

DeeMe – Experiment to search for muon to electron conversion at J-PARC MLF

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After Proton background estimation

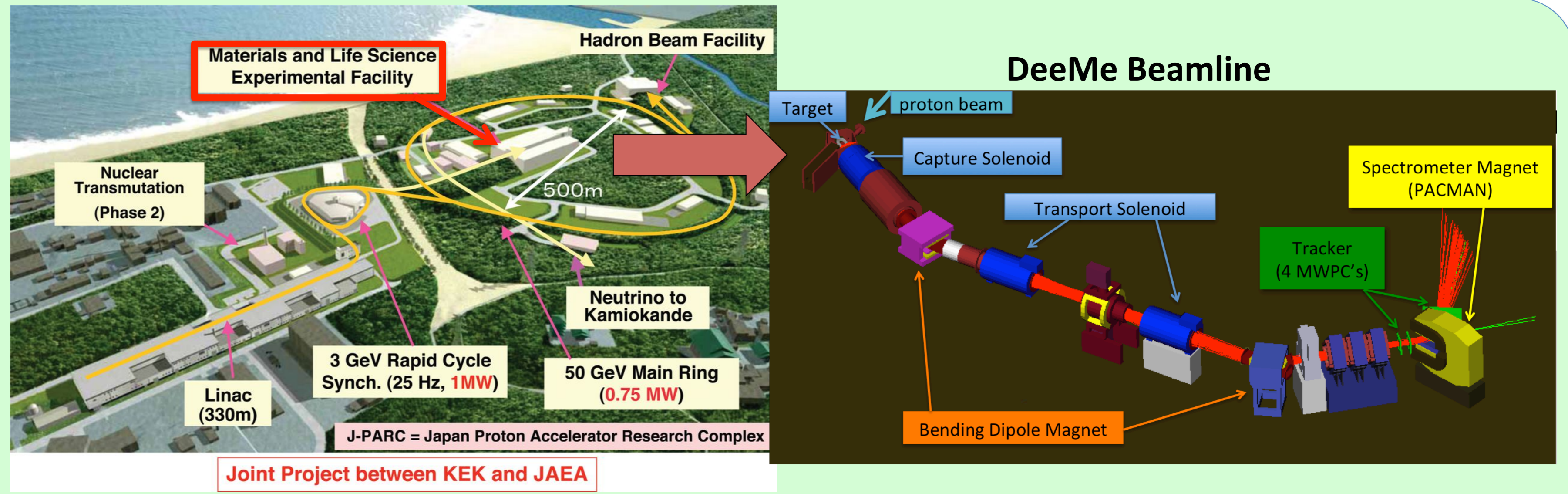
Introduction

Muon to electron conversion is one of the charged lepton flavor violation (cLFV).

- cLFV is forbidden in the Standard Model.
- Some theories beyond the Standard Model predict μ -e conversion signature at the branching ratio level of $\sim 10^{-14}$.

DeeMe is an experiment searching for μ -e conversion.

- A single event sensitivity of 2×10^{-14} (silicon carbide target)
- Being constructed at J-PARC, MLF
- 3-GeV 25Hz pulsed proton beam from Rapid Cycling Synchrotron (RCS)

