report
of
Muon Science Laboratory Review Committee

Institute of Material Structure Science
Inter-University Research Institute Corporation
High Energy Accelerator Research Organization

Meeting June 7-8, 2004
KEK, Tsukuba, Japan

Content

July 10, 2004

Executive summary:

The committee set up by the KEK laboratory management to review the activities of the Muon Science Laboratory (KEK-MSL) met at KEK on Monday and Tuesday June 7 and 8th 2004. The review committee was very impressed by the quality of the documents submitted as evidence of the scientific accomplishments of the MSL group and by the presentations during the open session.

The KEK-MSL group exploits the KEK muon facilities which are producing both surface and backward low energy muon beams from the proton booster synchrotron at the KEK-PS complex, as well as facilities they have established at TRIUMF and at the Rutherford Appleton Laboratory (RAL), these later being operated by RIKEN as the RIKEN/RAL facility. The group acts also as a support group for Japanese University scientists who wish to access muon beams at these facilities. The group has access as well to some of the best materials produced in Japan, a key requirement for material science studies.

The committee identified key results which can be attributed to the group in the area of correlated systems, magnetism, superconductors, semiconductors, few body (μCF) physics and instrumentation, for example: discovery of magnetic order in heavy fermion systems, studies of time reversal symmetry breaking states, new superconducting materials like MgB_2, organic conductors and shallow donors states in semiconductors.

The group has also contributed to major new advances in instrumentation with innovative beamline concepts, new detectors and new methodologies for extracting very slow muon beams. These achievements are also in a world-class category.

The group has had a very high productivity and has trained many good graduate students (7 PhD theses in the last 7 years were entirely based on muon physics done and supervised by the MSL group and 15 University based graduate students used the KEK-MSL facilities as part of their theses.). In terms of quality and quantity of the publications produced by the KEK-MSL group, the committee evaluates them as extremely good.

The group is leading the effort to establish a muon facility at the J-PARC project in Tokai. The prospect of developing the world's most advanced pulsed muon beams facility is extremely attractive and should position Japan at the forefront of Materials Science with an access to pulsed muon fluxes unequal anywhere else. With a concurrent access to one of the most intense neutron source on the same site, this will present a unique opportunity for Japan. It is also an opportunity to try and bring in other areas of Japanese Science and in this regards the committee has suggested that the KEK/MSL

group try to engage the chemical reaction dynamics community in Japan, since pulsed lasers coupled with Muonium reactivity could also provide a unique niche on the world scene.

The plan for the new muon facility are realistic but demanding and the ambitions of the group are limited by funding and manpower resources. Recognizing this limitation, the group has develop a staged approach which should let them have two muon channels soon after the turn-on of the J-PARC 3 GeV proton beam, with an upgrade path to four channels from a common production target. However, the funding in place is very tight and may lead to severe compromises which may affect the long term development of the full facilities. The plan calls for recycling some of the existing elements from the KEK facility to minimize the cost. This is possible except for the front end of the channels which have to be made more radiation hard and remotely handle-able and where short-cuts would be very costly in the long term. The committee is satisfied that a realistic plan is in place but recommends that KEK finds a way to mitigate the funding shortfall.

However, the Japanese community will have to rely on foreign muon sources to maintain a scientific program during the period when the KEK beams will be stopped and before J-PARC will start operation. This is a major threat to the program as university groups will want to have access to facilities if they are to maintain a graduate student program. The committee is of the opinion that the KEK management should lead an effort to negotiate preferential treatment for the Japanese users at foreign laboratories. In parallel and as importantly, the MSL group should assign a support person who is very familiar with the foreign mode of operation to help and mentor University groups during this transition period. The KEK-MSL group is most familiar with all aspect of the other laboratories modes of operation and can provide this valuable service for the community.

Overall the committee was very impressed by the accomplishments of the KEK-MSL group, by their enthusiasm for establishing a superb world class muon facility at J-PARC and believes that this group has a critical role to play in maintaining a science program at KEK and in the Japanese Universities both prior to and after the start up of J-PARC.

The committee believes that the muon part of the Institute of Materials Science of KEK is providing Japan with unique opportunities and its integration in the Institute must remain a strong objective of KEK.

Introduction:

The committee set up by the KEK laboratory management to review the activities of the Muon Science Laboratory (KEK-MSL) met at KEK on Monday and Tuesday June 7 and 8th 2004. The charge to the committee from the Director General of KEK, Prof Y. Totsuka, is reproduced in Appendix A. It consisted of evaluating the past scientific achievements of the MSL group, its preparation to exploit the new J-PARC complex under construction and to recommend advice on the plan for bridging the gap in the availability of muons to Japanese scientists during the transition phase between the shutdown of the KEK PS facilities and the start of operation of J-PARC.

