

Beam monitor collaboration

J-PARC ESS monitor knowledge exchange program
Proposed by K Satou (KEK) and V. Grishin (ESS)

MR beam monitor G, J-PARC/KEK

Kenichirou Satou

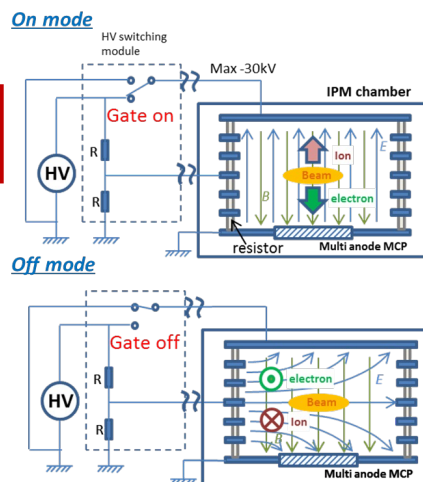
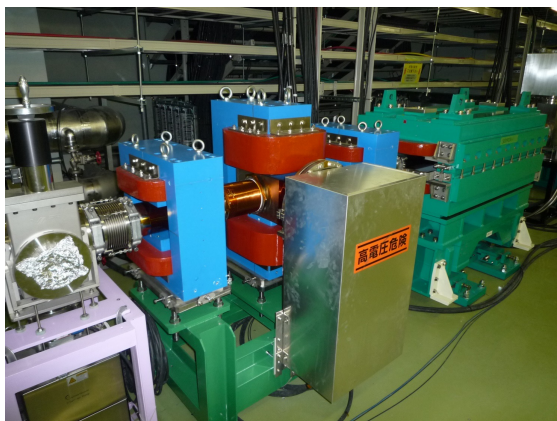
Background: Personal research exchange

- **IPM**

- **J-PARC and ESS had developed simulation code independently, and cross checking for these code were made**

- BLM

Gated IPM

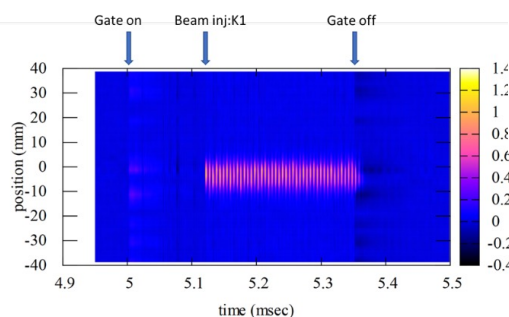
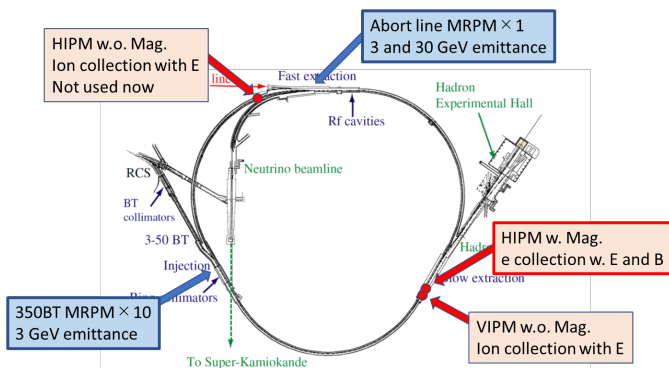
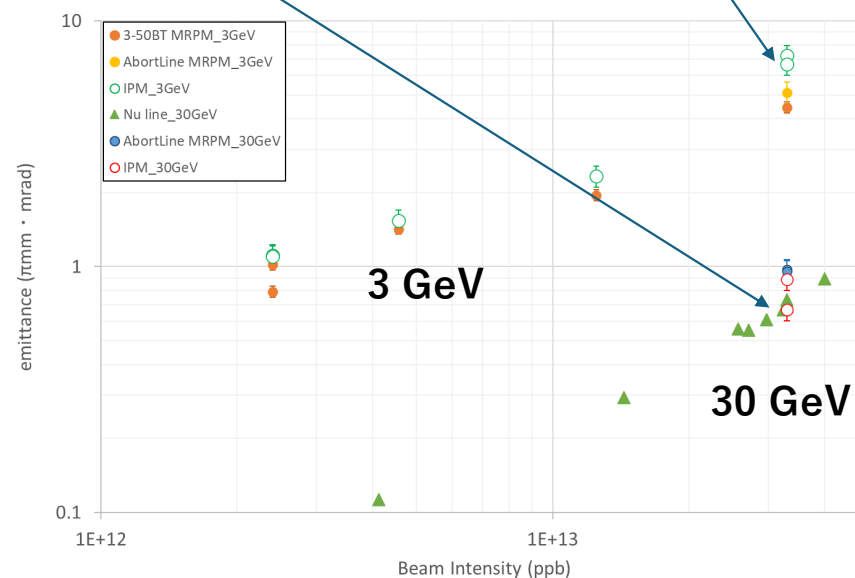
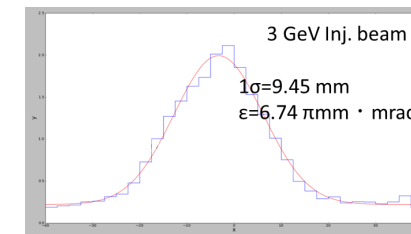
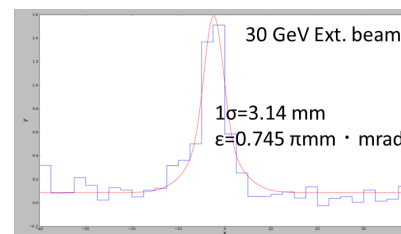


