13th MicroTCA Workshop for Industry and Research

Status of MTCA at J-PARC in 2024

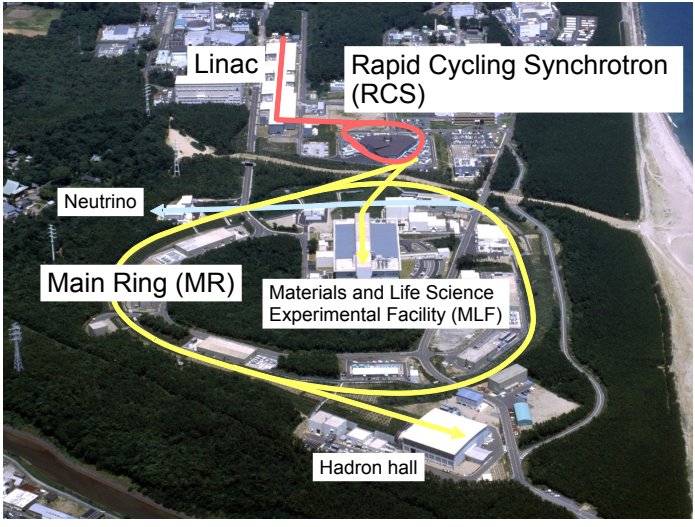
Fumihiko Tamura

J-PARC Center

December 2024

Contents

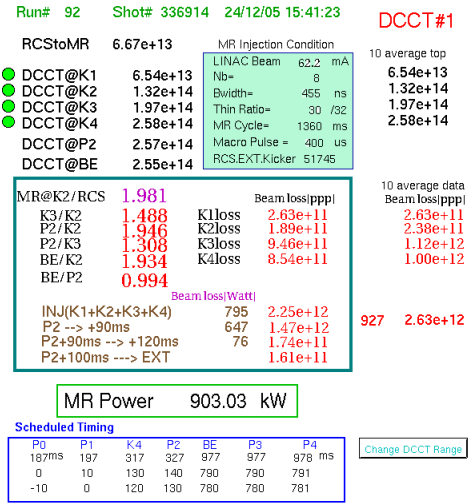
Japan Proton Accelerator Research Complex (J-PARC)

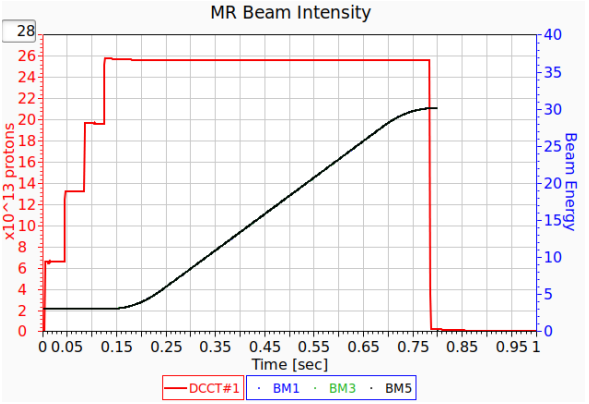


J-PARC Consists of 400 MeV linac, 3 GeV RCS, 30 GeV Main Ring, and experimental facilities (MLF, Hadron, Neutrino).

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

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





2.5×10^{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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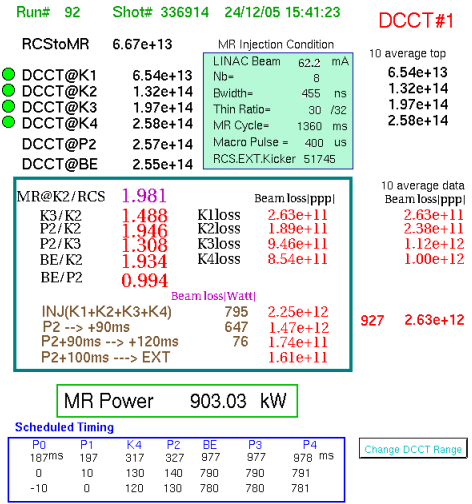

