

Report on the ESS-J-PARC workshop

This is the report on the ESS-J-PARC workshop, which was held on 18th and 19th January.

1. Introduction

ESS and J-PARC officially started collaboration since 2012, and the Memorandum of Collaboration (MOC) was renewed last year to strengthen further collaboration between the two world leading neutron facilities in front of two Prime Ministers, Shinzo Abe and Stefan Löfven. J-PARC started her operation since 2008 and has experiences to operate, maintain and develop to achieve 1MW capability. On the other hand, ESS is challenging an unprecedented competence with cutting edge technologies. Therefore, it is quite fruitful for both two facilities to exchange technical information and experiences, and we have organized a two-day workshop with participation of experts from two organization on 18th and 19th January.



ABOVE: Director of J-PARC Naohito Saito (l) and Chair of the ESS Council Lars Börjesson exchange the Memorandum of Collaboration between the two institutions. Looking on are prime ministers Abe and Löfven.
PHOTO: Maja Suslin/ESS

2. Here, reports from 4 working sessions are reported.

1-Accelerator session, J-PARC/ESS workshop

Session Moderators: Michikazu Kinsho/Mats Lindroos

Accelerator Operation, Maintenance and Development at J-PARC, Kinsho and Fang

The following two presentations were made as an experience of J-PARC.

- Power, Reliability, Spare Consumption and Stock, Issues and Development.
- Experiences on J-PARC LINAC LLFR system.

Beam physics questions at ESS

Potential Collaboration Subjects for Beam Physics, Ryoichi Miyamoto and Mamad Eshraqi

- The accelerator team of the J-PARC has successfully commissioned their high intensity H- beam, and have managed to revive the linac after the earthquake in the start of this decade. Expert visits and knowledge transfer for the commissioning of the ESS linac or start-ups of the J-PARC linac (RCS and main ring) as well as taking part in these interesting activities in either of the facilities.
- ESS uses mainly TraceWin for simulation of the linac and J-PARC uses IMPACT for their tracking. Both labs are expert in their respective codes and could, with some effort, benchmark the lattices of the linacs using another code than the main code.
- ESS uses OpenXAL framework in the control room, improving the codes, working on automating the start-up process and improving both the physics and performance of the control room applications could be beneficial for both labs.
- Evaluating the effect of dynamic errors, i.e., RF noise, on the beam loss along the linac, numerically and experimentally could be of common interest.

Beam Dynamics Error Studies of the ESS Linac, Yngve Levinson

The ESS beam physics lattice design has been optimised over many years, both in terms of cost and reliability. We have a multitude of integrated studies available where we look at losses from failures and the defined error tolerances. We expect that one important source of beam losses will be due to RF (longitudinal instabilities), and that the frequency cross over is of importance. The requirements, in particular perhaps for the dynamic RF tolerances, are challenging but we believe they will be achievable.

Possible collaboration topics:

- We think the experience from J-PARC in operation and optimising the RF system can be very useful to the ESS operations. At J-PARC there have been successful improvements of the LLRF (as shown by Mr. Fang presentation), they have obtained stability results which are in the ballpark of what we need at ESS, and they also have experience with a frequency jump from 324 to 972 MHz.
- The experience from J-PARC in commissioning and operations in general is of value to ESS which is now soon commencing this endeavour.
- Experience in developing and using control room applications, and potentially collaborations in this matter in the future could be of interest

ESS neutrino beam studies, Mohammad Eshraqi

The European Union has recently approved a grant to study the potential of the ESS for delivering a high intensity neutrino beam for a long baseline neutrino experiment with a detector at the second neutrino oscillation maximum. The experiment aims at finding the answer on why there is such a big asymmetry between matter and anti-matter in the universe.

Due to the limitations in the pion focusing horn the length of the pulse from the accelerator should be reduced from 2860 μs at the end of the ESS linac to almost 1 μs . This could be achieved by adding an accumulator ring at the ESS site. To improve the injection efficiency via charge exchange the ESS linac should accelerate H⁻ ion for the neutrino experiment in parallel to the proton beam to the neutron experiments.