$E \times B$ ($v_z = E_x B_y$) drift sweeps the charged particle away from the area of MCP detector

$$I_{bias} \gg \langle I_{out} \rangle \propto I_{ini} G_0 (V_{bias}) \tau f$$

IPM duty D_{IPM}

By tuning the IPM duty, averaged output charge can be optimized



Gated IPM: Pulse mode operation
Original idea from FNAL✳

The beam emittance of intense beams up to $3.3E13$ ppb was measured and compared with those from other profile monitors in the beam transport lines, 3–50 BT, Abort, and neutrino beamlines. The datasets used are consistent with each other by $\pm 20\%$.

✳J. R. Zagel et al., "Third Generation Residual Gas Ionization Profile Monitors at Fermilab.", in Proc. 3rd Int. Beam Instrumentation Conf. (IBIC'14), Monterey, CA, USA, Sep. 14-18, 2014, pp. 408-411.

World-wide collaboration IPM application to high intensity beams

U.S.-Japan collaboration program

Gated IPM system and simulation code development from 2014

w. Randy M Thurman-Keup

FNAL

IPM dev. for SPS, 2014~

Timepix3, Ion-catcher structure

w. James Storey group

CERN

J-PARC

Discussion from 2023

Electronics design

w. K. Searon, F. Andrea, B. Florian

QST IFMIF-LIPAc

ESS

Good Discussion from 2015

Simulation code development

w. Chrille Thomas

CEA

Strong collaboration

HW development

by Jacques Marroncle

SAKURA mobility program will strongly support this collaboration structure

Background: Personal research exchange

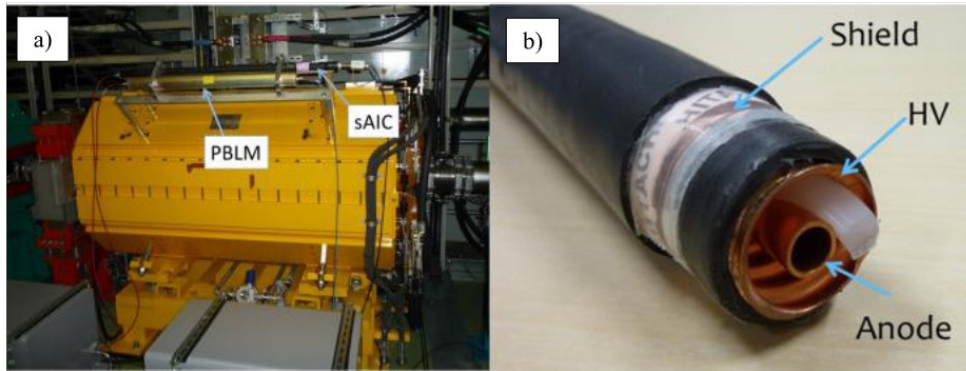
- IPM

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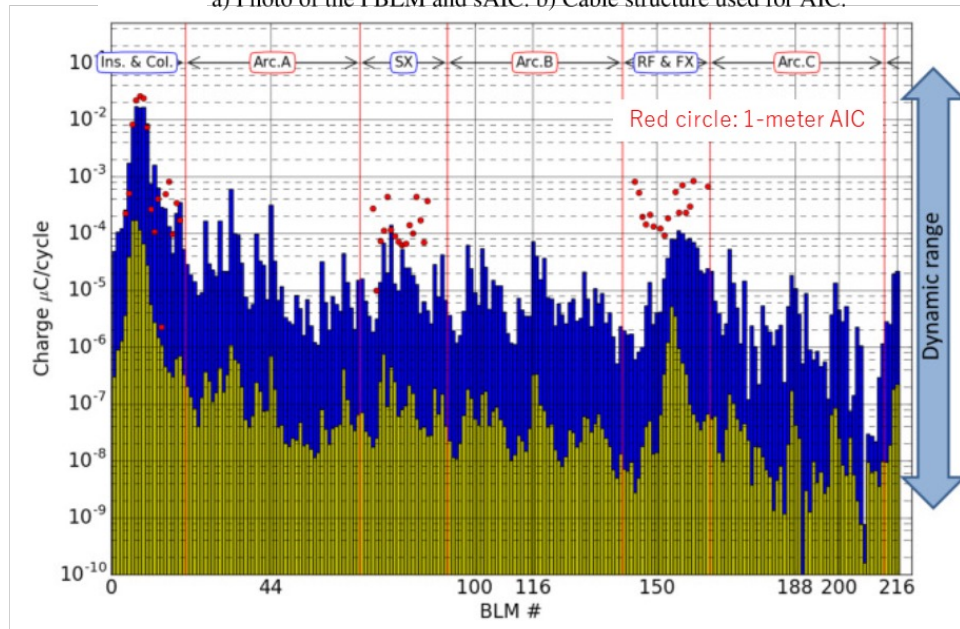
- BLM

- **I and Slava have worked in BLM section at CERN for one year and have been contacting to exchange experiences in BLM system.**

BLM



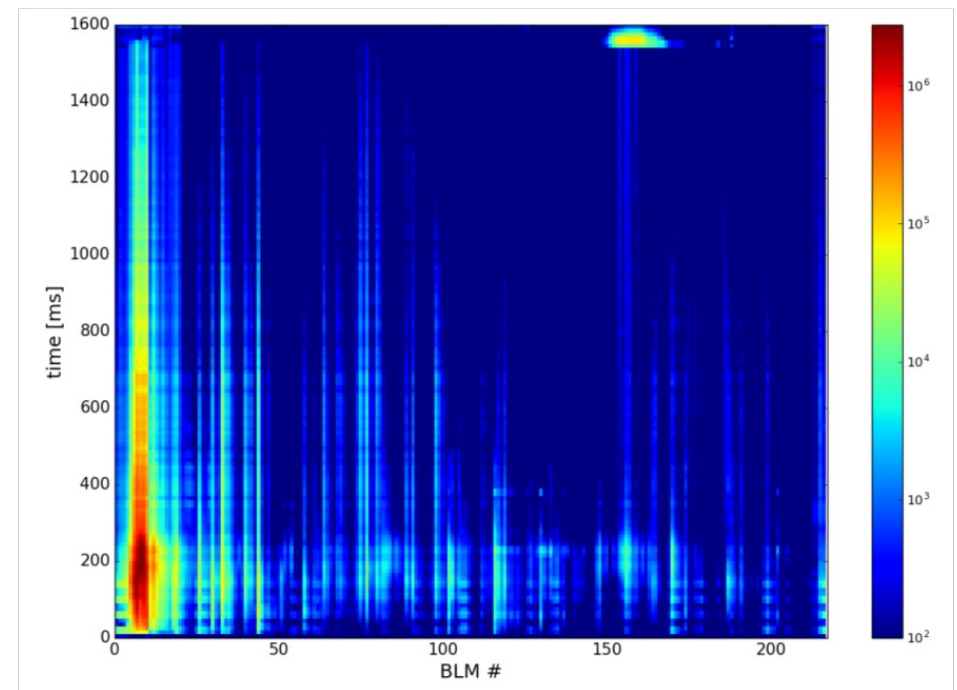
a) Photo of the PBLM and sAIC. b) Cable structure used for AIC.