The MSL group prepared two documents which were circulated to the committee members ahead of the meetings, a white paper covering all activities and giving statistical data and a record of recent publications with a selection of the 40 most important reprints as selected by the MSL-group leaders. Monday was devoted to oral presentations and interactions between users and the committee. The review committee was very impressed by the quality of the documents submitted as evidence and by the oral presentations during the open session. The committee developed its recommendations during the in-camera session on Monday evening and Tuesday morning. These were presented in a draft form to the director of IMSS-KEK, Dr. A. Koma and to the MSL group in a close-out session on Tuesday.

The KEK-MSL group exploits the KEK muon facilities, which are producing low energy muons beams from the proton booster synchrotron at the KEK-PS complex, as well as facilities they established at TRIUMF and at RIKEN/RAL. The group acts also as a support group for Japanese University scientists who wish to access muons at these facilities. The group has access to some of the best materials produced in Japan, a key requirement for material science studies.

This report is organized along the three elements of the charge given to the committee, scientific evaluation, J-PARC activities and transition period. The scientific evaluation is broken into the specific subfields of strongly correlated systems, superconductivity, new materials, semiconductors, muon catalyzed fusion and other muon science and instrumental developments

1) Review of the scientific achievements of the KEK-MSL group:

The first element of the charge for the committee was to review the scientific achievements of the KEK/MSL group.

"1. Review scientific output so far achieved at the Muon Science Laboratory of Institute of Materials Structure Science, KEK. Evaluate quality and productivity in general."

This evaluation is based on the white paper and publications circulated ahead of the meeting as well as on the oral presentations at the meeting. The committee was appreciative of the quality of these contributions. The next section is organized according to the topics identified in these documents.

a) Strongly correlated systems:

The KEK-MSL has achieved important contributions in the field of strongly correlated electron systems. In particular, the high sensitivity of the muon relaxation to small magnetic moments offers a unique opportunity to study heavy-fermion systems. One good example is the discovery of a magnetic order below 70 mK in $YbRh_2Si_2$ which is known by its non-Fermi liquid behavior associated with a quantum critical point [F. Iga et al., Phys. Rev. B65 (2002) 220408]. Another remarkable achievement in the heavy-fermion systems is the identification of the two phase competition in URu_2Si_2 between the antiferromagnetic state, with a moment of normal size and the non-magnetic state, which was reported by Prof. H. Amitsuka in the review.

The muon spin rotation and relaxation technique has been a powerful tool to study the unconventional nature of superconductivity. Dr. W. Higemoto reported in the review that recent μSR experiments on $PrOs_4Sb_{12}$ revealed the spontaneous appearance of static internal field below T_c. This is an indication that the time reversal symmetry may be broken in the superconducting state of this first $4f^2$-based heavy-Fermion superconductor. On the other hand, in the family of new heavy Fermion superconductors $Ce\mathit{T}In_5$ (T=Ir, Co), no sign of magnetic long range order or the breakdown of time reversal symmetry was detected by the muon relaxation.

Concerning the heavy-fermion behavior observed in the transition metal oxide, LiV_2O_4, results of muon spin relaxation measurements were reported in the review by Prof. Kadono. It is very interesting that the μSR signal suggests the presence of inequivalent local magnetic moments at V sites.

The review committee finds that the activities of the KEK-MSL on the strongly correlated electron systems to be outstanding and recommends that they will be further strengthened in the future.

b) Superconductivity:

A strong case was presented to the committee about the specific advantage to use the μSR technique to study the superconducting state of novel systems (presentations by Dr.Y. Koike, Dr. W. Higemoto, Dr. J. Arai, Dr. R. Kadono and Dr. Y. Aoki). Hence, by using μSR one is able: i) to probe the spin-state of Cooper pairs below T_c; ii) to study the temperature dependence of the penetration depth; and iii) to test the occurrence of possible "Time Reversal Symmetry Breaking" (TRSB) states.

Such μSR measurements are considered nowadays as ultimate tests for potential unconventional superconducting states and it is the committee' opinion that KEK-MSL played a leading role in this field. Several studies reported to the committee made extensive use of the μSR specificity.