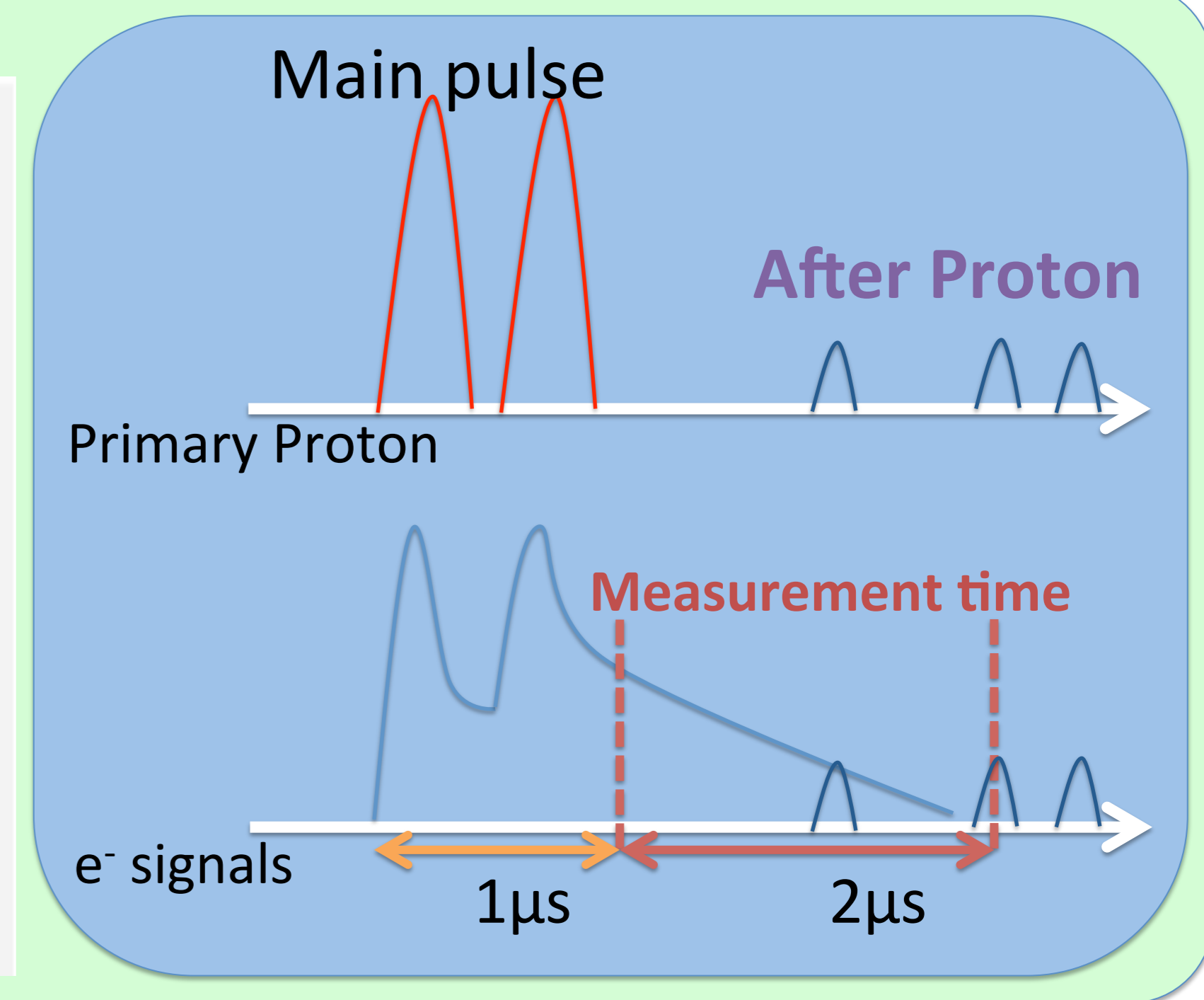
