

## Status of MTCA at J-PARC in 2024

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J-PARC Center

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# Contents

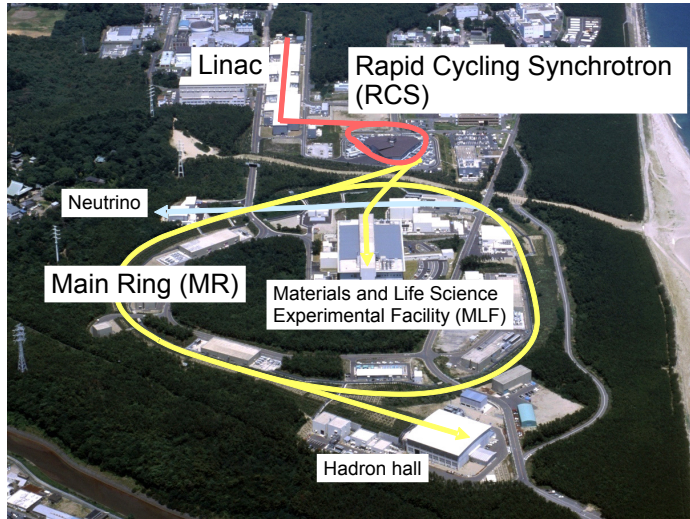
## 1. Introduction

## 2. Applications at J-PARC

New digitizer for linac Beam Loss Monitor (BLM)

## 3. MTCA workshop in Japan 2025

# Japan Proton Accelerator Research Complex (J-PARC)



J-PARC Consists of 400 MeV linac, 3 GeV RCS, 30 GeV Main Ring, and experimental facilities (MLF, Hadron, Neutrino).

- Secondary particles used for material/life science and nuclear/particle physics

# MR output beam power of 900 kW achieved (single shot)

Run# 92 Shot# 336914 24/12/05 15:41:23

DCCT#1

RCStoMR 6.67e+13

MR Injection Condition

● DCCT@K1 6.54e+13  
● DCCT@K2 1.32e+14  
● DCCT@K3 1.97e+14  
● DCCT@K4 2.58e+14  
DCCT@P2 2.57e+14  
DCCT@BE 2.55e+14

LINAC Beam 62.2 mA  
Nb= 8  
Bwidth= 455 ns  
Thin Ratio= 30 /32  
MR Cycle= 1360 ms  
Macro Pulse = 400 us  
RCS.EXT.Kicker 51745

10 average top

6.54e+13  
1.32e+14  
1.97e+14  
2.58e+14

MR@K2/RCS

1.981

Beam loss|ppp|

K3/K2	1.488	K1loss	2.63e+11	2.63e+11
P2/K2	1.946	K2loss	1.89e+11	2.38e+11
P2/K3	1.308	K3loss	9.46e+11	1.12e+12
BE/K2	1.934	K4loss	8.54e+11	1.00e+12
BE/P2	0.994			

Beam loss|Watt|

INJ(K1+K2+K3+K4)	795	2.25e+12
P2 --> +90ms	647	1.47e+12
P2+90ms --> +120ms	76	1.74e+11
P2+100ms --> EXT		1.61e+11

10 average data  
Beam loss|ppp|

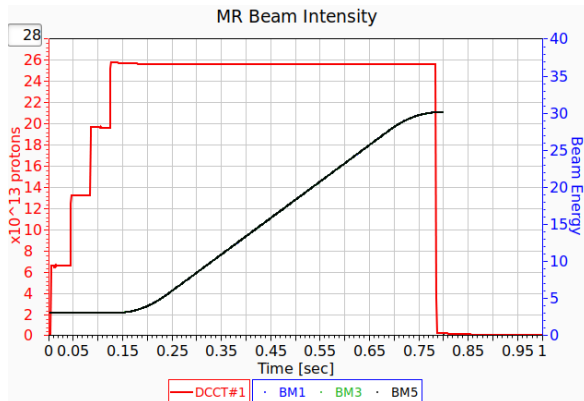
927 2.63e+12

MR Power 903.03 kW

Scheduled Timing

P0	P1	K4	P2	BE	P3	P4
187ms	187	317	327	977	977	978 ms
0	10	130	140	780	780	781
-10	0	120	130	780	780	781

Change DCCT Range



$2.5 \times 10^{14}$  protons per pulse were accelerated without significant beam losses.

