Report of the Neutron Advisory Committee – 2013 for J-PARC MLF Facility

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Introduction
The 2013 NAC met on 14 and 15 February 2013 in Tokai. A number of NAC members also enjoyed a very well focused tour of MLF the day before, on 13 February. The NAC appreciated the detailed written response by the MLF management to the recommendations from the 2012 NAC meeting.

We congratulate the MLF team on the continuing excellent progress achieved on many fronts. All these achievements are even more spectacular in view of the recovery period after the great earthquake in March 2011. There is a strong focus on R&D in preparation for 1MW operation and if progress continues at this pace, MLF is in a good position to achieve this goal within the expected timelines.

The NAC perceives a closer and more collaborative spirit between the different organizations that deliver the user programme. The widening influence of the CROSS organization has had a very positive impact, with staffing levels for technical support significantly increased. The reorganization of the MLF is expected to further contribute to improved technical support.

We are aware of the situation with 'outsourced staff'. This is acceptable for routine technical jobs and maintenance; however, using outsourced staff for more high tech activities including development, is counterproductive as critical expertise is quickly lost. We strongly support MLF/J-PARC management to make a case for exemption to the authorities for staff in key technical and scientific areas.

We heard from the senior management of J-PARC and MLF that there is a strong desire to internationalise MLF. We recommend forming a clear vision what this actually means and this will help to put into place the tools to achieve the goal of internationalisation.

The NAC also discussed its own future. There was general agreement that the performance of the MLF has improved year on year and the facility is now well launched to become a world leader in neutron scattering. The MLF/J-PARC management should consider if the purpose, role and composition of the NAC in its current form are still appropriate. For example, if the future focus would be on advice in achieving 1MW operation the target / moderator expertise should be strengthened further.

The NAC would also like to see an increase in the number of Japanese MLF users on the committee. International perspectives are important, but so are the views of the Japanese user community.

In the following we comment on individual areas of the facility operation as presented during the meeting.

Spallation target

We commend the J-PARC team having demonstrated a 500 kW operation test even with only 180 MeV linac energy. The test has proven that after the upgrade of the linac to full energy, the 1 MW goal would be in comfortable reach.

We were pleased to see that J-PARC worked on the development of proton beam distribution flattening by having ordered and received two octupole magnets to be installed in the beamline in 2013. The result of this measure will also be of great interest for other facilities.

The bubbling system installed in the presently operated target has demonstrated that such bubbling system is functioning in the realistic environment. Vibration measured by laser Doppler vibrometer showed significant damping of the velocity amplitude; these are very promising results in terms of mitigating the pressure waves imposed by the proton beam pulses.

The investigation of the present target window, planned for the second half of this year, is expected to give first information on the efficiency of the bubbling system on the mitigation of the pitting erosion.

In this chain of development, the follow-up target to operate full-time with a functioning bubbling system will be an important test object for further investigations scrutinising its efficiency.

These measures combined with some other proposed modifications to the target design, i.e. the double-walled beam entrance window, give confidence that a reliable 1-MW target system can be ready along with the accelerator power ramp-up schedule.

Moderators

We commend the reliable operation of the cryogenic system and the cold moderators, and the efforts of the MLF team to optimize the design and improve the procedures.

Following the 2012 NAC recommendation, MLF has realized a para-H_2-fraction measurement device and succeeded in measuring the para-H_2 fraction in the moderator loop. 100% para-H_2 fraction was confirmed just after cool-down, stable also in a 300 kW proton beam. This is a great step forward in terms of an optimal functioning of the H_2 cold moderators.

Progress was reported in improving the cryogenic hydrogen system, among others filtering and removal of impurities, in particular moisture, installation of a heater to prevent temperature variations of the moderators in case of beam trips or interrupts, and the improvement of the off-gas processing system, including the development and planned implementation of a cold charcoal trap system.

NAC was pleased to hear about the success in the development of a new Au-In-Cd decoupler, to later replace the present Ag-matrix decoupler for the sake of reduced radioactive inventory.

All together J-PARC has developed and implemented the best optimised cold moderator system for a MW class spallation source and demonstrated performance as expected

Safety

The NAC endorses the formation of a team dedicated to safety at the facility. This group is responsible for all aspects of the safety program including radiation, electrical, chemical, gas, and industrial safety. They have implemented a suitable safety review process for all proposals and tracking of samples. This is necessary as the number of samples examined at the MLF in 2012 was well over 3000 and expected to grow rapidly in the future.

The NAC congratulates the team for achieving a resolution of the issue of doing experiments on free surfaces of deuterated materials in the MLF in a way that is fully consistent with applicable regulations. The approach adopted is quite pragmatic requiring a radiation work permit, but allowing the work to be done under "uncontaminated control" allowing scientists to work at the MLF without wearing special clothes and shoes. Radiation surveys are done before and after each experiment. We also are satisfied with the procedure described to deal with an accidental spill of the sample. This is an excellent outcome.