For the recently discovered superconductor $Na_xCoO_2\ yH_2O$, evidence was shown about the occurrence of a novel superconducting state characterized by a gap with line node and no TRSB (talk by Dr. W. Higemoto; W. Higemoto et al., to be published).

Precise studies performed on the heavy-fermion series of Ce*T*In_5 (*T*=Ir,Co,Rh) confirmed the spin singlet state and the absence of TRSB phenomenon [presentation of Dr. W. Higemoto; W. Higemoto et al., J. Phys. Soc. Jpn. 71 (2002) 1023].

On the novel superconductor MgB_2, the temperature of the penetration depth obtained by μSR confirmed the two-gap model for the superconducting state. In addition, the magnetic dependence of the penetration depth shows an increase characterized by a gradient incompatible with a d-wave superconducting state (talk by Dr. Ohishi).

Through several high quality oral presentations (talks by Dr. Y. Koike and Dr. J. Arai) and an impressive list of published articles [M. Akoshima et al., Phys. Rev. B62 (2000) 6761; I. Watanabe et al., Phys. Rev. B62 (2000) R11985; I. Watanabe et al., Phys. Rev. B60 (1999) R9955; M. Fujita et al., Phys. Rev. B67 (2003) 014514; H. Mikuno et al., Phys. Rev. B68 (2003) 024524; J. Arai et al., J. Low Temp. Phys.131 (2003) 375], a strong case was made for the capability of μSR to provide unique information on the interplay between magnetism and superconductivity. This is recognized to be one of the key issues for the so-called high-T_c cuprate superconductors. By investigating several cuprate families, it was demonstrated that the anomaly occurring at a hole-doping of 1/8

is common to all high-T_c cuprate systems. In addition, evidence for the major role played by the dynamical stripes of holes and spins on the appearance of high-$T_c$superconductivity was presented. The committee was also favourably impressed by the development of pressure cells reaching 1.3 GPa, which, in a first step, have been used to clarify the interplay between magnetism and superconductivity in high-T_c cuprates.

c) New materials:

The committee heard a presentation by Dr. K. Ohisi, representing a collaboration between KEK-MSL and ASU, on "materials", with MgB_2 as a illustrative case, all of which fall in the area of high-T_c new superconductivity and related systems. Since High-T_c superconductivity is a phenomenon of the past 15 years, all such materials could be called "new". The KEK-MSL group has an impressive track record in utilizing μSR, both at KEK and abroad (mainly TRIUMF and RAL) in exploring these new materials and this is an important "flagship" area for the initial phase of the J-PARC project. These kind of studies will continue to be important and should be strongly encouraged in the future. Other example of new materials fall in the realm of organic conductors and organic magnets and conducting polymers and this was showcased in the "40 selected papers" compilation from the group. [I.Watanabe et al., Phys Rev. B58 (1998) 2438; F.L.Pratt et al., Phys. Rev. Lett. 79 (1997)] In these papers nice examples of the true interdisciplinary nature of μSR research can be found, where quantum chemistry and condensed matter physics go hand in hand. This area should perhaps be strengthened more in the future since there are many organo-metallic and inorganic chemists developing new devices from these kind of materials. The involvement from the chemistry community would benefit the μSR program and would bring a more broadly based appeal in Japan for the J-PARC project. It can also be noted that understanding the spin relaxation phenomena in conducting polymers is an important starting point to evaluate proposed ID electron transport phenomena in biological macromolecules. Though not a new material, the paper of R.M. Macrae et al., Chem. Phys. Lett. 259 (1996) is another nice example of the interplay between quantum chemistry and μSR.

d) Semiconductors:

Muonium atom is an isotope of hydrogen which can be used to get information on the role of hydrogen in the technologically very important field of semiconductors. Dr. Shimomura presented two recent excellent studies demonstrating that it was in fact hydrogen impurities that provided shallow donors states in ZnO and GaN samples [Phys.Rev.Lett.92 (2004) 135505] and possibly in many other semiconductors. The use of laser techniques particularly well adapted to the pulsed nature of the KEK and later of the J-PARC muon beams opens up a new opportunity in pulse beam muon research for

example in reaction dynamics as commented in the executive summary of this document. Another important scientific contribution is contained in a paper on the bond center site of muonium [K.Shimomura et al. Hyp. Int.138 (2001) 515].

e) Muon catalyzed fusion and other muon sciences:

The KEK-MSL group has played a pioneering and leading role in studies of the optimal parameters for muon catalyzed fusion in pure deuterium and tritium-deuterium mixtures, both in solid and liquid phases. The KEK-MSL group, under Prof. K.Nagamine, has established the most definitive experimental determination of the key muon sticking probability (the probability that a muon would stick to the fusion produced helium and consequently be removed from further possible fusion cycles). Key experimental techniques were developed to do such measurements by exploiting the pulse structure of the muon beams at KEK and RAL. The group has demonstrated that up to 100 fusion cycles can be achieved so far, but a much wider range of temperatures and pressures could be studied at J-PARC with better higher energy negative muon beams.

