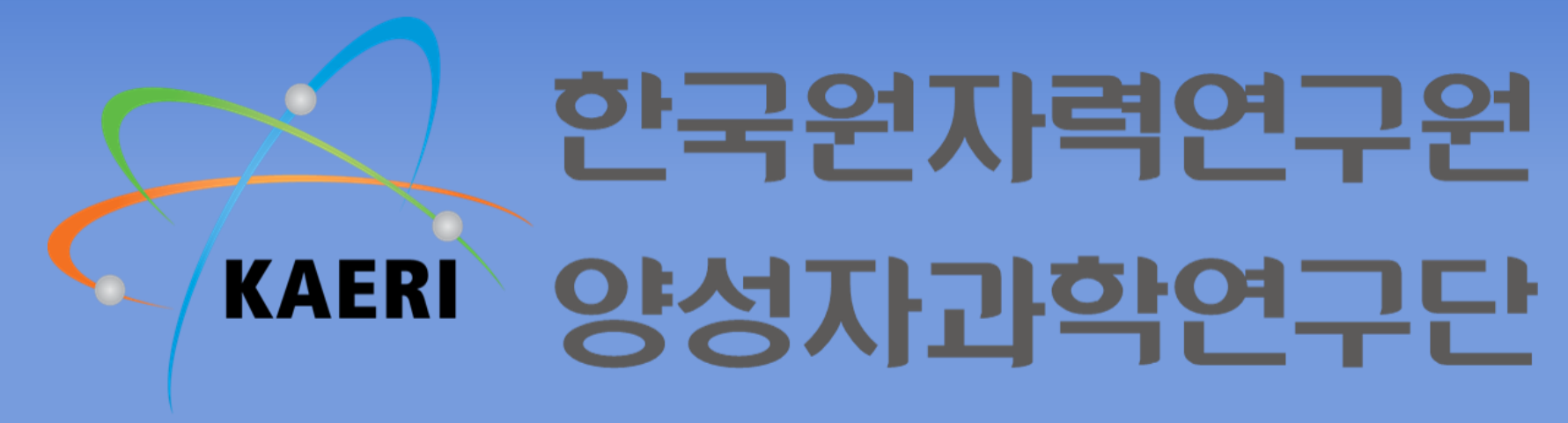


A Preliminary Study on Beam Loss Monitor Calibration for KOMAC DTL Tanks

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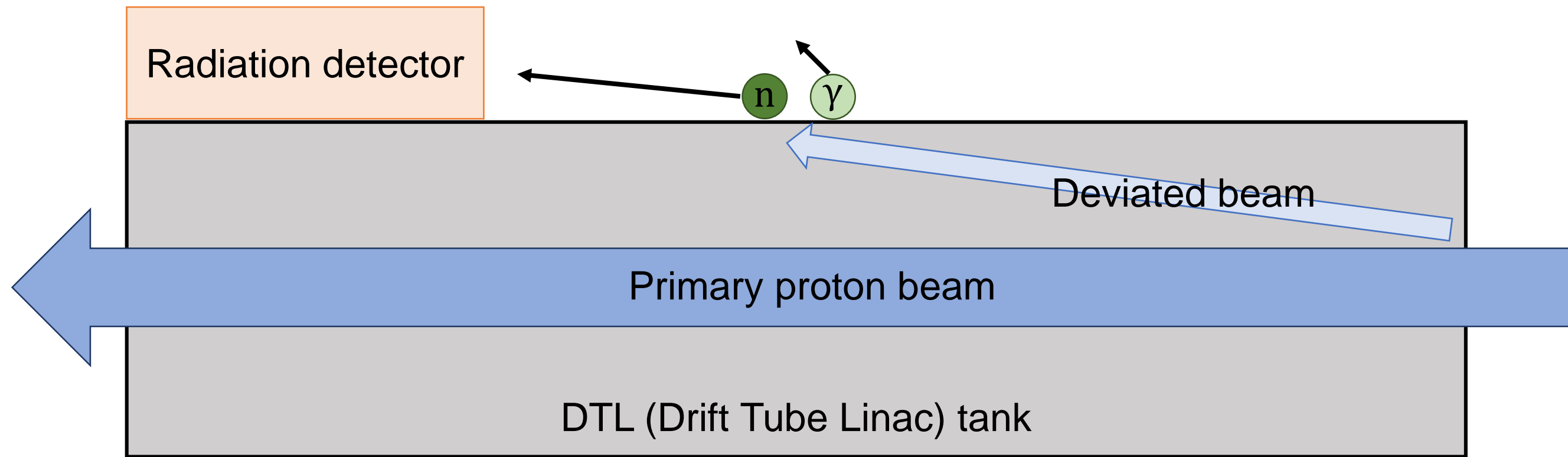
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Abstract

