Neutron Advisory Committee Meeting for J-PARC MLF Facility
NAC2020
Tokai 17-18 February 2020

Close-out slides:

Committee members:
Jamie Schulz (chair), Bertrand Blau, Michael Dayton, Yoshiaki Kiyanagi, Yoshie Otake, Masaaki Sugiyama & Robert McGreevy (via Skype)

Introductory remarks:

- The committee thanks the participants for the detailed presentations and their helpful and open responses to the discussions, and for responding to the recommendations of NAC2019
- The committee gives a special thanks to Toshiji Kanaya
- The committee highly values the hospitality and excellent support provided during the committee meeting.
- The chair thanks the committee for their enthusiastic participation.

NAC 2020 Committee

Charge to NAC 2020

- Review our efforts to strengthen the facility
  - adequacy of renewed target development strategy in the context of 1MW stable operation in a few years; including moderator cryogenics, tritium treatment and backend plan.
  - timely construction and future direction of beam lines, sample environment and devices to maintain the uniqueness of the facility
- Evaluate the appropriateness of the science promotion efforts
  - activities of science group and science promotion board
  - any suggestions to help the smooth penetration of science driven Atmosphere
- Review our efforts to develop business model in MLF suitable to 1MW facility, especially the discussion by young researchers.
- Any suggestions for improvements are appreciated. Our particular concerns include but not limited to the followings:
  - yet to be unified MLF activities between JAEA, KEK, CROSS, and Ibaraki prefecture, as pointed out at the NAC
  - improving paper production rate
  - promotion of industrial use
  - user program handling and user support
- Any suggestions on the future plan on neutron source and beamlines in TS1 are appreciated.

*Red items are new items added in 2020

Neutron source session
9:00-11:40、Feb. 18

Operation Plan of Neutron Source

Now

FY	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Power (kW)	500	500	600	700	700~800	600	800~1000			
Target #	#9	#11		#13	#14	#10	#15			
Spare Target	#10	#12	#13	#14	#15	#16				
Target Fabrication	#13	#14	#15	#16						
Number of used target	7	8	9	10	11	12	13	14	15	16
Moderator/ Reflector	#1 operation							#2 operation		
	#3 Fabrication				#4 Fabrication (Design improvement is in scope.) Operation starts in 2031.					

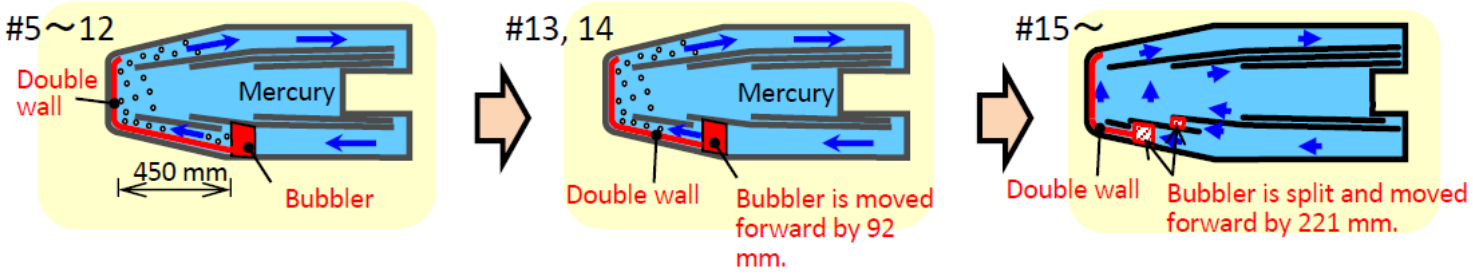
- Power ramp-up schedule was decided based on the pitting damage depth data in the past and damage depth prediction.
- Schedule advancement will be considered if the damage depth is much less than estimation.
- Suppression of tritium release is also an important factor.

Fabrication period will be extended to 3 years.

- Shortening the fabrication schedule of #15 for half year can advance the power-up schedule.

The total storage capacity in MLF and RAM is around 22. ⇨ R&D for volume reduction technology is indispensable.