The MLF experienced a safety incident where a sample stick was ejected from an orange cryostat and reached the ceiling of the experimental hall. The response to this incident was reasonable. After ascertaining that there was no release of radioactive material from the sample can, they banned the use of orange cryostat and performed a root cause analysis. This showed a damaged O-ring that allowed air into the throat causing the stick to be frozen in the throat and gas pressure to build upon heating the sample. When the air ice blockage melted, the stick was ejected. The safety staff communicated this incident with others at J-PARC and also with other facilities so that they could learn from the incident. The NAC is pleased with all aspects of the response to the incident. Other neutron facilities have had similar incidents and have developed modified sample sticks to prevent this type of accident. Thus the MLF should be able to modify their sample sticks as well.

Finally, The NAC applauds the dedication that Kasugi-san displayed to getting the job done safely. Safety at the MLF appears to not be simply an add-on, but rather there is a commitment to doing all things safely.

Instruments

Instrument development at the MLF has progressed well. There are currently 18 operating instruments with 3 more currently under construction. More importantly, the data produced by these instruments is extremely impressive making the MLF a world-leading facility for neutron scattering research. Based on the results reported to date and the increasing number of instruments, the NAC expects that the quantity of publications will increase quickly over the next few years. The NAC congratulates all partners in the MLF for quickly developing this exceptional instrument suite.

However, many of the instruments, particularly those used for inelastic scattering experiments are operating without a full complement of detectors. Because of the world-wide shortage of ^{3}He, this is a rather difficult situation that will require a multi-pronged approach, including the procurement of currently available detectors and the development of new types of detectors. The leadership of J-PARC and the MLF realize this and are working on a variety of technologies to resolve this issue. Thus the NAC applauds the approach taken by the MLF to address this

issue, but believes the MLF should prioritize the acquisition and/or development of detectors to achieve full detector complements on the entire suite of neutron scattering instruments.

Four different organizations operate instruments in the MLF. This results in a complex management environment. The NAC urges all partners to work together so that this complexity is not readily apparent to users of the MLF. Users must have a uniform experience no matter which organization operates the instrument. Perhaps the key ingredient in achieving this is providing similar and appropriate levels of user support. The formation of CROSS (Comprehensive Research Organization for Science and Society) is an important step in this direction. CROSS currently operates five instruments, runs the user office, etc. with other instruments being added. The level of user support on these machines is adequate and similar to that of the instruments operated by Ibaraki prefecture. The NAC is quite pleased with this development and encourages the MLF to work to expand its partnership with CROSS. While the additional staffing provided by CROSS has significantly improved staffing across the neutron instrument suite, the NAC urges the MLF to continue its efforts to achieve similar levels of staffing on instruments operated by JAEA and KEK, in particular for scientific support of the user programme.

The experimental halls at the MLF are now nearly fully instrumented with only two beam ports left for new projects, one of which (BL07) has severe space constraints. The NAC strongly supports the plan to review on a regular basis the scientific productivity and impact of each instrument to assess the need for upgrades or replacement. In addition, the MLF should develop a transparent, written procedure for closing instruments.

Infrastructure

It is a tremendous achievement that funding for the new 5-storey User Building has been approved, with stimulus package money. The NAC encourages MLF to build the biggest building it can afford, because space in any form is always at a premium. For example, the space within the building earmarked for deuteration is insufficient to do both bio- and chemical deuteration. In addition, there are as yet no funds to equip the deuteration laboratories, nor to staff them. Staff with specific expertise will be required. We suggest that the MLF choose one or other of the deuteration techniques and focus on the most important one first. We know that this planned, but it would be good to consult with other leading laboratories in this field before staffing up and/or buying the necessary equipment: ILL-Grenoble for bio-deuteration; Oxford/ISIS for chemical-deuteration; and ANSTO's National Deuteration Facility for both.

It would also be good to consult with the molecular biology group in the Quantum Beam Science Directorate at JAEA, to see what overlap in staffing and facilities can be achieved, as they are essentially on the same site.

Sample Environment

There has clearly been major progress in the sample-environment area, with the appointment of a new team and a dedicated sample-environment group leader. We endorse the MLF's plans to send some of these staff to overseas facilities, in order to observe practice elsewhere and to learn from it.

While we endorse the provision of extra space for sample-environment activities in the User building, the total amount of space is totally inadequate, and it is too far from the experiments. We wonder if the larger area of new space behind beamlines 08 and 09 could not be used instead for sample-environment activities: the space appears to be larger, and is much closer to the action on the instruments.

Devices

Regarding ^{3}He polarisation efforts, we applaud the focus on one polarisation method: SEOP. To some extent, this effort seems to have fallen behind best international practice, and we recommend that the team interacts more strongly with the facilities that are routinely achieving 80%+ ^{3}He polarisation, namely NIST and/or Jülich. It is our belief that this will be the fastest way to make immediate progress.

We applaud the development of *in-situ* ^{3}He polarisation and its implementation on the polarised reflectometer. However, we see a definite need for a dedicated laboratory space for this effort, and would urge that J-PARC also considers developing an *ex-situ* ^{3}He polarisation capability, so that many more cells can be polarised and deployed in parallel on a much larger number of instruments.