Possible collaboration topics:

- Development of a high current H⁻ ion source which is of common interest of both projects, also the lossless transport and acceleration of the H⁻ ions is also another topic of mutual interest. The transferline and the accumulator ring of the ESSnuSB will be studied by Uppsala University and that is another area where the valuable experience of J-PARC could benefit the design.

ESS Linac Integrated Planning for the Installation, Testing, and Commissioning, Ciprian Plostinar

At ESS the Ion Source and LEBT installation has started with the first beam expected Q1/Q2 2018.

The normal conducting linac will be installed gradually starting Q3 2018, with beam commissioned planned for 2019. A shielding wall at the end of the DTL allows the installation to continue in the cold linac while beam commissioning takes part in the warm part.

Opportunities for dialogue and collaboration with J-PARC:

- What was the installation experience at J-PARC.
- What were the challenges and what were the lessons learned?
- Are there opportunities for ESS to further optimise the installation sequence?
- In terms of beam commissioning, do you envisage any difficulties with a staged commissioning approach?
- How long did it take J-PARC to commission the linac and when were the design parameters met?
- What were the main schedule priorities and pressures?

Beam diagnostics at ESS (Cyril Thomas)

Overview of Dump and Target diagnostics was presented, showing how critical they are for the tuning of the beam on target and supporting operation. Prototyping of GRID and APTM is an ongoing activity done under collaboration with several institutes, including J-Parc. Testing and qualification of these two instruments prototype is proposed to be done on the 3NTB Dump at J-Parc, during the Autumn restart. Imaging systems are critical to establish safely beam on Dump / Target: a key component of the system is the luminescent material. Selection of the first luminescent material is done; however, this material doesn't fully satisfy the requirements to permit long term reliability. Materials offering luminescence

properties and radiation tolerance matching ESS requirement can be found with necessary studies, coating process developed, and radiation tolerance qualification Irradiation campaigns for luminescent materials take a long time, and possible shortcuts have been found with low energy proton irradiation. This is being exercised at DTU within existing active collaboration; further collaboration on luminescent coating material for high power target with J-Parc are highly encouraged. Initial discussion on the topic and how to collaborate have been already engaged.

Possible collaboration topics:

- Test of ESS target collimator monitor and grid at J-PARC
- Share experience with luminescent coatings from ESS

RF issues at ESS (Anders Sunesson/Rihua Zheng/Morten Jensen)

ESS has challenging LLRF demands. We will try to meet these by employing adaptive Feed Forward and PI feedback with multiple loops. Pay special attention to phase reference line achievements @ J-parc and how what this could say about ESS. A MTCA.4 system is designed and it will be delivered from our partners in Spain (352 MHz) and Poland (704 MHz)

Suggested collaboration topics:

- Suggested collaboration by visits and system tests (ESS can test MTCA @ J-Parc, ESS can consider J-Parc test bench use)
- ESS MTCA LLRF system could be an option for next generation of LLRF at J-PARC
- Possible to use J-PARC klystron test stand even though frequencies are different (more work as ESS has to bring driver and some of the controls)
- Help and expertise from J-PARC with follow up at Japanese manufacturer

Summary Collaboration topics

We confirmed that it is possible to collaborate with ESS and J-PARC on the following items.

- **RF:**
 - ✓ Suggested collaboration by visits and system tests (ESS can test MTCA @ J-PARC, ESS can consider J-PARC test bench use)
 - ✓ ESS MTCA LLRF system could be an option for next generation of LLRF at J-PARC
 - ✓ Possible to use J-PARC klystron test stand even though frequencies are different (more work as ESS has to bring driver and some of the controls)
 - ✓ Help and expertise from J-PARC with follow up at Japanese manufacturer
- **Beam physics:**
 - ✓ OpenXAL developments
 - ✓ Cross check multi-particle simulations between IMPACT (J-PARC) and Tracewin (ESS)
 - ✓ LINAC upgrade studies and H- issues for European design study for a neutrino beam at ESS (not lead by ESS)
- **Beam commissioning:**
 - ✓ Feed-back based on experience from J-PARC on ESS installation and commissioning plans
 - ✓ Participation from ESS to J-PARC start-up and commissioning runs