Target improvement for pitting damage mitigation



Target

- The NAC highly recognizes the proposed target management and operation plan presented at the meeting. It is a very reasonable approach for the coming 4 years to reach the design goal of 1MW operation
  - It is recommended that this information be developed into a released document that outlines not only the target operational philosophy presented, but also target development efforts and also contingency operations.
  - As mentioned in the previous NAC, the PIE results should be reflected to develop a new target, and then the PIE result of the #13 target should be reflected to the #15 target.
  - The method of damage estimation relies on several empirical relationships that are often difficult to correlate to the complex operational environment of the operating target. It is highly recommended that a strategy for target PIE be developed that validates the empirical method.
    - It is also recommended that strategies for sampling the target nose outside of the current locations be explored as cavitation damage often occurs far outside of the beam

Target

- First operation experience with target #11, the first constraint-free target, looks very promising. It will be interesting to compare results with target #10 (or #12) at a later stage, since they were manufactured by a different supplier.
- An impressive amount of effort has resulted in an improved method of target cavitation damage estimation. Use of an audio microphone represents a novel solution that supplements the existing laser doppler vibrometer system. The sound measurement dependency on the gas bubble flow rate found in target # 11 appears to be a very interesting new approach and should be further investigated in close collaboration with SNS which is also working on pressure wave measurement techniques and mitigation possibilities.
- The strategy for the proposed countermeasures in the event of recurrent needle valve clogging of the helium bubbler is not clear to the committee. Importantly the proposed strategy with the bypass valve should be reconsidered as a loss of the flow rate measurement appears to be crucial at all times.

Refrigerator (CMS)

- Recent positive experience with the 3rd ADS looks very promising in terms of having overcome the problem with oil contamination in the helium refrigeration system

Tritium Reduction

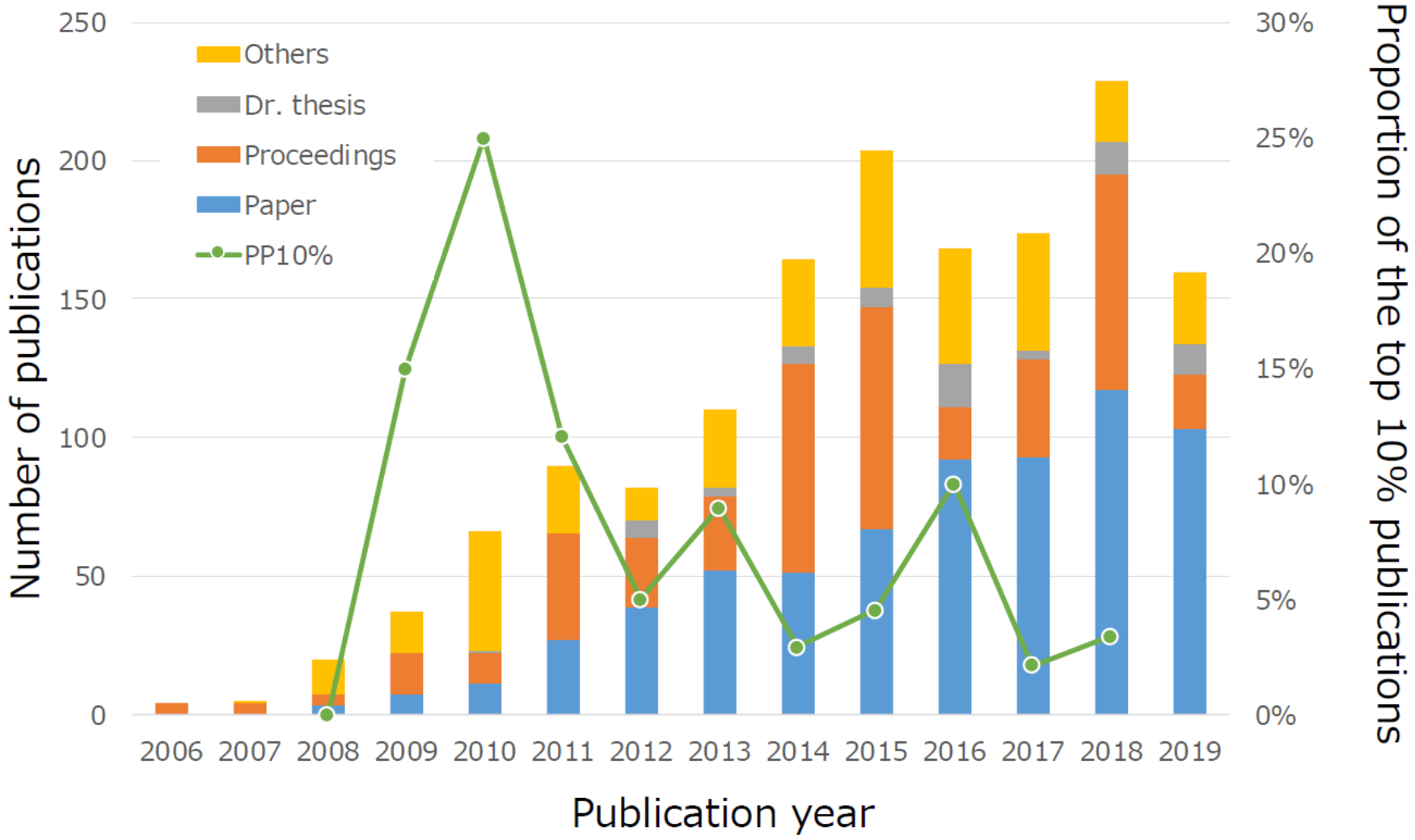
- Significant effort has been made in understanding and mitigating the tritium release issues
  - Process improvements such as utilization of negative pressure, closure plates and residence time in the gas holder system appear to be very effective
- Collaboration with other facilities having experience on tritium handling such as the tritium lab at KIT/Germany might be advisable to choose the right countermeasures for preventing unintended tritium release after target exchange. The proposed upgrade program of the proposed off-gas system appears reasonable but will not come into operation before 2022. So it will not be available for the 2020 and 2021 target exchange.
- The evidence presented indicates that the water-based cutting lubricant used during target PIE cutting operations contributed greatly to the amount of tritium produced
  - It is recommended that future target PIE cutting operations be performed without the use of a lubricating fluid. Mock-up testing of the cutting operation should be utilized to establish cutting speed parameters that will enable successful sample removal without lubricating fluids.