Regarding supermirrors and focussing mirrors, we were very impressed with technical developments, particularly the use of ultra-precise etching in combination with ion-beam sputtering. We believe that MLF has a real competitive edge here, and urge that such technology be employed in a compact SANS instrument – the resultant advantage in terms of cost savings, smaller beam size and the greater bandwidth made available by the shorter flight path could be revolutionary for time-of-flight SANS.

As for detectors, there has been great progress, and we really liked the MWPC/BL17 and SENJU detectors. We applaud the strategy of handing over the technical knowhow to companies who can then commercialise these detectors. One of the risks of having a very strong in-house detector group is that one can become tied to its effort, even when it cannot supply the appropriate detectors for a given application. Time will tell whether the iBix/SENJU type detectors can be made sufficiently γ-ray insensitive for inelastic scattering experiments. We would therefore recommend that MLF continues to monitor the parallel developments of BF_3 and solid-boron detectors at HZB-Berlin and ILL-Grenoble respectively. In parallel it would be worth discussing with Toshiba its possible responses to the current helium-3 shortage, with a view to other technologies it might make available.

Software development – data analysis, visualisation and modelling

The amount of data from a state of the art pulsed neutron scattering instrument is huge and not easily interpretable. A key to high quality (and high quantity) scientific output / publications is powerful data analysis, visualisation and modelling software. To provide just the basic necessary tools is a huge task and to provide a full complement of software can only be achieved in a world-wide joint effort between facilities and data analysis centres.

NAC was very pleased to see that the MLF team had carefully examined their need for software, how to structure the different components, standardise on internally developed hardware

specific software and use a data format / data structure and software environment (python) that allows for interchange of visualisation and analysis software with MANTID. i.e. MLF can both benefit from and contribute to software developments internationally.

For a focused and effective route to a full software complement it is Important to be able to prioritise, to develop a strategy for how to interact with the users, learn their most urgent needs and involve super/expert users in developing or sharing their software for general use and establish links to experts in computer simulation.

With an increasing number of NON-expert users it will also be important to have a simple graphical user interface, and software allowing such users to easily transform their measured data into physically meaningful publishable results.

User management software

Given the complexity of the management structure and process flow, we appreciate the decision to develop a customised system for J-PARC. With an increasing number of users it is essential to automate processes as much as possible.

NAC recommends to pay close attention to the 3 main beneficiaries of the user management software:

1) The user management software should provide a single user friendly entry point for the **users** – for proposal submission, arrangement for the visit to the facility, the necessary paperwork for planning and subsequently reporting on the experiment etc.
2) The user management software should be an efficient and user friendly system for the **user office** – automating the interaction with the user, the facility and authorities.
3) The user management software should be an easy (user friendly) tool for **management** to extract 'business' information on almost any combination of use, users, facilities, topics, publications, etc

User Program and Outreach

From the outside, the user programme does now seem to be more integrated than a year ago, and we commend the J-PARC, CROSS, JAEA and KEK managements for this progress. However more could yet be done. We expect that the new user portal software will help with this integration. It is heartening that there is such strong international engagement at the MLF, particularly from Korea and China, and we agree that the target of 10% international usage is a good one.

The level of publications, as recorded in two of the talks, is good and is appropriate for this stage of MLF's development. At the next meeting, it would be good to receive a full list of publications from the facility, and an analysis by contribution from each instrument, by institution/country and by scientific field. We recommend benchmarking this and other

performance metrics with other facilities, especially those (like SNS, ISIS-TS2, ANSTO, HANARO and FRM-II) which are also growing fast after a new build.

We applaud the goal of sending user admin staff to other facilities with strong international user programmes, to learn from and share experiences with their peers. We would recommend such visits to ISIS, NIST, PSI and ANSTO, at a minimum. This will have the advantage of exposing J-PARC staff to best international practice and will give them a network from which to draw ongoing advice. It will be a good way to capture established practice and cater to the needs of expert users who use many similar international facilities.

But the real international growth opportunity for MLF will lie in Asia, and particularly China along with the South-East Asian countries. Experience elsewhere would suggest that the needs of users from these counties, and particularly novice users, is somewhat different – we recommend that J-PARC actively surveys its already significant cadre of users from Korea and China, in order to find out what they would like to see changed or improved about the whole experience of coming to J-PARC to do experiments. This ongoing feedback should include students and postdocs, and not just the professors.

Finally, and most importantly, the J-PARC leadership must identify its goals for internationalisation. Why is it important to J-PARC? And what does the facility seek to achieve? This should only then be backed up by specific actions and targets. This should be reported in more depth at the next NAC meeting.

We heard about the extensive MLF outreach programme, but were concerned that it is lacking focus. We recommend that clear objectives are establishes and priorities are being set.

Finally we would like to thank all MLF/J-PARC staff for the careful preparation of the documentation, the frank and open discussions and the hospitality throughout the meeting.