- ✓ Possible to use J-PARC test stand with ion source and RFQ for ESS testing
- **Beam diagnostics:**
 - ✓ Test of ESS target collimator monitor and grid at J-PARC
 - ✓ Share experience with luminescent coatings from ESS

2-Target session, J-PARC/ESS workshop

Session Moderators: Hiroshi Takada/Mark Anthony

Base Information of JSNS

JSNS spallation neutron source using a mercury target
 maintenance sequence of exchanging PBW (they changed once in 2years, also target one 5years)

Component changeout

Important to have a mockup of all the inner connections is used to train the rad workers
 The schedule is 8 days to change a PBW, working 8 hr shift
 Total staff to do the exchange 4 persons, only 2 go in the accessible space
 Floor blocks have rubber seal
 They have similar design floor valve (gamma blockers) as ESS plans, with step to avoid streaming
 The gamma blocker on the cast can be hand cranked shut/open
 They use continuous air samples during work activities
 The lines are marked with numbers and color coded
 The water lines are dried before opening by pulling a vacuum
 Cask contact dose is 2msv
 He gas used for leak check water connections

Lessons Learned

Additional dry run can be done early on if there is a problem and/or premature replacement of a component is necessary as activation levels are low
 Take care to adequately plan on how to address tritium, where is it and how to handle
 They stuck a bolt on the Hg pipe connection, needed to use molykote grease and fab an impact wrench to break it loose
 Seal connections for water and He are Hiltap
 Inspection of PBW failure, can ESS do this level investigation if they needed to? Root cause was Nox generated from stagnant air
 Cryogenic problem with producing L-H2 found difficult problem with delta P in He refrigerator system, the ADS adsorber, all in spec but unacceptable performance

ACF

The ACF was fully commissioned prior to BOT a decision we will face
 All maint procedures written during commissioning
 Some activities require person to go into the hot cell, work need to be done by hand , so they have a portable 15ton steel wall

ESS Support and continued collaboration

JParc will test our grid and aperture monitor at 3Gev in their beam dump

Maintenance pictures and videos will be shared

Maintenance procedures will be shared

They have a H2 sampling method to determine para to ortho conversion and we will have an online monitoring system, perhaps compare

Possible site visit during the next maintenance outage summer 2018

More collaboration areas identified with material test and analysis, possibly adding electronics, beryllium

Also collaboration on characterizations of catalyzers, nitric acid formation

interesting systems

In-situ target diagnostic system, we have at ESS a target monitoring plug but need to do more work on diagnostics potential.?

They have a spallation products monitoring system which includes stack monitoring and release limits, alarms to control room

PBW

Safety

Green house concept – area with locally exhausting devise is prepared as a safety measure against internal exposure at disconnecting pipes

Evaluation of radioactive gas generation in target, tritium and Xe127 are substantial , need filtered via charcoal, and hepa

Xe127 is storred for 1 yr and released, H3 absorbed by molecular sieve

3 - Instrument session, J-PARC/ESS workshop

Session Moderators: Toshiya Otomo/Shane Kennedy

time	[id] title	presenter
09:00	[44] Introduction	
09:05	[29] 1) Performance of Instruments (intensity, resolution and backgrounds in comparison to design	Mr. NAKAJIMA, Kenji
09:20	[30] 2) Status of choppers (Fast Chopper, To chopper) and Shielding Performance (including B-Concrete, B4C etc)	Mr. AIZAWA, Kazuya
09:35	[31] 3) Data reduction : Softwares and Hardware (Neutron Monitors incl. Proton monitor)	Mr. OTOMO, Toshiya
09:45	[32] Present status of the Instruments development at ESS	ANDERSEN, Ken
10:15	[33] Data Management Scheme at ESS and at DMSC	TAYLOR, Jonathan
10:40	Coffee Break	
11:00	[34] Discussion items raised from NSS and her present status/strategy	SUTTON, Iain
11:30	[38] Detector Systems, Monitors and Collaboration Opportunities	HALL-WILTON, Richard
11:50	[36] Bench mark test with PHITS and GEANT4	DI JULIO, Douglas
12:05	[37] Possible implementation and collaboration of PHITS at ESS, Collaboration with other organization (university, lab, etc.) at ESS	Dr. BENTLEY, Phillip
12:20	[39] Session close out	

Summary of mutual interests discussed

•Choppers and shielding: (Aizawa & Niko)

–JPARC now updating and replacing chopper (2nd generation). ESS designing choppers – chance to collaborate involving ESS chopper partners (e.g. with T_{zero} and High Speed disc choppers (e.g. with FZJ?))