❖ Beam loss monitor (BLM) is a key device for protecting accelerator systems, as it measures secondary radiation produced by a particle beam colliding with the inner wall of the accelerator or field emission induced by the radiofrequency. Therefore, in the KOMAC 100 MeV proton accelerator, BLMs were installed on each DTL (Drift tube linac) tanks for the purpose of machine protection. These BLMs are scintillator-based radiation detectors capable of operating in high radiation background environments, with two or more devices installed on each DTL tank. In this study, through the evaluation of the linearity between BLM signal intensity and beam loss in each DTL tank, the performance of the BLM as a machine protection system (MPS) for the accelerator was analyzed.

About beam loss monitor



Generation of secondary radiation by beam loss

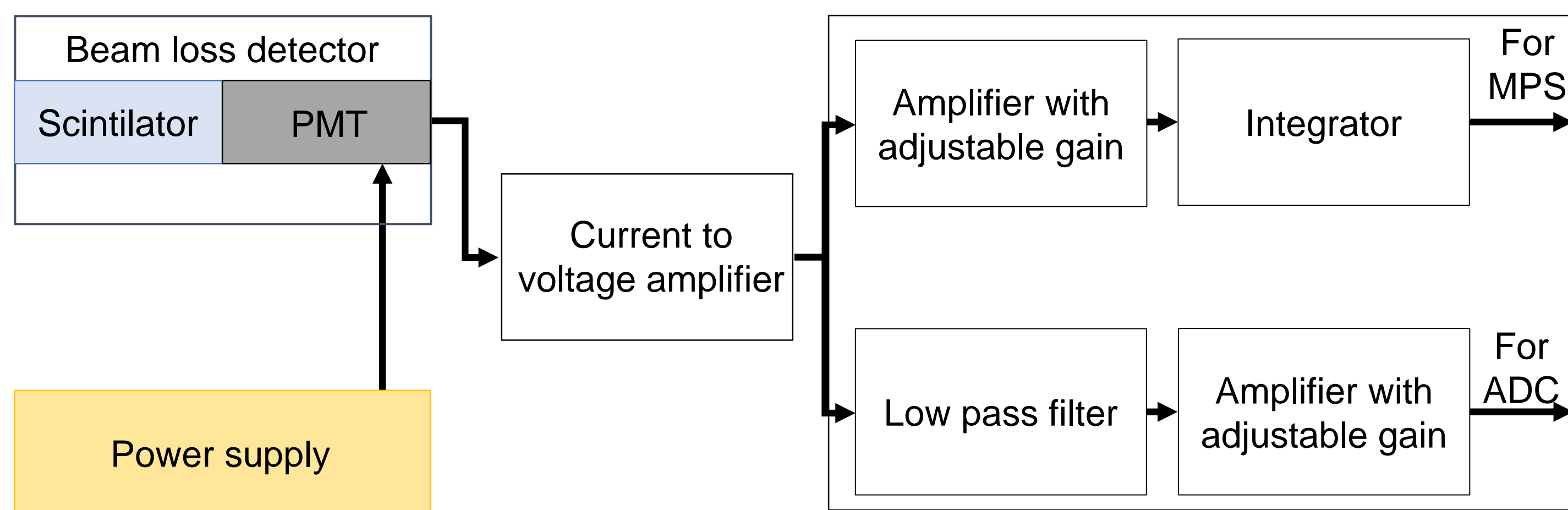
- Unavoidable beam loss always occur due to imperfect alignment, beam instability, etc.

➔ Beam loss monitoring through secondary radiation detection is essential for the sake of long lifetime of the system equipped.