Volume Reduction (Backed Plan for Radioactive Material)

- Long term MLF operation is challenged by the limited storage space for spent components
- The MLF is strongly encouraged to consider different options to minimize radioactive waste or to make separation of material more easy
  - To expand the life of each component is one method to reduce the volume. Life of some of components are determined by DPA. Therefore, the precise estimation of the DPA is recommended with the use of recent experiences at other spallation facilities, and the international collaboration will be effective for promoting such activity.
  - Activity of each component should be evaluated to consider the effect of the radioactivity when elongating the life of the components.
- The construction of the RAM facility and the development of a shielded container system to enable transport and storage represents a major accomplishment
  - The RAM facility, in conjunction with the MLF, provides storage for approximately 22 targets
  - This limited storage capacity may threaten future MLF operation
  - Plans for volume reduction of the target modules was presented, however the technical challenges associated with these operations are significant and it is not clear that they represent a long-term solution
- A coherent strategy should be developed that addresses the technical and regulatory challenges along with schedule and cost estimates to ensure a successful solution.

Source data @ 2020-01-10
Citation data @ 2020-01-15
Figure revision @ 2020-01-23

Publications and Proportion of top10% publications



MLF論文(BL関連のみ)

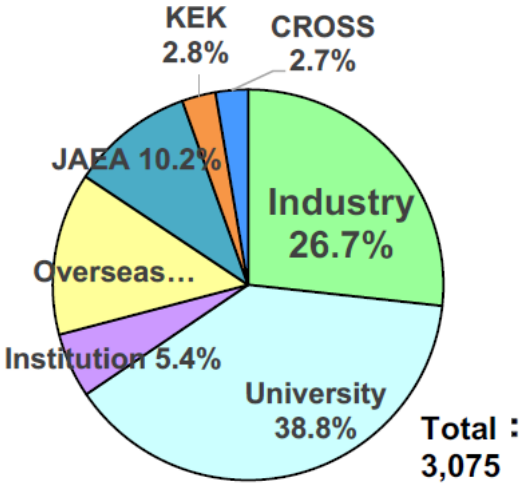
Others：日本語学会誌、査読無し英語論文, 修士論文
(修士論文は2019夏より追加)

User Program and Publication Rate

- The NAC is pleased to see that the user satisfaction is increasing and that the publication per proposal rate has increased. Efforts must continue to be prioritised to increase the publication per proposal rate.
- The publication rate does not seem to be affected by the number of the industrial use.
- Actions should be undertaken to determine the pain/problem points for users to further increase user satisfaction.