–Shielding –performance checking –facility mapping such as ESS did at SNS may be interesting for J-PARC

•Data management (Toshiya & Jon)

–JPARC-DMSC: possible future testing of integrated control and DAQ at JPARC. Further discussion to identify opportunities.

•Radiation management

–Collaborate on testing of radiation resistance of material in Japan (Aizawa & Thomas)

–Remote Handling: ESS is designing for extensive RH in bunker. In future JPARC may develop RH system for Tzero choppers. (Erik is managing RH for ESS Instruments)

• Detectors (Soyama & Richard)

–ESS is developing high performance detectors and needs to test and benchmark in high flux spallation sources. JPARC is interested in high performance low cost detector for chopper spectrometers. Testing of ESS detector prototype at JPARC may benefit all.

–Neutron Monitors: when ESS becomes active in monitor development testing of systems for ESS could be done at J-PARC.

•Simulations and modelling (Harada & Phil)

good collaboration already exists . Total bgd over whole facility and maximization of signal to noise ratios (S/N) of mutual interest. Joint work with GEANT4 (for S/N) and Phits (for safety) is producing useful information.

–Collaborate on continuous code development &

–Benchmarking of codes and against measurements at J-PARC

–Performance verification & corrective measures on intensity and bgd. For now ESS could learn from J-PARC (*maybe for future collaboration*)

ESS is in design stage, J-PARC is in operation. ESS could benefit from experience and lessons learnt at JPARC: JPARC experts could provide advice in NSS design reviews (Kenji & Ken (instruments) or Oliver (technologies) as appropriate)

4 – Radiation Safety session, J-PARC/ESS workshop

Session Moderators: H. Yamazaki and R. Trant ; about 15 participants

The session started with a brief discussion of the Safety Management System at J-Park and ESS including organisational, legal and, in case of J-Park, host lab aspects. In matters of safety, the Radiation Safety domain is of particular importance to both laboratories. The RS topics discussed in more detail at this meeting were: radiation zoning including access control, confinement strategy for airborne activity, dosimeters and radiation monitoring system including alarm thresholds.

The intense discussion revealed many common challenges as well as common or complementary approaches and technologies to address them. In general the time was short to address the issues of interest at the level of detail wished for.

Topics of common interest in addition to what could be discussed during this workshop are training, detector development, hot cell, ALARA in operation, Safety functions, maintenance work and contamination, detector response simulation as well as emergency preparedness. All participants appreciated the fruitful discussions, the open minded exchange and are looking forward to the next workshop as well as opportunities for exchange until then.

Remarks at the Summay Session

Roland Galoby on behalf of John Womersley and Naohito Saito

Thank you all for an excellent and enjoyable workshop!

- J-PARC and ESS have a lot in common and we can both gain at working together on multiple subjects.
- Demonstrated good quality of existing relations and very valuable joint activities as reported for the different sessions.
- Clearly big potential for additional open exchange between our two facilities.

Great spirit – and passion on both sides!

•What next?

- Encouragement to pursue on-going joint activities (e.g. high interest for ESS to test instrumentation and other ideas at J-PARC...)
- Explore possibilities to exchange personnel – secondments. Most areas can be interested: accelerator, target, instrumentation, computing, use of facility by industry ...
- J-PARC branch at ESS/ESS branch at J-PARC?
- Connection of student programmes deserves investigation (e.g. SwednESS access to J-PARC)
- Next collaboration workshop Sept/Oct 2018 in Japan?