❖ Beam loss requirements for the accelerator operation

- Under 1 W/m: acceptable beam loss ➔ normal operation
- Over 10 W/m: severe beam loss ➔ machine shutdown

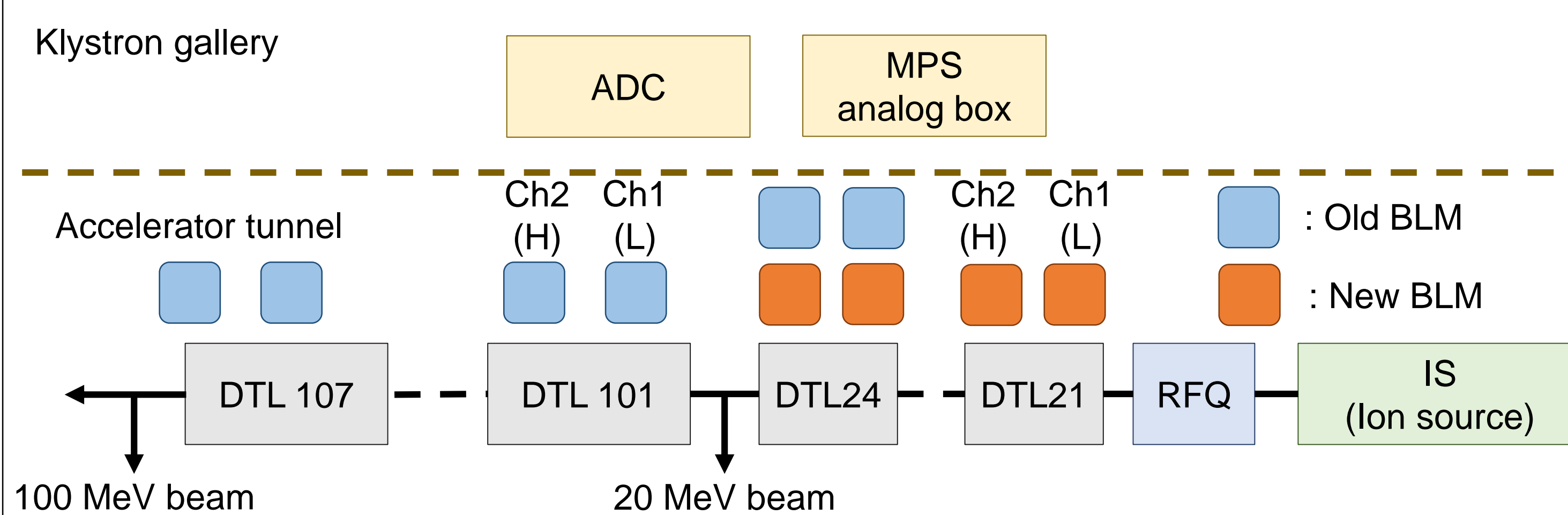
BLM experiment setup



Typical beam loss monitor structure

❖ Scintillator-based BLM specifications exploited at KOMAC

	Old BLM	New BLM
Scintillator type	BC-408 plastic (Saint-Gobain)	EJ-200 plastic (Scionix)
Scintillator size	φ25.4 × 30 mm	φ22 × 100 mm
PMT type	R1924A (φ25.4 mm, Hamamatsu)	H10721-110 (φ8 mm, Hamamatsu)
Applied voltage	-500 V	Power over Ethernet
Default sampling rate [kHz]	800	976.6