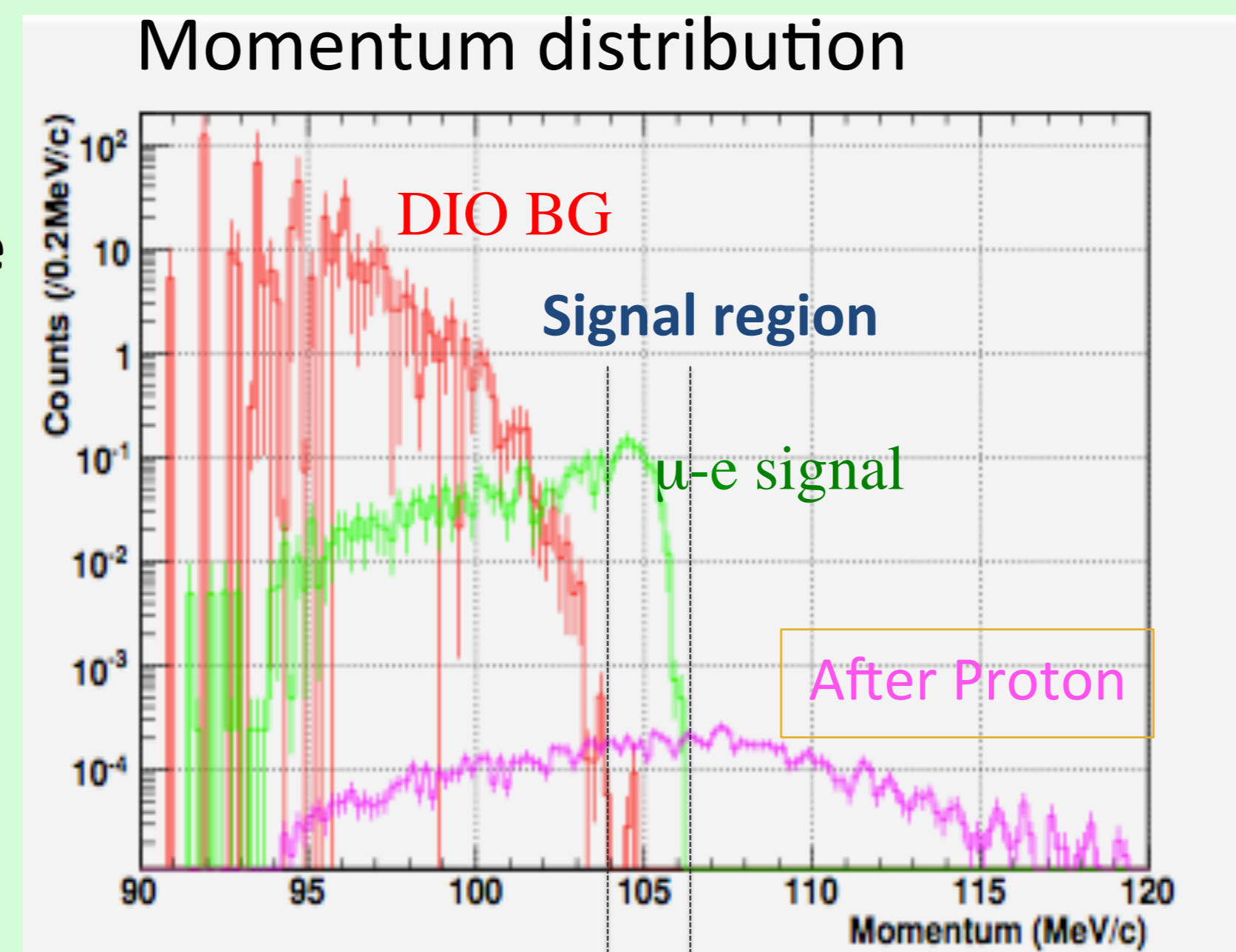