Promotion of Industrial Use

J-PARC JOIN (J-PARC Joint Office for Innovation)



Aim of JOIN:
Unification of industrial use activities of KEK, JAEA, CROSS and Ibaraki prefecture in collaboration with Industrial User Society for Neutron Application

Role of JOIN

- To combine industrials needs and academic seeds
- To promote new industrial activities based on collaborations with industry, academia and government
- To create new innovation based on neutron science

Researchers (Univ., Industry, Inst.)

↓

Consulting Counter

Industrial User Society for Neutron Application

collaboration

J-PARC JOIN

- Unified window
- Introduction of researchers to solve industrial problems
- Information transmission

⇒neutron experiments ⇒ research outcomes ⇒ Innovation

JOIN: Unification of Industrial use activities of KEK, JAEA, CROSS and Ibaraki in J-PARC MLF

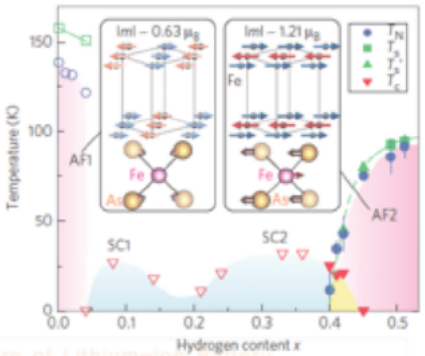
J-PARC MLF	JRR-3
・neutron ・muon	・neutron

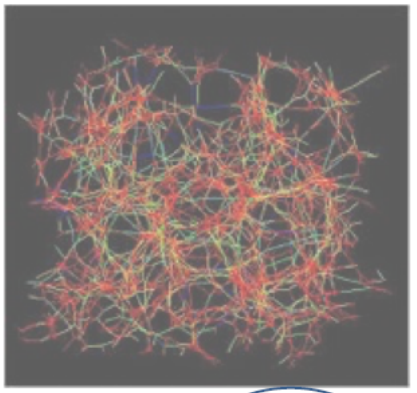
Industry Engagement

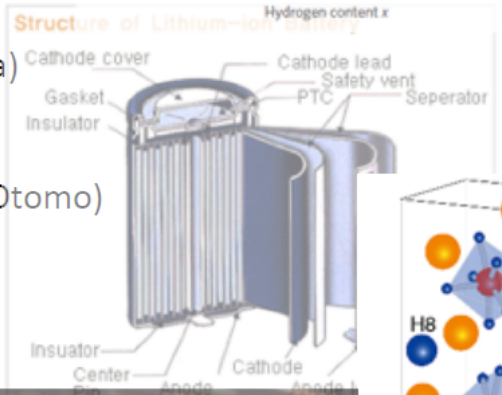
- The industry program at MLF continues to be commendable in comparison to other international facilities with the average ratio of industrial use of 26.7%
- The NAC suggests that MLF clarifies what the value of industry usage is to J- PARC (eg promotional value to government, revenue) and determines the corresponding metrics of success.
- NAC understands that the SPICA instrument is used by industry, is highly successful and recommends the inclusion of the high level industry statistics. Alternatively a different industry collaboration statistic could be introduced.
- J-PARC must be commended upon the 2 new industry initiatives recently realised:
  - J-PARC Joint office for Innovation – which facilitates Industry-University-Facility cooperation
  - Consortium model they have adopted to work with industry. The consortium approach links industry with universities and takes pressure off beamline scientists enabling them to focus on user support.