Integrated charge plot. The beam loss signals from PBLMs and sAICs are shown as blue bars and red solid circles, respectively. The yellow bars show the residual dose.

Day-one signal processing circuits are replaced upgraded system in FY2016-2017

Absolute amount of the beam loss is compared to the DCCT value or residual radiation



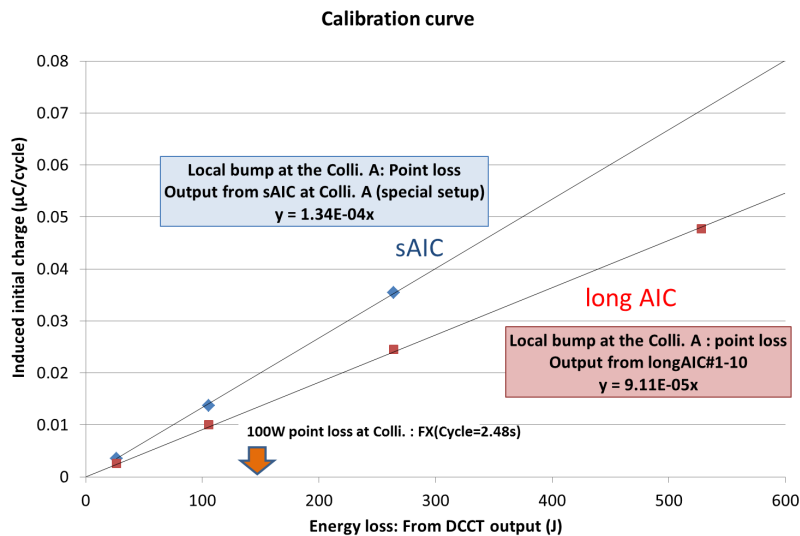
Contour plot of the waveforms from the PBLMs.

K Satou *et al* 2017 *J. Phys.: Conf. Ser.* **874** 012087
 K. Satou *et al.*, NIM, A 887 (2018) 174–183

AIC : Sensitivity for the real beam loss and γ

Real beam loss ←

→ γ : ^{60}Co source

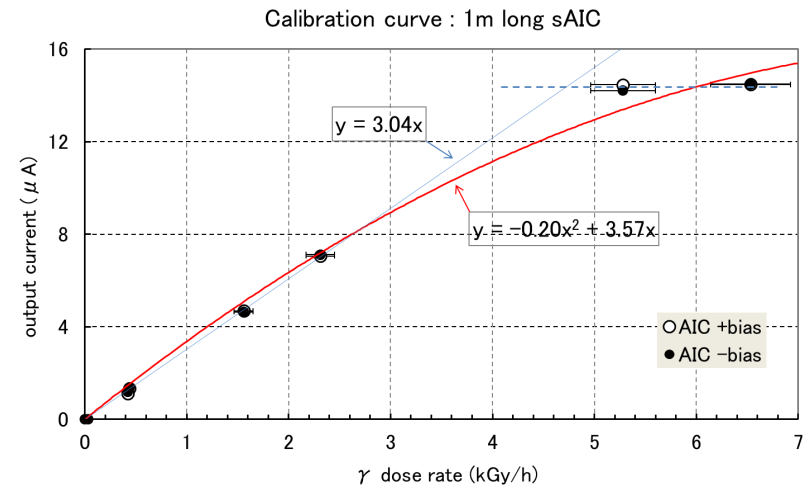


- Sensitivity of sAIC : point loss at Colli.

$$\frac{\text{Initial charge}}{\text{Loss Energy}} = 1.34 \cdot 10^{-4} \text{ uC/J}$$

- Sensitivity of longAIC

Point loss at Colli. A	$9.11 \cdot 10^{-5} \mu\text{C/J}$
Line loss at Collimators	$2.78 \cdot 10^{-4} \mu\text{C/J}$
Line loss at Arc. (averaged)	$1.12 \cdot 10^{-4} \mu\text{C/J}$