Recently the focus of the group has shifted towards understanding the importance of the initial molecular state of the deuterium molecule, e.g. ortho-para effects, in the formation of the meso-molecular state. New experimental results have challenged the ab-initio theoretical calculations of this formation process. Resonant formation could be involved and would provide for many possible enhancement factors. A strong theoretical support in few body physics is available both in Japan and in Russia to confront the experimental findings.

As diagnostic tools, muons and in particular high energy muons, offer unique opportunities in many fields. Their long range in matter due to the absence of strong interactions, and the Z dependence of the multiple scattering cross section make muons ideal probes of bulk materials and their elemental compositions. Several innovative use of muons were presented ranging from the use of high energy cosmic ray muons to study the progression of magma in volcano chimneys to detecting structural anomalies on railway car wheels. The high quality of monochromatic 150MeV muons beams from kaon decay expected at the J-PARC muon facility could provide a unique tool for such investigations.

f) Instrumental developments—Ultra Slow Muons & Dai Omega:

(presented by Y.Miyake and K.Shimomura)

The ultra slow muon beam project in progress at KEK-MSL has various important

features such as its low kinetic energy, low emittance, high spin polarization and particularly its narrow pulse width. The KEK-MSL group has succeeded to prepare ultra slow muon beams with a pulse width as narrow as 9ns(FWHM), employing laser resonant ionization of thermal muonium emitted from a hot W target directly irradiated by the proton beam from KEK PSB. The pulse width realized here is at least ten times narrower than that from a straightforward degrader method employed during preliminary studies at ISIS, which is governed by the pulse structure of the primary proton beam. In addition, it appears to be of the same order as the width obtained at PSI. In the coming J-PARC project, a further improvement of the pulse width is foreseen into the picosecond range, which is only reachable with the laser ionization method developed by the KEK-MSL group. The beam intensity is now ~10 muons/s, and is expected to reach 2-4x10^4/s if a new dedicated slow muon channel is approved. Once enough number of ultra slow muons are available, a new field of muon science will emerge, which could include surface physics, surface chemistry, pulsed laser excitation and laser induced fluorescence in muonium chemistry at very low pressure, and high precision QED measurements.

Further as a byproduct, ultra slow tritium beams have also been successfully extracted by slightly re-tuning the ionization laser at the present KEK-MSL, which could be an interesting new probe in various fields of science.

The Dai Omega is a muon collector newly developed by the KEK-MSL group and has 20 times larger solid angle (~1str) than a conventional muon channel. This order of magnitude improvement allows one to investigate new aspects in muon science.

Actually, the 4MeV surface positive muon intensity available at KEK-MSL with the Dai Omega solenoid is comparable to that of RIKEN-RAL facility, currently the world strongest pulsed muon beam. The group has in parallel developed an electric separator and a high rate μSR spectrometer, both of which are essential to use the Dai Omega to its full capability. Another important aspect of the Dai Omega is its strong axial focusing feature, which is also quite a unique property.

Such high abilities in developing excellent “tools” described above clearly show that the KEK-MSL group is a world-leading group of muon science not only in their own research aspects but also in the support aspects of the muon community. Once the proposed projects are approved combining with the J-PARC facility, a new generation of muon science will start.

2) **Review of the J-PARC muon facilities:**

"2. Review experimental facilities at the start of the J-PARC muon facility, which is scheduled in early 2008."

The committee heard presentations of the concepts for the muon facility at J-PARC. These are in a very advanced state and incorporate lessons learned from existing high intensity beam facilities. There is a good integration of the infrastructure with that of the neutron facilities. No show-stopper is foreseen, with the possible exception of the lifetime of the thin carbon target used for muon production when J-PARC will be operating at the designed luminosity of 1MW.