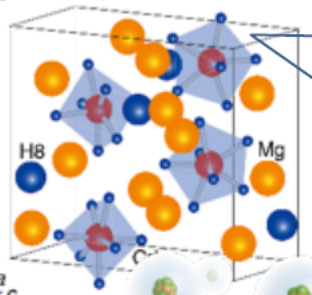
5 Focusing Science Areas and Science Groups in MLF

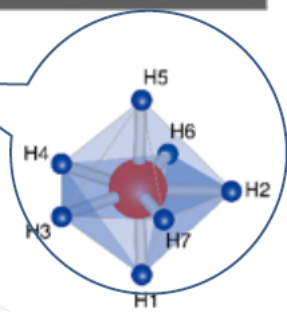
- **Hard Matter**
  - Electric properties research Gr. (K. Nakajima)
  - Quantum properties research Gr. (S. Ito)
- **Liquid and Soft Matter**
  - Polymer research Gr. (T. Kanaya)
  - Soft material research Gr. (H. Seto)
  - Disordered Materials Research Gr. (Y. Kawakita)
- **Energy Material**
  - Hydrogen absorbing material research Gr. (T. Otomo)
  - Structure science (battery) Gr. (T. Kamiyama)
- **Engineering Material**
  - Residual stress research Gr. (K. Aizawa)
  - Structure sensitive material research Gr. (J. Suzuki)
- **Muon Science**
  - Muon property research Gr. (R. Kadono)
  - Muon science research Gr. (Y. Miyake)

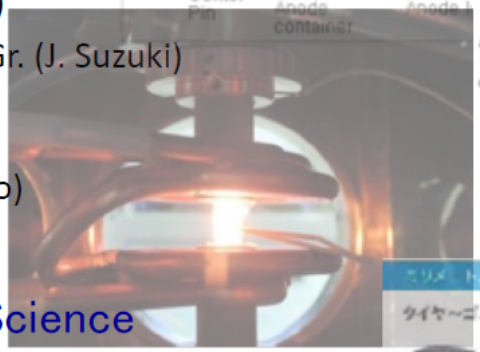


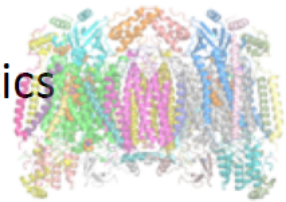












- Neutron Optics
- KENS-DAQ

Life Science
High pressure science
Industrial Application

Science Promotion

- The NAC was enthralled by the selected scientific case studies presented by the newly established science groups. Good examples of collaboration within J-PARC and with external organisations were presented.
- The NAC recommends to keep this type collaboration and to make new ones in order to promote the quality of J-PARC science.
- The NAC recommends the expansion of the external engagement with universities through the participation of J-PARC staff on grant applications and the co-supervison of post-docs and students.
- The NAC congratulates J-PARC on it's continued successful neutron & muon school. However the NAC suggests that J-PARC further promotes neutron scattering for Japanese students and develops more Japanese schools, making access easier for students.

J-PARC 1MW Trial

1MW test operation (10h40m) July 3, 2019

BL02(DNA): Temperature induced dynamics change in hydrated starch
BL09(SPICA): Cryofurnace demonstration measurement
BL10(NOBORU): Neutron source diagnostics measurement
BL14(AMATERAS): Demonstration of small sample measurement
BL15(TAIKAN): Protein solution measurement & DAQ performance test
BL16(SOFIA): GEM detector performance test
BL17(SHARAKU): GI-SANS demonstration
BL19(TAKUMI): In-situ measurement (rapid cycle deformation 1 data/2 sec.)
BL20(iMATERIA): Small sample & in-situ (buttery charge-discharge)
BL21(NOVA): Perfomance test of DAQ hardware and software