Good linearity up to 10 μA output

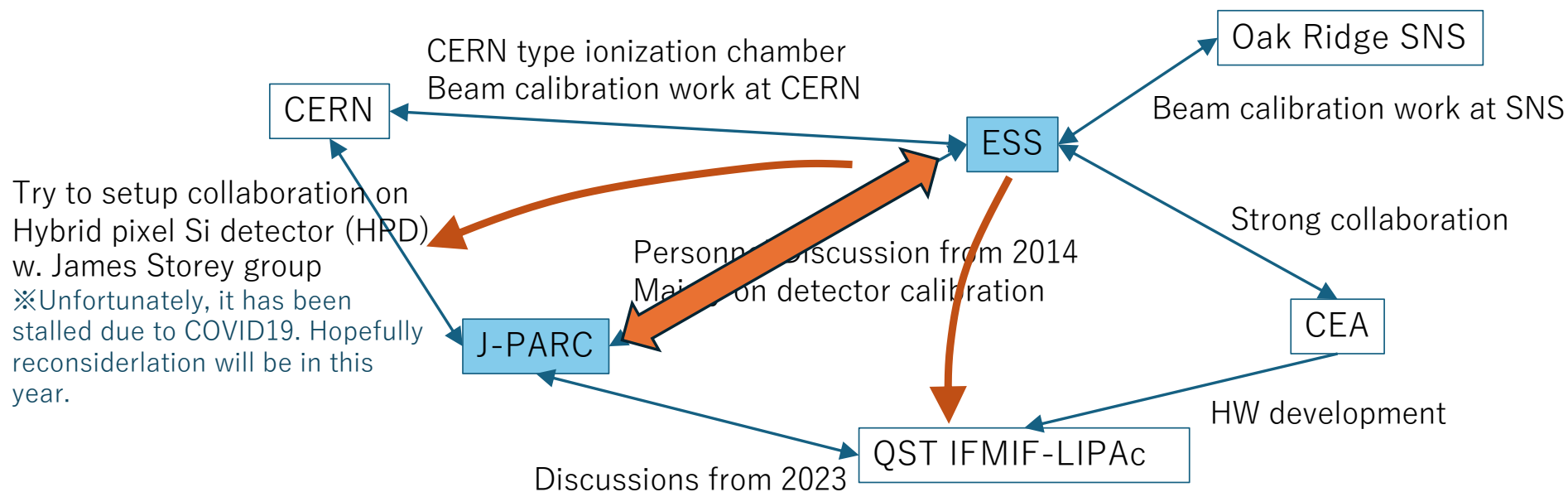
$$\frac{\text{Induced current}}{\text{Dose rate}} = 3.04 \frac{\text{uA}}{\text{kGy/h}}$$



Assuming here, $\text{Gy}=\text{Sv}$

$$\frac{\text{Initial charge}}{\text{Dose rate}} = 4.86 \cdot 10^{-6} \frac{\text{uC}(1.6\text{ s integral})}{\text{uSv/h}}$$

BLM collaboration structure



The SAKURA mobility program is set to enhance collaboration between J-PARC and ESS, and also serving as a gateway to further partnerships.

Interests on both sides

- J-PARC Interests to ESS

- IPM project
- Transvers profile monitors
- Neutron BLM
- BLM detector calibration

- ESS interests to J-PARC

- IPM project
- AIC detector
- HPD collaboration between J-PARC-CERN-ESS
- BLM collaboration between J-PARC-ESS-LIPAc
- BLM detector calibration

BLM senser calibration

Cross check of different type of detector

AIC vs. CERN type icBLM

Monitor knowledge exchange program: 2020 proposal

- Proposal from J-PARC side
 - PI: Kenichirou Satou
 - One week stay at ESS for discussion
- Proposal from ESS side
 - PI: Viatcheslav Grishin (Slava)
Young engineer: Clemen Derrez
 - Planned to visit two times to J-PARC
 - 1 week for discussion
 - 1 week for participation in beam test
,BLM detector test stand at MR

These proposals are complementary

The impact of COVID-19 has forced us to drastically reconsider our plans

Plans are delayed

- 2020 -> 2023
- Delay in budget execution (From Sep.)