The initial facility will include the front-end parts (that is the components of the beamline that are in the radiation shield of the muon source and primary proton beamline) of two muon channels, and one general purpose beam line from the relocated KEK-MSL superconducting muon channel. It is important to concentrate the effort on the front end systems as any intervention after start-up of beam delivery will be made extremely difficult and costly in time and manpower. This is the area where funding pressures may lead to short-cut measures. However the committee recommends that no compromises be tolerated in these front end components as they would translate in much larger costs and downtime later for both muon and neutron users.

By incorporating the new spectrometer developed for the DAI-Omega project (which can handle large data rates due to its 128 fold multiplicity), a general purpose facility should be available for the initial operation of the muon arena that delivers surface and decay muons with a two-order-of-magnitude intensity improvement over the existing KEK-MSL line, during the ramp up of the proton beam power (10% of design value). This should be attractive from day one. One other order of magnitude will be realized when the full 1MW beam is available but this will also necessitate further upgrades of the data acquisition systems.

By providing the front end-parts for a second muon beam line to the north, it will be possible to develop a second source of surface muons using other components from existing lines at KEK, if other funds can be found from other sources to complete the installation. This is an attractive proposition which fits well in the Collaborative Research Group Initiative as envisaged by the IAC. The newly established JAERI muon group could be the leader of such initiative.

The committee would like to recommend going beyond just reestablishing the present excellent program of the KEK-MSL laboratory at J-PARC. It sees a much more exciting prospect of developing new unexplored areas of research bringing together an

extended user community in materials research, life sciences, physical chemistry and industrial applications. To reiterate, the unique combination of very high intense pulsed muons beams and powerful pulsed lasers within the same repetition rate opens up a new realm of possibilities marrying Mu reactivity to the (Japanese) chemical reaction dynamics community, which would be truly unique to both J-PARC and the world. The newly developed slow muon source based upon laser excitation of muonium is one such exciting prospect as was discussed in section 1-f. The committee would like to recommend that the level of awareness of such prospects be raised in the Japanese and international community by sponsoring topical symposia at major scientific society annual general meetings.

In parallel the continued strategic development of state of the art instrumentation should be fostered to match the unprecedented intensities that could be available at J-PARC. In that respect the availability of the RIKEN-RAL pulsed beam facility is key to such development program both in terms of beam tests and training of young researchers.

The committee agrees with the MSL proponents that the high brightness, slow pulsed muon beams that could be developed at J-PARC would represent a flag ship program of international appeal. However, the installation of such a channel in the second phase of J-PARC will be challenging and such an installation must already be anticipated in the present design of the new target area and its remote handling capabilities. A second example of a new exciting prospect is the development of a high resolution 150MeV muon beam from kaon decay at rest which would open up the field of bulk material characterization.

The committee is of the opinion that the prospects for excitement at the J-PARC facility outweigh the short term pain necessary to get there and congratulates the MSL group for leading the charge.

3) **Transition period:**

"3. Recommend the way how to keep activity during dead time between the PS shut-down and the start-up of J-PARC facility."

The committee sees three main tasks to be accomplished during the transition period, estimated to be of the order of three years, during which no muon beams will be available in Japan.

- the new J-PARC based muon facility has to be built
- the university based community has to be supported to transfer their activities abroad at existing muon facilities like TRIUMF, PSI and RAL.
- new state of the art instruments have to be developed to fully exploit the unique features of J-PARC to provide the world with those unique opportunities.

The KEK-MSL group is too stretched to carry out all three of these missions effectively. However the committee believes that the development of the J-PARC muon facility is of utmost importance and every thing has to be done to get the initial phase of the J-PARC muon source on schedule for first beam delivery in the initial commissioning phase of the J-PARC accelerators. The muon source and associated primary beamline infrastructure represent a formidable engineering task. Concepts are being developed and will be transferred to industry within a year. It is very crucial that these activities be of utmost quality as it will affect not only the muon users but the neutron users as well. (See comments in the J-PARC section of the report) The committee recommends that additional engineering/technical support be provided by J-PARC management.

One of the missions of KEK is to provide a vigorous Inter-University program. The present KEK-MSL group has accomplished this goal very well with about 330 users (70% from Japanese Universities) and 123 students participating over the last 7 years (white paper on muon research's document).

Creative solutions must be found to nurture this community in the transitional period. It was clear to the committee that the current support devoted to the provision of infrastructure and travel support for Japanese groups to work at KEK must be extended to allow similar activities in foreign laboratories. The committee saw two issues: one is a supplementary budget requirement to approximately double the current level of financial support; and the second is a role of mentorship to help University groups access foreign muon beams. In that respect the KEK-MSL group has the necessary expertise and contacts with international laboratories to act as the go-between. The committee recommends that a μSR scientist be identified to fulfill that role and smooth out the relocation of the Japanese University program. In parallel KEK as the national laboratory should develop the necessary agreements with such foreign laboratories to

access more muon beam time for Japanese users.