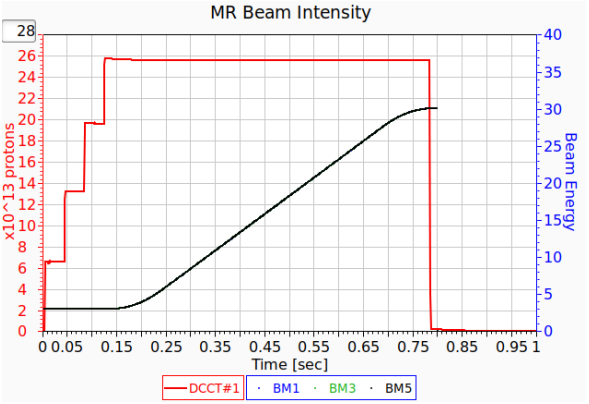

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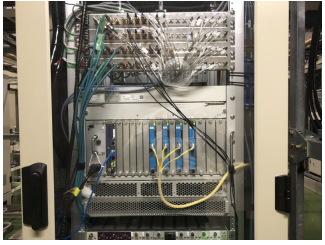
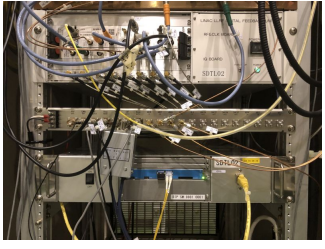
This achievement is supported by...

Stable LLRF based on MTCA

Linac:

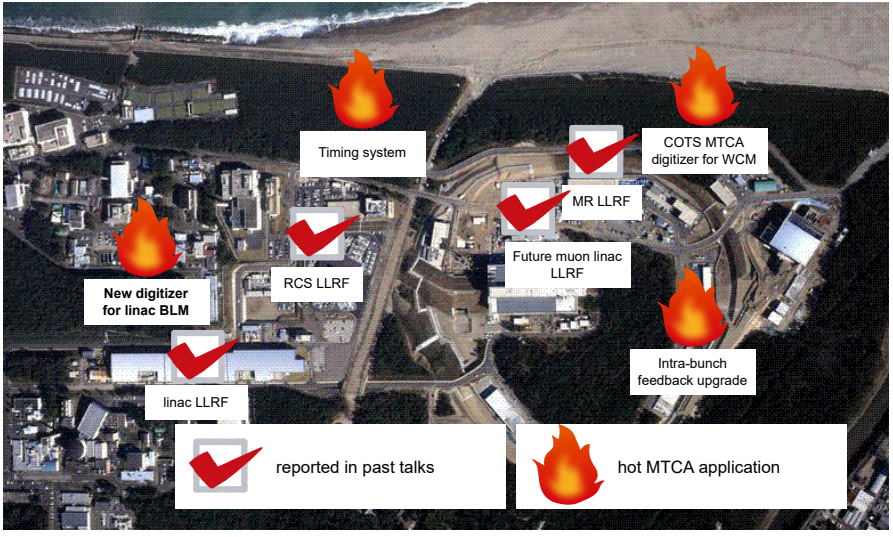




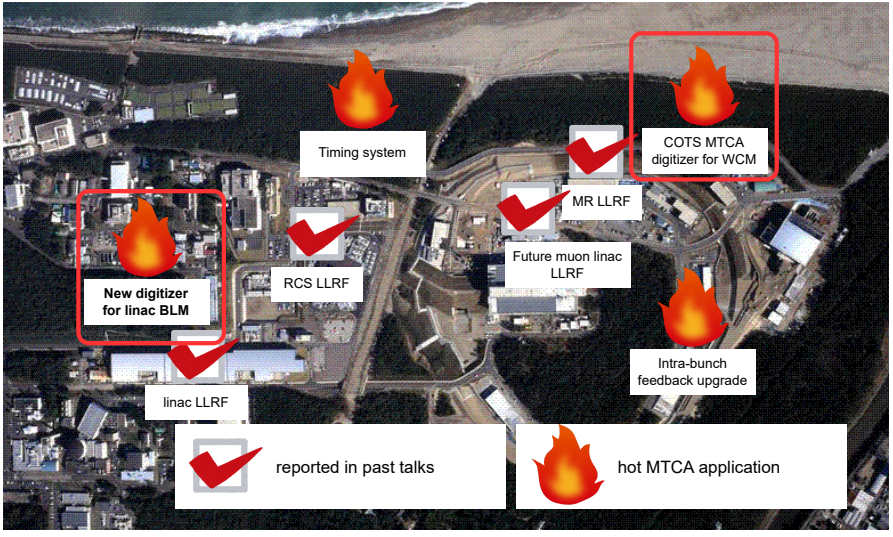
Synchrotrons:

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

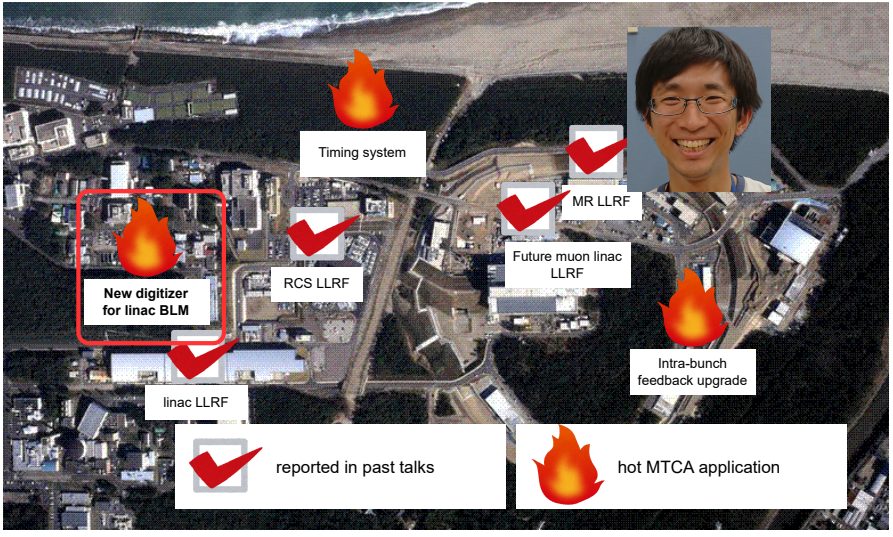
MTCA applications in J-PARC



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	**BLM**

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

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

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

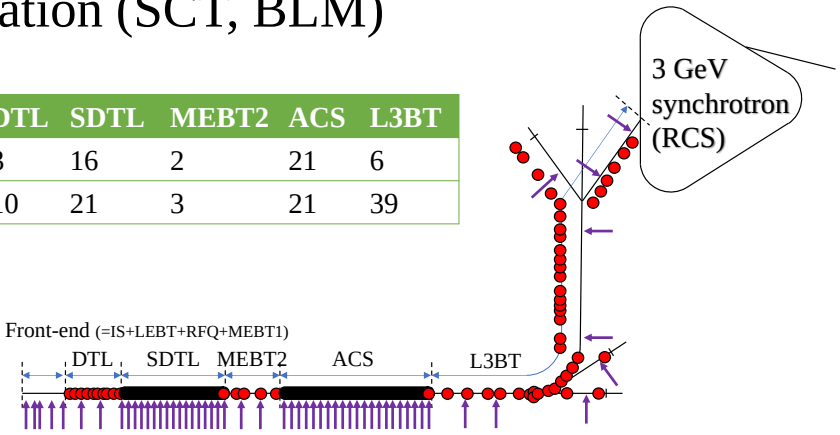
Realization of a microsecond response time makes it ideal for machine protection systems. (Taken from the website)

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



SCT and BLM are installed everywhere.