- No longer matches the beam operation schedule at J-PARC
- Clemen leaves ESS

K. Satou

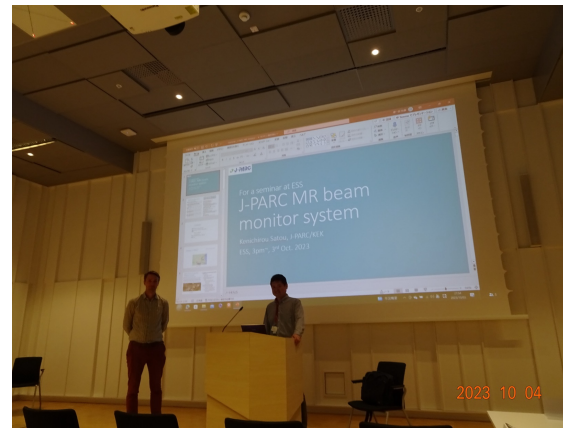
5 days stayed in ESS for discussion

Slava

4 days visit at J-PARC and KEKB and 2 days at QST IFMIF-LIPAc for discussion

Face to Face discussion at ESS

- 10/2
 - 9:20~11:30
 - Dr. Elena Donegani
 - Introduction of ESS beam diagnostics
 - 12:10~14:30
 - Dr. Elena Donegani
 - Fast faraday cup of MEBT
- 10/3
 - 9:30~10:30
 - Dr. Hooman Hassanzadegan
 - Current monitor of MEBT
 - 10:30~11:30
 - Dr. Irena Dolenc Kittelmann and Slava
 - BLM system
 - CERN icBLM, nBLM, pBLM(same as J-PARC)
 - MPS
 - 12:00~13:00
 - Dr. Joakim Pettersson
 - icBLM
 - 15:00~16:30
 - **Seminar: “J-PARC MR monitor system”**
- 10/4
 - Lab tour
 - Slava, Hooman
 - CT system
 - 10:00~12:00
 - Tour 1
 - klystron gallery, Acc. tunnel
- 10/5
 - 13:00~
 - Dr. Chrille Thomas
 - IPM issue
 - Tour 2
 - Acc. Tunnel, Exp. Hall



Slava's activities in Japan

- 10/25
 - AM
 - J-PARC Linac tour
 - Discussion on linac diagnostics
 - Dr. Akihiko Miura, Dr. Ersin Cicek, Dr. Kenichirou Satou
 - 1500~16:00
 - **Seminer at J-PARC**
- 10/26
 - PM
 - KEKB tour
 - Discussion on BLM system of KEKB
 - Dr. Hitomi Ikeda
 - **Seminer at KEKB**
- 10/27
 - AM
 - RCS tour, 2 hour
 - Discussion on RCS beam diagnostics, especially on yearly BLM calibration
 - Dr. Masahiro Yoshimoto, Dr. Kenichirou Satou
 - PM
 - MR tour, 2 hour
 - Discussion on MR beam diagnostics
 - Dr. Takeshi Nakamura, Dr. Kenichirou Satou
- 10/30, 31
 - **Seminer at QST rokkasho**
 - IFMIF LIPAc Tour
 - Discussion on LIPAc beam diagnostics especially on icBLM, nBLM
 - Dr. K. Searon, Dr. F. Andrea, B. Florian

Major outcomes and highlights

- Discussion covering a wide range of beam monitor development topics
 - Comparison of J-PARC and ESS BLM system
 - Detectors (AIC, icBLM, pBLM, nBLM), calibration methods (checking source, γ facility, beam based, HiRadMat facility at CERN), periodic health check methods
 - icBLM from CERN, pBLM from Toshiba Ltd. (same as J-PARC), Micromagas nBLM
 - Fast MPS alarm within 5 seconds
 - BPM
 - A unique structure installed inside the DTL tank
 - Faraday cup
 - Interesting measurements of the 21MeV proton beam at the DTL exit
 - IPM
 - Noise countermeasures at accelerator facilities
 - IS switching PS near the monitor rack
 - Copper plates for the monitor equipment were installed (also in the tunnel)
 - To reduce impedance, there were anchors in various places that were hammered into the concrete
 - Use of shielded twisted-pair cable for CT
- Exchanged experience in operating the monitors of BLM and IPM, FC, WS and CTs
- Preliminary agreement of exchange the younger researchers

New proposal for 2024 SAKURA program and future perspective

- We hold regular Zoom meetings with Slava to exchange information in a wide range of fields: Once every two months
- As a result of this SAKURA program, we have come to a common understanding that it is important to build a sustainable collaborative research system
- Agreement to promote efforts to encourage personnel exchanges among young researchers
- We remains interested in collaborative research to solve problems related to IPM and BLM
 - J-PARC are particularly interested in Micromegas type nBLM
- Due to schedule constraints, only BLM-related items are proposed for the 2024 proposal
- In the 2024 proposal, we proposed personnel exchanges among young researchers