- User operation for NU at 807 kW now

This achievement is supported by...

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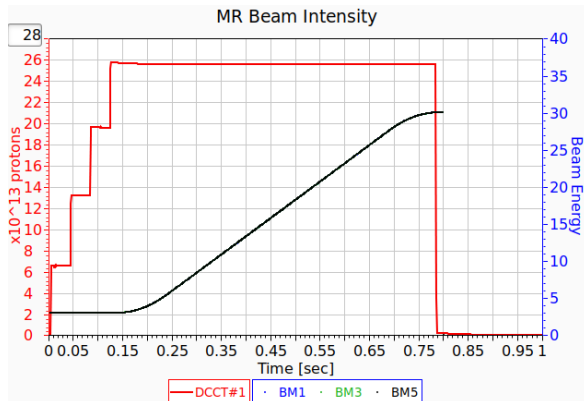
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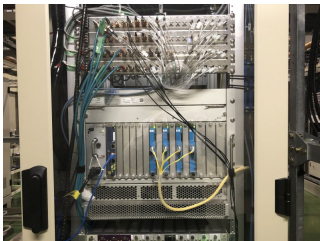
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# Stable LLRF based on MTCA

Linac:

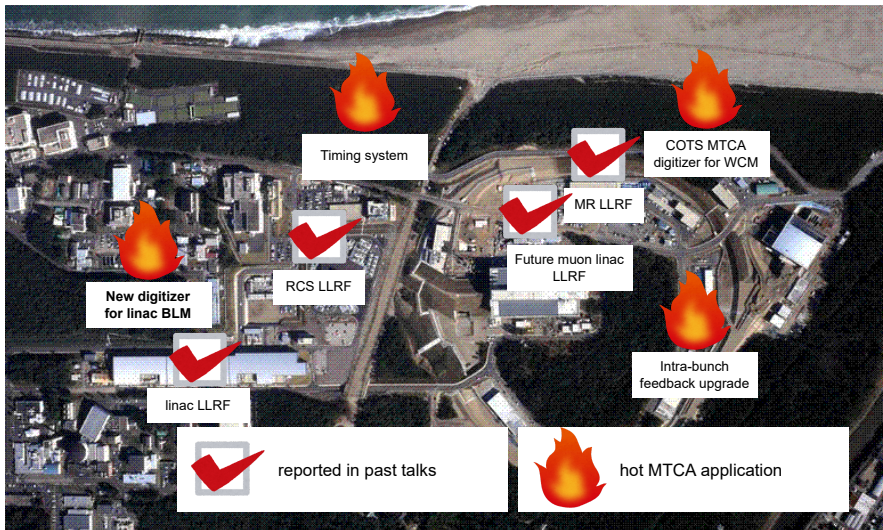


Synchrotrons:

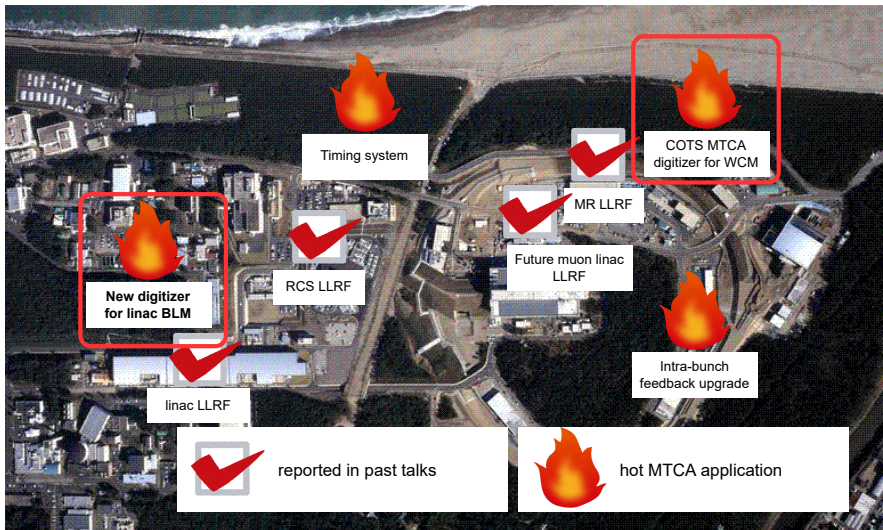


RCS output beam power at 1 MW for MLF also achieved.