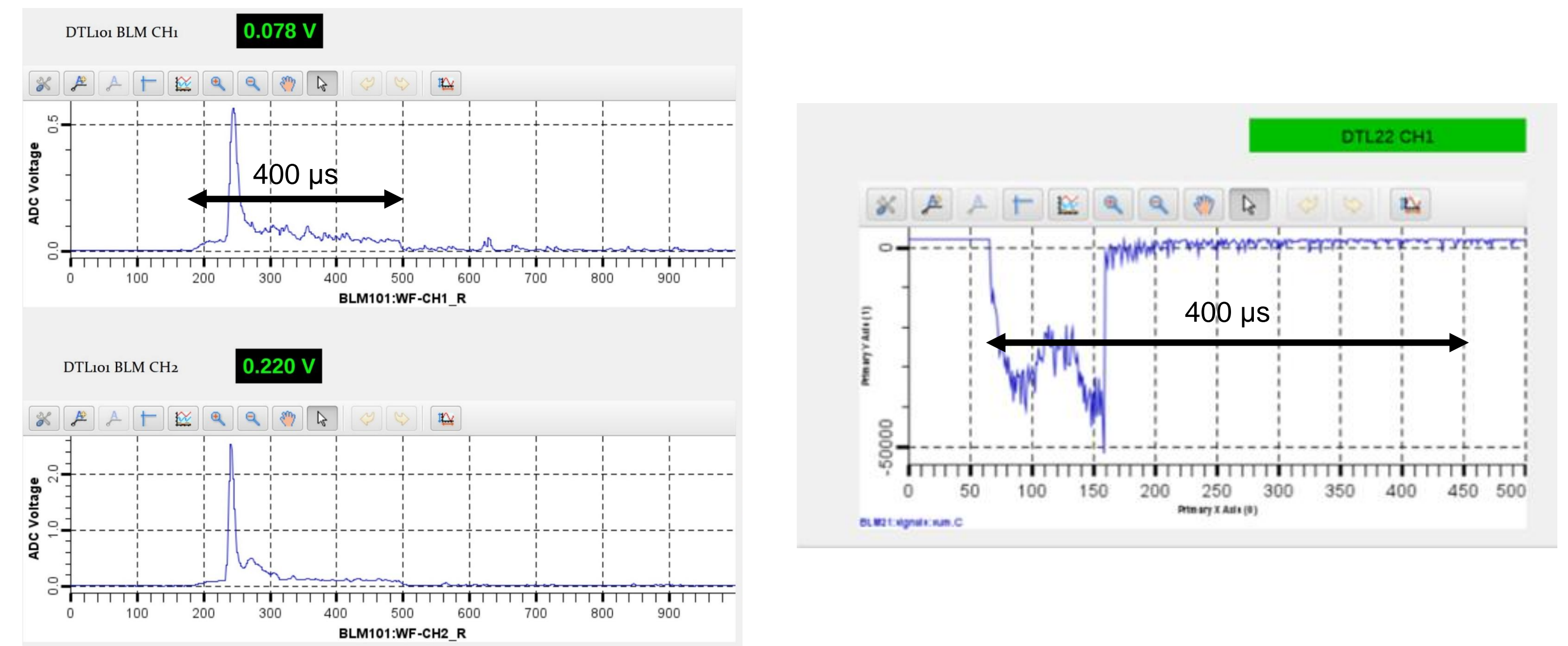
Scintillator BLM spots at KOMAC 100 MeV accelerator

- Ch1: at the center of each DTL, Ch2: at the high energy end of each DTL

Acknowledgments

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BLM signal acquisition results