The third plank in this transition period is the development of state of art instrumentation to fully exploit the unique capabilities of the J-PARC muon source. This will be very important for an effective program at J-PARC when the full intensity of the Booster synchrotron will be realized. Although the initial program can make use of existing KEK spectrometers, it is every-body's expectations that by 2012 these instruments will not handle the rates available at J-PARC. The lead time for developing new instruments is rather long (2-3 years) and this responsibility seems to be left with the KEK-MSL group. It would be advantageous to engage some of the muon user community in these R/D activities and effort should be expanded along those lines with a possible benefit to University students who need projects as part of their curriculum.

However as important these developments will be for the future of J-PARC, they cannot take precedence over the first two objectives.

Conclusions:

Overall the committee was very impressed by the accomplishments of the KEK-MSL group, by the enthusiasm for establishing a superb world class muon facility at J-PARC and it believes that this group has a critical role to play in maintaining a science program at KEK and in the Japanese Universities while waiting for the J-PARC start up.

The committee believes that the muon part of the Institute of Material Science of KEK is providing Japan with unique opportunities and its integration in the Institute must remain a strong objective of KEK.

Appendix A:

Charge to the external review committee

The Director General of High energy Accelerator Research Organization, Dr. Yoji Totsuka, delivers the following charge to the External Review Committee of the Muon Science laboratory at the beginning of its deliberations:

1. Review scientific output so far achieved at the Muon Science Laboratory of Institute of Materials Structure Science, KEK. Evaluate quality and productivity in general.
2. Review experimental facilities at the start of the J-PARC muon facility, which is scheduled in early 2008.
3. Recommend the way how to keep activity during dead time between the PS shut-down and the start-up of J-PARC facility.

Appendix B:

Committee membership:

Dr. A. Amato (PSI)
Prof. D.G. Fleming (UBC)
Dr. J.-M. Poutissou (TRIUMF) chair
Prof. K. Ueda (ISSP, U of Tokyo)
Prof. H. Yasuoka (ASRC, JAERI)
Prof. Y. Yamazaki (U. of Tokyo, RIKEN)

Secretary: Prof. K Nishiyama (KEK-MSL)

Appendix C:

Agenda:

Program of Evaluation Committee Meeting

7th & 8th June 2004
Meeting Room 1, 2nd Floor, Bldg. 4

<1st day> 7th June (Mon)

Executive Meeting by the Committee Members		9:30-10:00
Greeting & Address	A. Koma (IMSS Director)	
Presentation on Overview of KEK-MSL	K. Nishiyama	10:00-10:25
Presentation on Scientific Activities		
Materials Science		
Strongly Correlated Systems	R. Kadono	10:25-10:50
Heavy Fermion Superconductor $CeTIn_5$, UPt_3	W. Higemoto	10:50-11:15
Time-Reversal Symmetry-Breaking Superconductivity in Skutterudites	Y. Aoki	11:15-11:40
μSR Study of $La_{2-x-y}M_xN_yCuO_4$ (M=Sr,Ba, N=Eu) under Ambient Pressure & High Pressure	J. Arai	11:40-12:05
-----Lunch-----		
1/8 Problem of High T_c Superconductor Studies by μSR	Y. Koike	1:00-1:25
μSR Study on URu_2Si_2	H. Amitsuka	1:25-1:50
New Materials Studied by μSR	K. Oishi/J. Akimitsu	1:50-2:15
Hydrogen Impurity Effect on Semiconductor Studied by μSR	K. Shimomura	2:15-2:40
Development		
Dai-Omega Project	K. Shimomura/H. Miyadera	2:40-3:10
Slow Positive Muon Beam	Y. Miyake	3:10-3:30
-----Coffee break-----		
Other Activities		
Muon catalyzed Fusion and Cosmic Ray Muon Radiography	K. Nagamine	3:45-4:10
Presentation on J-PARC Construction	Y. Miyake/S. Makimura	4:10-4:50
Future Plans of KEK-MSL	K. Nishiyama	4:50-5:00
Executive Meeting by the Committee Members		5:00-5:30
-----Party-----		6:00-

<2nd day> 8th June (Tue)

Executive Meeting by the Committee Members		9:30-11:30
Summary Talk		11:30-12:00
-----Lunch-----		