Beamline Operations

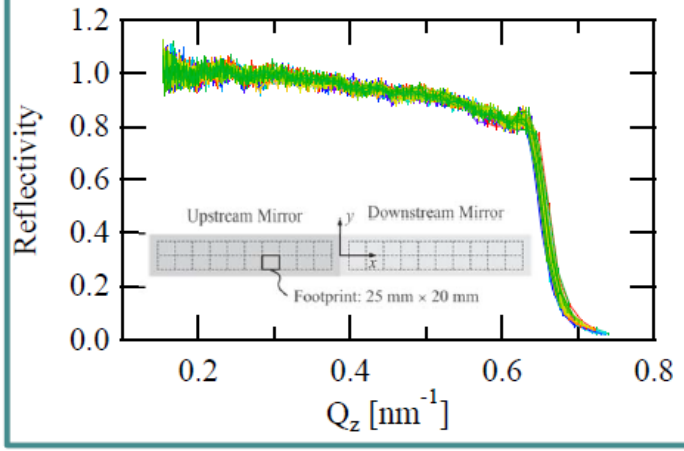
- The NAC congratulates J-PARC on the 10.5 hr 1MW test that was performed in July 2019.
- Overall the NAC is impressed with the J-PARC beamline performance and reliability. However end of life equipment failures and equipment obsolesce has resulted in some beamline outages. The NAC understands that a pro-active plan has been prepared and the NAC supports prioritisation of these activities to ensure J-PARC instruments' high performance and reliability is maintained.
- Beamline staff appear to be responsible for administrative & technical tasks that would/could be more efficiently completed by central resources (eg preparation of visa support letters). NAC suggest a review of instrument scientists tasks and arrangements is undertaken to maximise instrument scientists time for user support.
- Concerns about the clarity and visibility of safety approval process for experiments were also raised. The NAC suggests these processes are clarified and documented. A review of other facilities procedures could assist with this processes.

Some of Developments I

☐ Focusing mirror for neutron reflectometry at BL16

0.13 mm in FWHM, 0.3mm in full width was achieved!

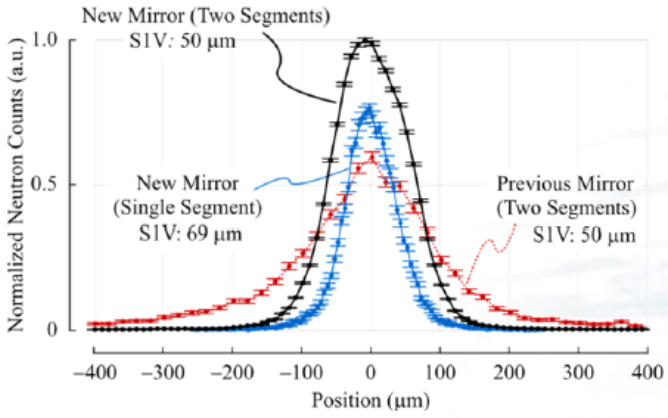
Homogeneity in reflectivity

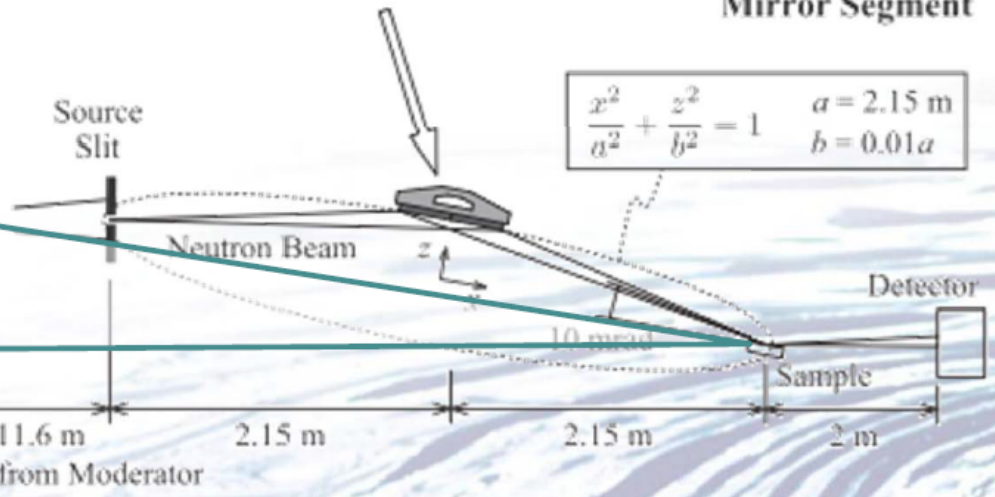


Elliptic Supermirror Assembly

Mirror Segment

Beam spot at sample





The mirror has been already open for uses.