Examples of old BLM signal at DTL101 tank for 100 μs beam

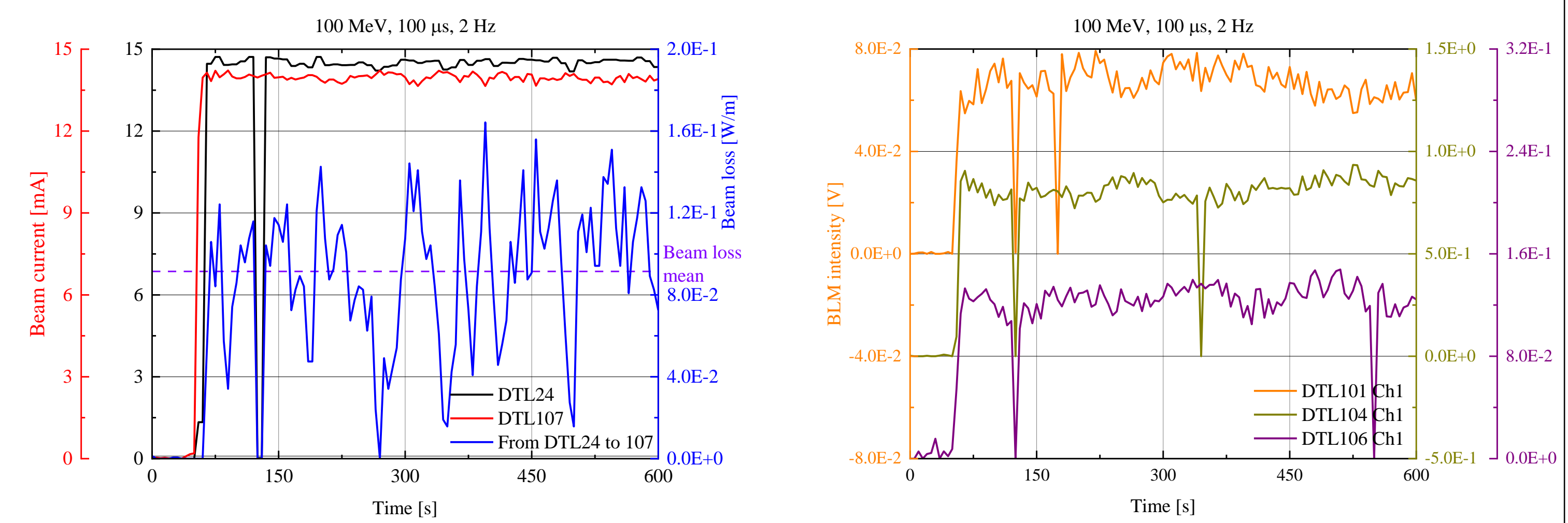
Examples of new BLM signal at DTL22 tank for 100 μs beam

- Cavity x-ray whose width is 400 μs is always detected, which is induced by the klystron. ➔ Main flat background radiation
- These backgrounds can be reduced by utilizing the thin metal cover at the new BLMs.

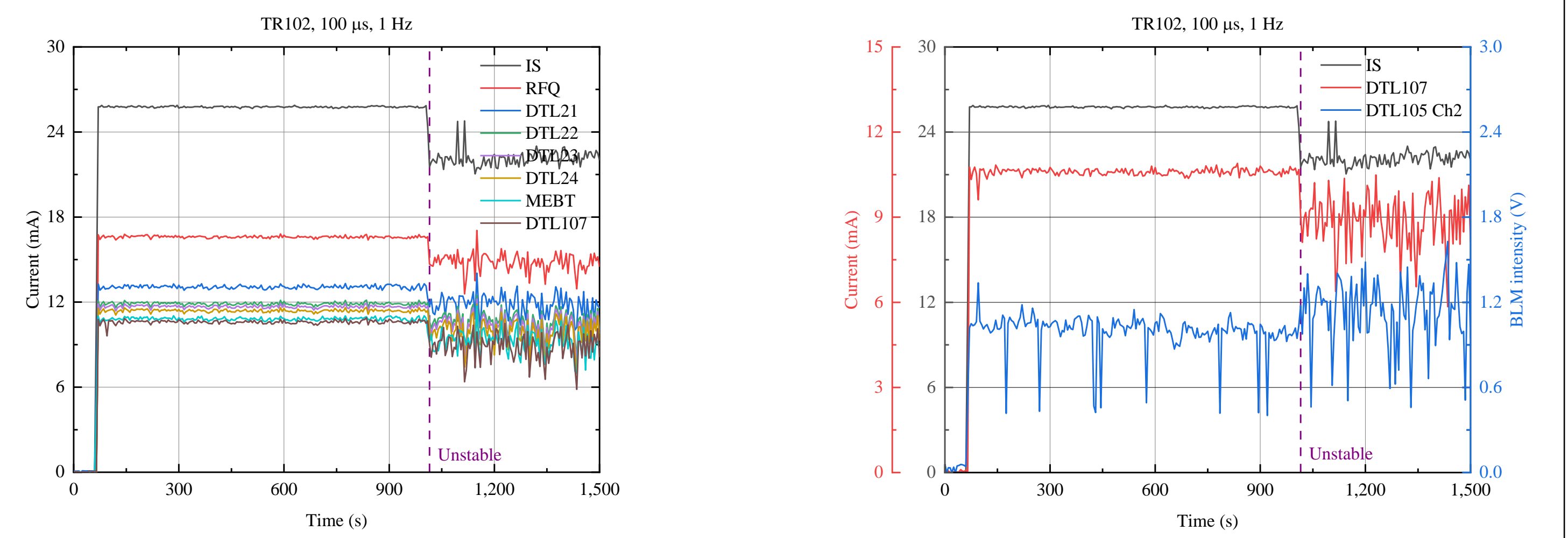
Pb transmission rate for the high energy photon