# MTCA applications in J-PARC

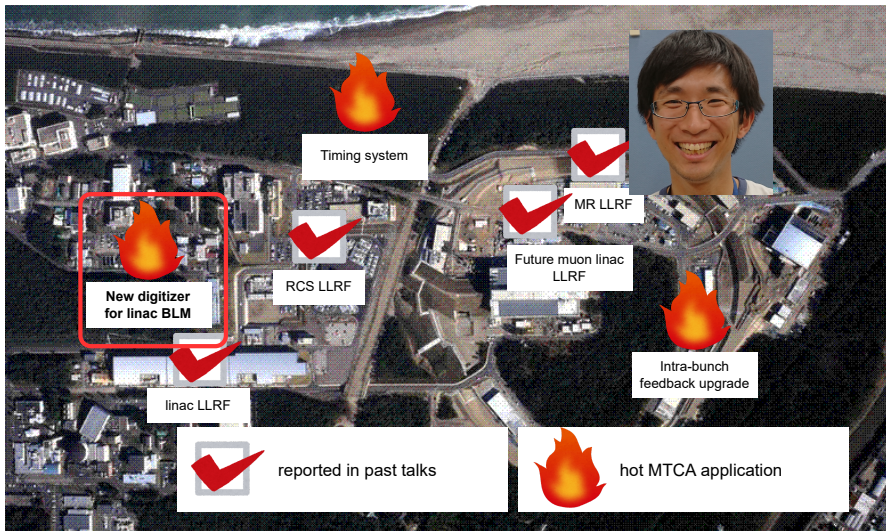


# MTCA applications in J-PARC





# MTCA applications in J-PARC



## 1. Introduction

## 2. Applications at J-PARC

New digitizer for linac Beam Loss Monitor (BLM)

## 3. MTCA workshop in Japan 2025

# List of Beam Monitors

Invasive monitor

Non-invasive monitor

Beam parameter	J-PARC Linac
Beam current	SCT
Centroid position (Trans.)	BPM
Centroid position (Long.)	FCT
Profile (Trans.)	WSM
Profile (Long.)	BSM
Beam loss	<b>BLM</b>

A non-destructive profile monitors are currently under development at J-PARC Linac.  
I will introduce the developing monitors at the end of this presentation.

# BLM: Beam Loss Monitor



BLM

Gas Proportional BLM, E6876-600  
Canon Electron Tubes & Devices Co., Ltd.

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Length	600 mm
Diameter	50.8 mm
Enclosed Gas	Ar and additive gas
Gas Pressure	Approx. 1 atm

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Realization of a microsecond response time makes it ideal for machine protection systems.  
(Taken from the website)

Abnormality detection is determined from signal peak value.  
The integral value of the BLM signal is recorded as a trend.

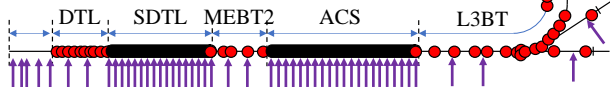
# Monitor Location (SCT, BLM)

Monitor	MEBT1	DTL	SDTL	MEBT2	ACS	L3BT
SCT ↑	5	3	16	2	21	6
BLM ●	0	10	21	3	21	39

SCT : Beam current

BLM : Beam loss

Front-end (=IS+LEBT+RFQ+MEBT1)



3 GeV  
synchrotron  
(RCS)

SCT and BLM are installed everywhere.