Collaboration with RIKEN and KURRI

T. Hosobata *et al.*, Optics Express **27**, 26807 (2019).

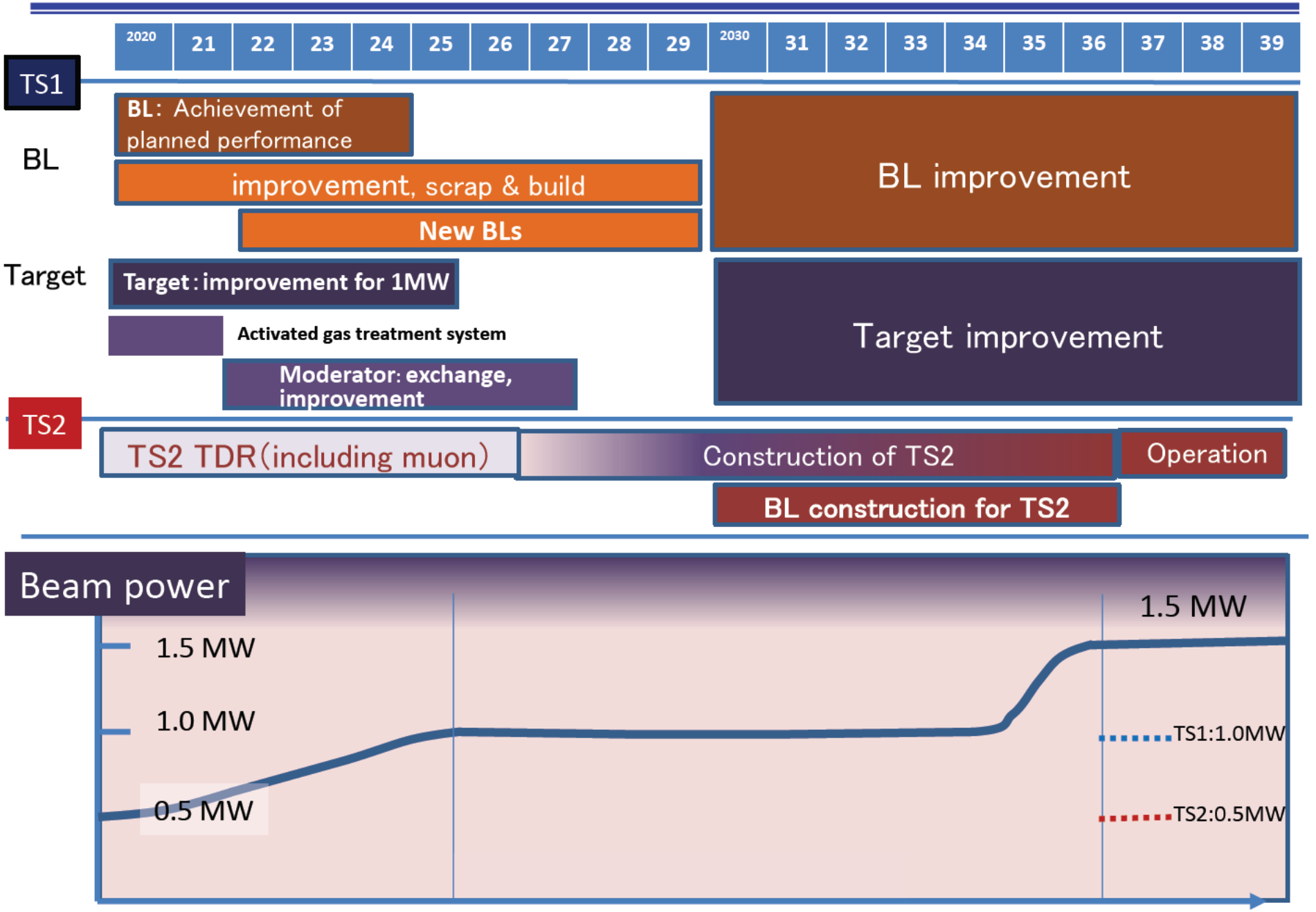
Beamline Development

- The NAC continues to be impressed with the construction and technical development activities with respect to both instruments and development and construction of targets. These highly appreciated skills lay a foundation for the continual renewal of the facility.
- The NAC is pleased to see that unconstrained instrument improvement plans have been prepared for beamlines. Significant work will be required to prioritise these activities and to secure funding to implement these plans.