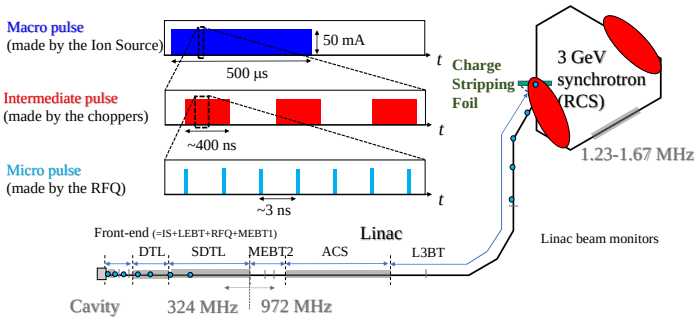
Usage of BLM

Machine Protection System (MPS) / Interlock

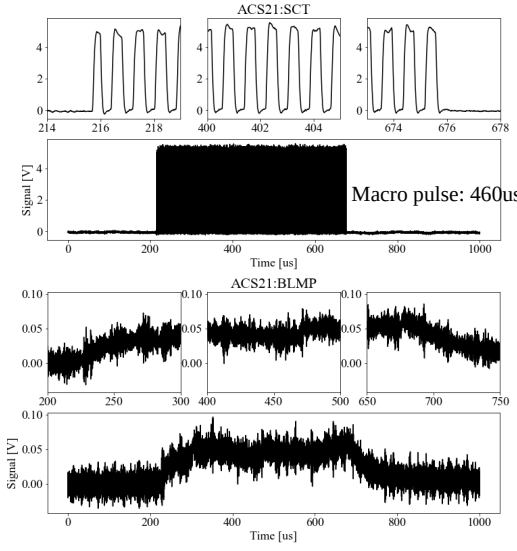
- Abnormal beam loss → beam stop

Beam diagnostics

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

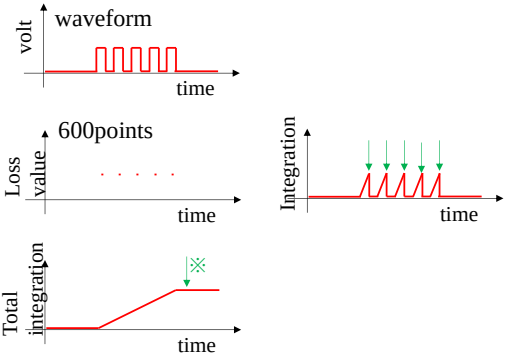


Waveforms and analysis



Digitizer acquires:

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



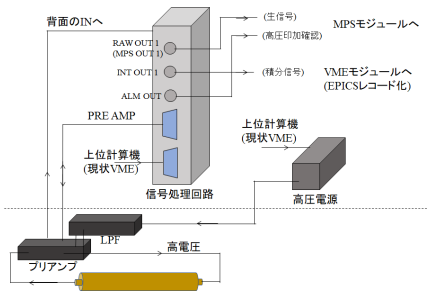
Original and new BLM data acquisition

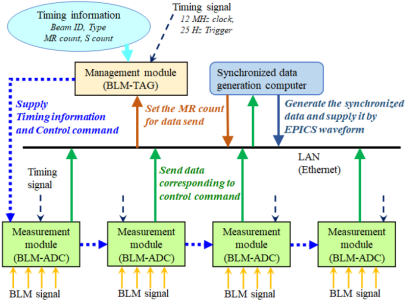
Original: BLM → pre-amp → analog signal processing module → VME (more than 15 yeas old)

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.

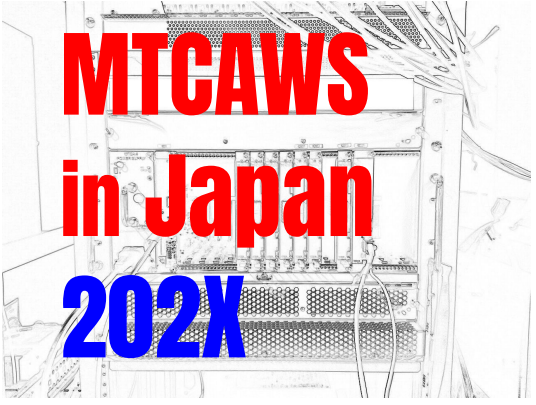
- Sophisticated signal processing on FPGA
- High speed data transfer to storage server from MTCA CPU

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)