Organized by Toshiya Otomo, Weiyang Li, Alex Schmidli, Masatoshi Arai
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brightness



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Thursday 18 January 2018 - Friday 19 January 2018

Lund Sweden
Programme

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Thursday 18 January 2018

Arrival at ESS site - BrightnESS (09:15-09:30)

Welcome and ESS status update - BrightnESS (09:30-10:00)

- Presenters: WOMERSLEY, John

Safety induction and guided site tour (10:00-11:30)

- Presenters: SCHMIDLI, Alexandra

J-PARC Status update - Tänkartanken (13:00-13:30)

- Presenters: Mr. SAITO, Naohito

Technical Challenge at ESS building in the green field - Tänkartanken (13:30-13:50)

- Presenters: GAROBY, Roland

Accelerator Status and Topics (ESS & J-PARC) - Tänkartanken (13:50-14:30)

- Presenters: Dr. LINDROOS, Mats; Mr. KINSHO, Michikazu

Target Status and Topics (ESS & J-PARC) - Tänkartanken (14:30-15:10)

- Presenters: Mr. ANTHONY, Mark; Mr. TAKADA, Hiroshi

MLF and NSS Status and Topics - Tänkartanken (15:40-16:20)

- Presenters: Prof. SCHREYER, Andreas; Mr. KANAYA, Toshiji

Safety Status and Topics - Tänkartanken (16:20-17:00)

- Presenters: TRANT, Ralf; Mr. NAKANE, Yoshihiro

Dinner (18:30-22:30)

Friday 19 January 2018

Workshop - Accelerator - Scheele (09:00-12:40)

- Conveners: Dr. Lindroos, Mats; Mr. Kinsho, M.

time	[id] title	presenter
09:00	[22] Power, Reliability, Spare Consumption and Stock, Issues and Development	Mr. KINSHO, Michikazu
09:30	[23] Experiences on J-PARC LINAC LLRF system	Mr. FANG, ZhiGao
10:00	[45] Potential Collaboration Subjects for Beam Physics	Dr. MIYAMOTO, Ryoichi
10:10	[25] Beam Dynamics Error Studies of the ESS Linac	Dr. LEVINSEN, Yngve Intjore
10:25	[26] ESS neutrino beam studies	ESHRAQI, Mamad
10:40	[24] ESS Linac Integrated Planning for the Installation, Testing, and Commissioning	PLOSTINAR, Ciprian
10:55	Coffee Break	
11:10	[27] Beam diagnostics at ESS	Dr. THOMAS, Cyrille
11:40	[28] RF issues at ESS	Prof. SUNESSON, Anders ZENG, Rihua
12:10	Extra time	

Workshop - Instrument (09:00-12:30)

- Conveners: Dr. Kennedy, Shane; Mr. Otomo, Toshiya

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09:00	[44] Introduction	
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Workshop - Radiation Safety (13:30-16:30)

- Conveners: Trant, Ralf; Mr. Yamazaki, H.

Time [id]	Title	Presenter
13:30	Radiation Safety at J-PARC at JAEA	MAZAKI, Hirohito
14:00	Radiation Safety at ESS	COBSSON, Peter
14:30	Discussion items raised from ESS	COBSSON, Lena
15:00	Break	
15:20	Discussion	

Workshop - Target - Tänkartanken (13:30-16:30)

- Conveners: Mr. Anthony, Mark; Mr. Takada, H.

time [id]	title	presenter
13:30 [15]	Target Station Operation and Maintenance Experience at J-PARC	Mr. TAKADA, Hiroshi
14:00 [16]	Moderator Operation and Maintenance Experience at J-PARC	Mr. TESHIGAWARA, Makoto
14:20 [17]	Moderator Neutronics Development at ESS	Mr. TAKIBAYEV, Alan KICKULIES, Marc
14:35 [18]	Experiments on the Moderator Neutronics results and provision	Mr. TESHIGAWARA, Makoto
14:50 [19]	Structural Design, Maintenance Scenario at ESS	Mr. LINANDER, Rikard
15:20	Coffee Break	
15:40 [20]	Materials at ESS Target Station	LEE, Yong Joong
16:00 [21]	Operation and Maintenance of Target at ESS	GÖHRAN, Magnus Mr. SJÖGREEN, Kristoffer

Summary of the Workshop - Tänkartanken (16:30-17:00)