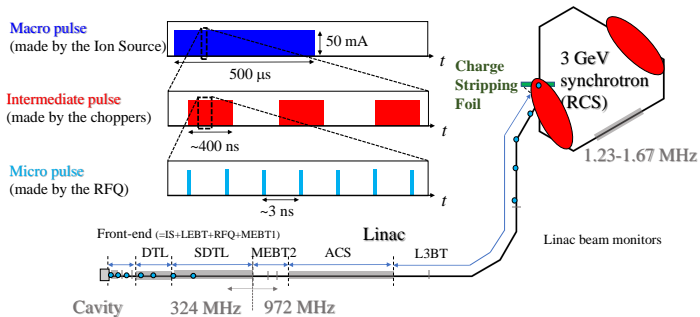
# Usage of BLM

## Machine Protection System (MPS) / Interlock

- Abnormal beam loss  $\rightarrow$  beam stop

## Beam diagnostics

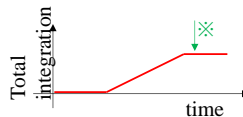
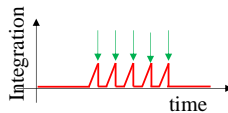
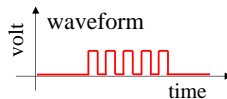
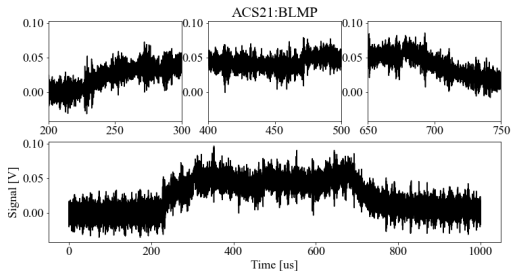
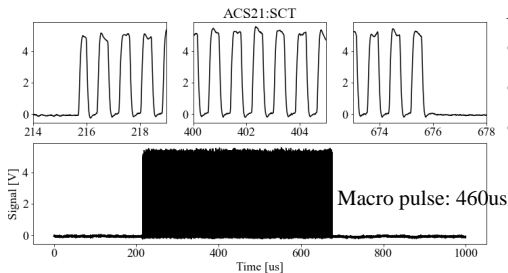
- BLM is indirect but related to beam quality
- To characterize the beam in macro pulse



# Waveforms and analysis

Digitizer acquires:

- Raw waveform
- Integration over an intermediate pulse
- Integration over macro pulse



# Original and new BLM data acquisition

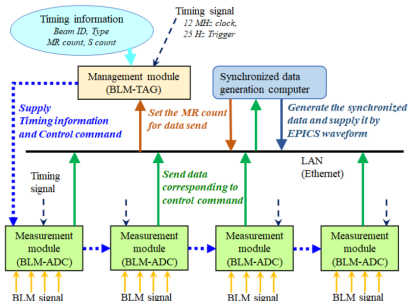
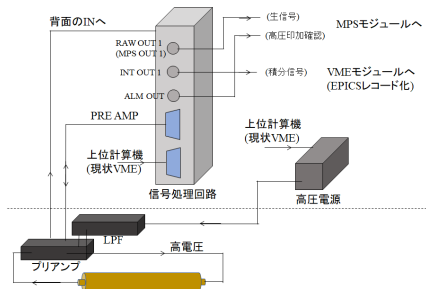
Original: BLM → pre-amp → analog signal processing module → VME (more than 15 years old)

New (planned): BLM → pre-amp → MicroTCA ADC/signal processing

Also, “synchronized data acquisition” is introduced, so that well-organized data storage according to beam destination (MLF/MR) is possible

- Sophisticated signal processing on FPGA
- High speed data transfer to storage server

MicroTCA is a good choice.





# New digitizer for linac BLM: Summary

A new digitizer for linac BLM based on MTCA is considered.

- Sophisticated signal processing on FPGA
- High speed data transfer to storage server from MTCA CPU

The synchronized-data setup can be also used for SCT and BPM.

# MTCA workshop in Japan 2025

We would like to hold next MTCA workshop in Japan. (The last/first one was hold in 2021)

(From 2021 closing slides)

Dates: TBD

Venue: J-PARC (Tokai) or KEK (Tsukuba)

Organizers:

Fumihiko Tamura (JAEA/J-PARC)

Tetsuya Kobayashi (KEK)

Hirokazu Maesaka (SPRING-8/SACLA)