Pb thickness [mm]	Transmission rate for 1 MeV photon
1	9.61E-1
3	9.16E-1
5	7.76E-1

- However, installing metal cover at the old BLMs would be inefficient due to the high energy cavity x-ray. ➔ An additional separation technique between the background and the beam loss is essential for the old BLMs.

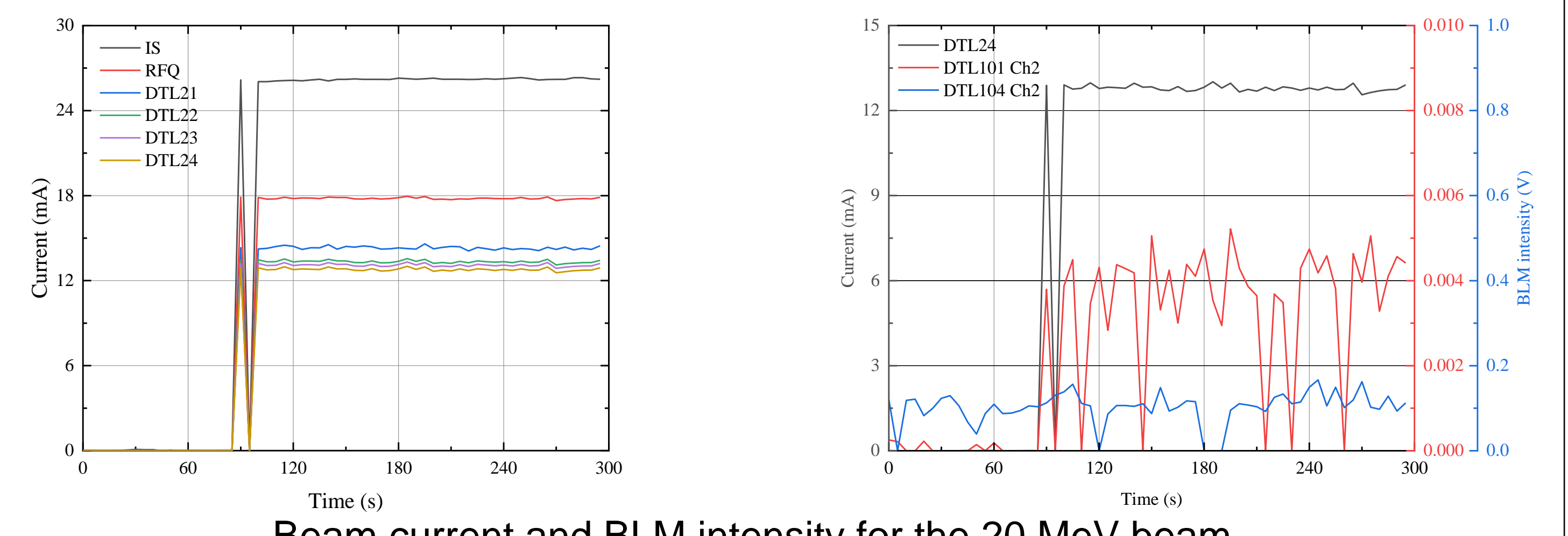


Beam current and BLM intensity for the stable beam



Beam current and BLM intensity for the unstable beam

- Detecting the occurrence of the beam instability for machine protection is achievable through BLMs.



Beam current and BLM intensity for the 20 MeV beam

- It is observed that the detection of the beam loss whose position is far from the BLMs.

Conclusions & Future Works

- ❖ Clarifying the relationship between the BLM spots and the actual beam loss points is crucial for exploiting BLMs as a standard of magnet current control.
- ❖ Calibration of BLM signals based on Monte Carlo simulations will be carried out to determine the beam loss in units of 'W/m' with only BLMs.

Reference

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