Sample Environment and Laboratories

- The NAC was pleased to see the realisation of the Pulsed Magnet System in MLF. The development of this system is a significant milestone for J-PARC.
- The NAC was also pleased to hear that sample environment capabilities were being developed through collaborations with external users and being funded by external sources of funding. These capabilities are also made available to the user program once completed.
- Most of the instruments are mature now and effort must be placed on the enrichment of sample environment equipment. World-leading neutron scattering facilities are recognised not only for their source, beamlines and staff - but the sample environment capabilities they offer.
- A strategic plan for future sample environment capabilities at J-PARC must be developed to ensure that J-PARC remains at the forefront of scientific research.
- The NAC also was pleased to see that deuterated material synthesised in the J-PARC D-Lab was being utilised in experiments.

Road Map in MLF



TS1 & TS2 Future Plans

- The science case for TS2 needs to be refined to demonstrate enhancements of neutron scattering capabilities that complement TS1
- Strong focus should remain on TS1 to ensure continued progress towards instrument improvement and reliable target operation leading to sustained 1 MW operation
- The upgrade of moderator-reflector system is quite important, especially after 1MW operation.
- The new moderator-reflector system should also be linked and optimised with the scrap-and-build plan for beamlines and also the upgrades of certain instruments.

Business Model of MLF

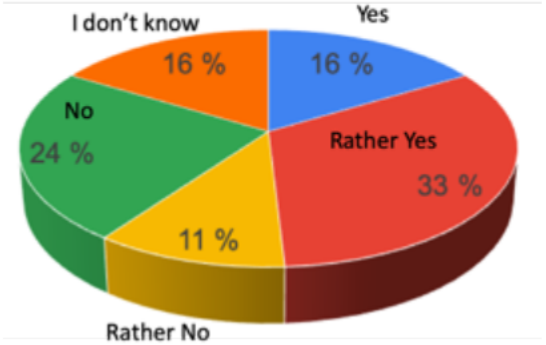
R. Kiyanagi
NAC2020-3

The business model for operation of MLF needs to be appropriate. (from the NAC report 2018)

➡ Launch "MLF comfortablization committee" and discussed how to improve MLF performance.

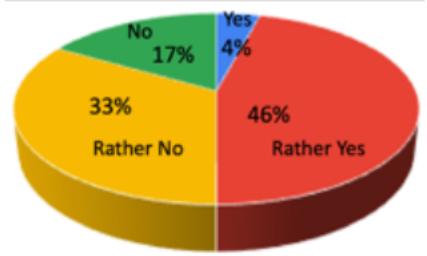
■ Consensus about the direction of MLF

Is the role of MLF clear and well-shared?

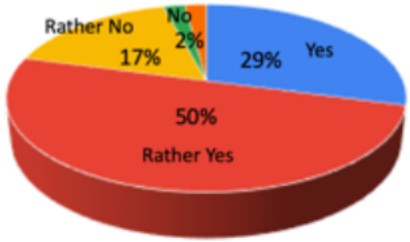


■ How people are working at MLF.

Is the working environment good?



Do you feel Overloaded?



■ <u>For ideal organization</u>

- The policy of MLF is not necessarily well shared among MLF staff.
  - ➢ Should the management **clearly show what MLF is aiming for**.
- MLF is not necessarily providing a good working environment.
  - ➢ Should MLF **continuously work on for more comfortable working environment**.

■ <u>Management/Safety</u>

- Most of inconveniences in the works at MLF is due to mis-communication and lack of information.
  - ➢ **Setup an information platform** of MLF, in which all information regarding MLF is found or accessible via it.

Business Model

- The engagement of younger staff in developing the business model is highly commended.
- The establishment of the “comfortabilization” or “staff engagement” committee is a great initiative which will assist in communication between staff and management.
- It is clear from the survey that was undertaken that not all staff understand or can communicate the purpose of MLF. Management should work with staff to define the MLF mission/vision/values and a common agreed strategy for MLF.
- Some questions to be considered
  - What is the role of MLF? - user facility, research organisation or both
  - What is the appropriate balance for instrument scientists activities – user support/research/development
  - How will MLF accommodate the additional throughput of 1 MW? more experiments, more complicated, or just smaller samples

Conclusion

- It is clear that MLF staff are highly dedicated and working hard towards the success of the facility.
- Good progress is being made towards high power operation according to the target management plan that has been developed. This should be continued.
- MLF has an excellent suite of instruments that provide the capability to produce correspondingly excellent science.
- The business model for operation of MLF needs to be appropriate to the capabilities of the facility.