After Proton

After Proton(AP) = Delayed proton

Proton beam produces a lot of prompt electrons.

- Possibility of delayed proton approach in the measurement time
- Overlapping the signal region (102–105 MeV/c)
- AP doesn't exist in principle because of RCS feature.
 - High-Intensity Proton Ring
 - Large aperture of RCS to avoid radio-activation of the ring equipment
 - Large kicker angle to be extracted
- Fast extraction
 - No protons in RCS ring after extraction



AP counter

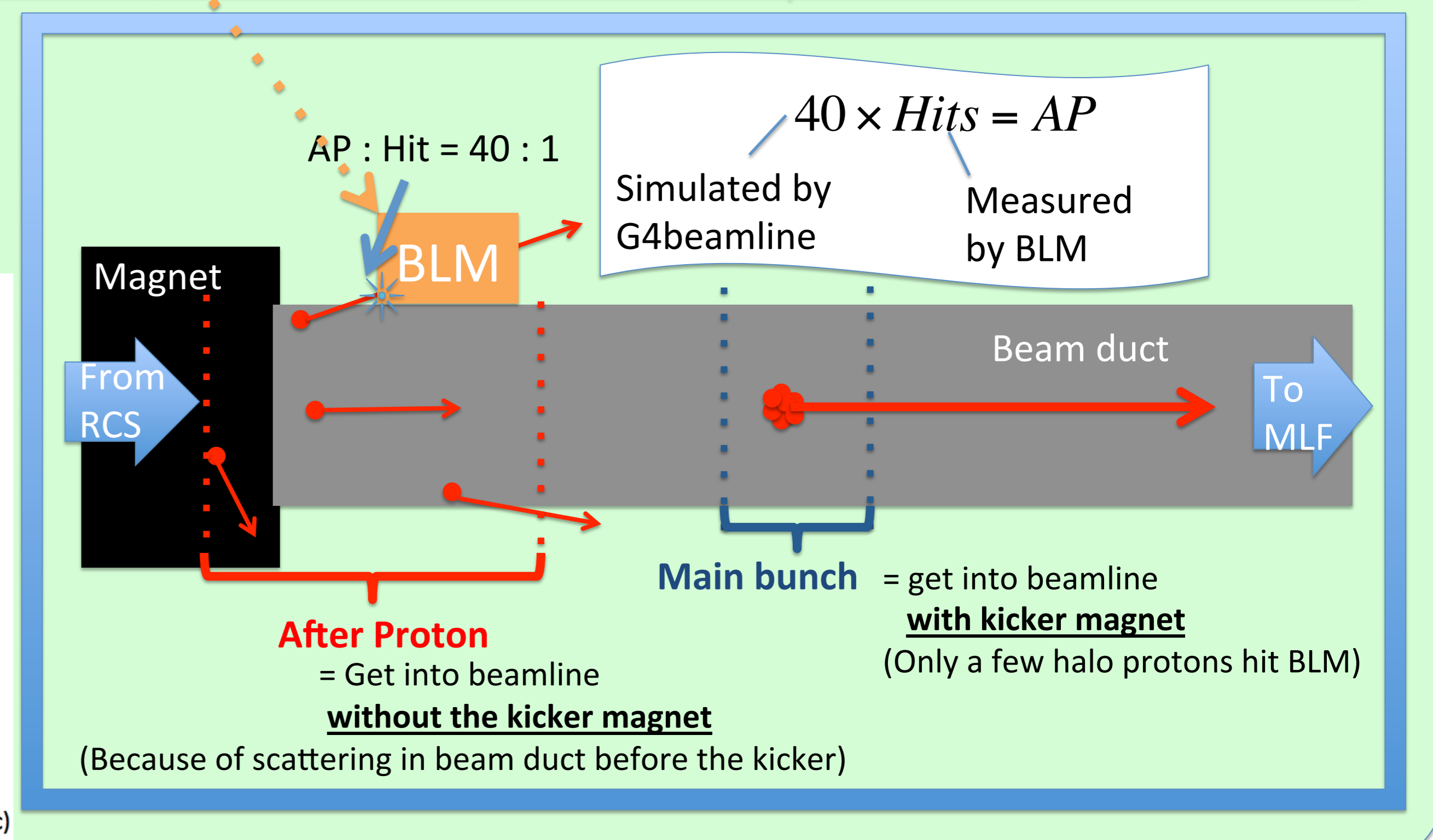
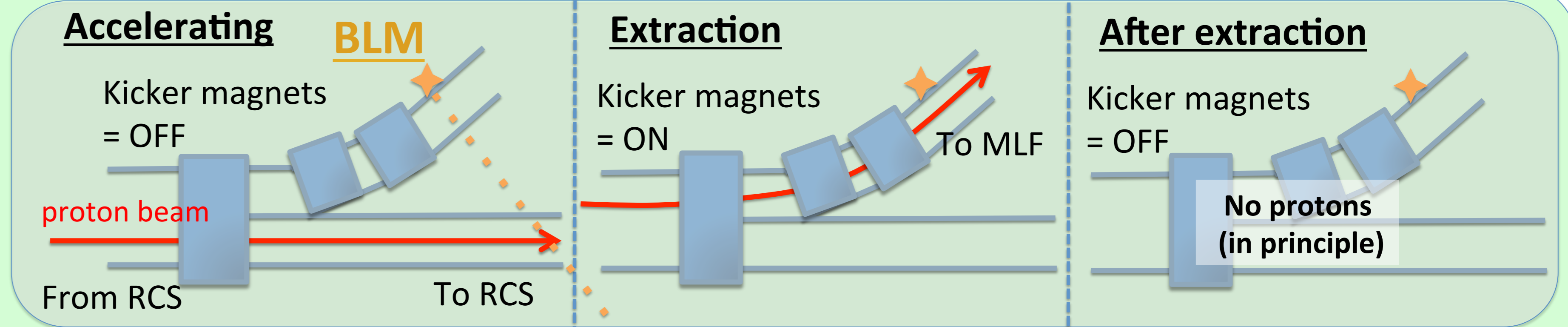
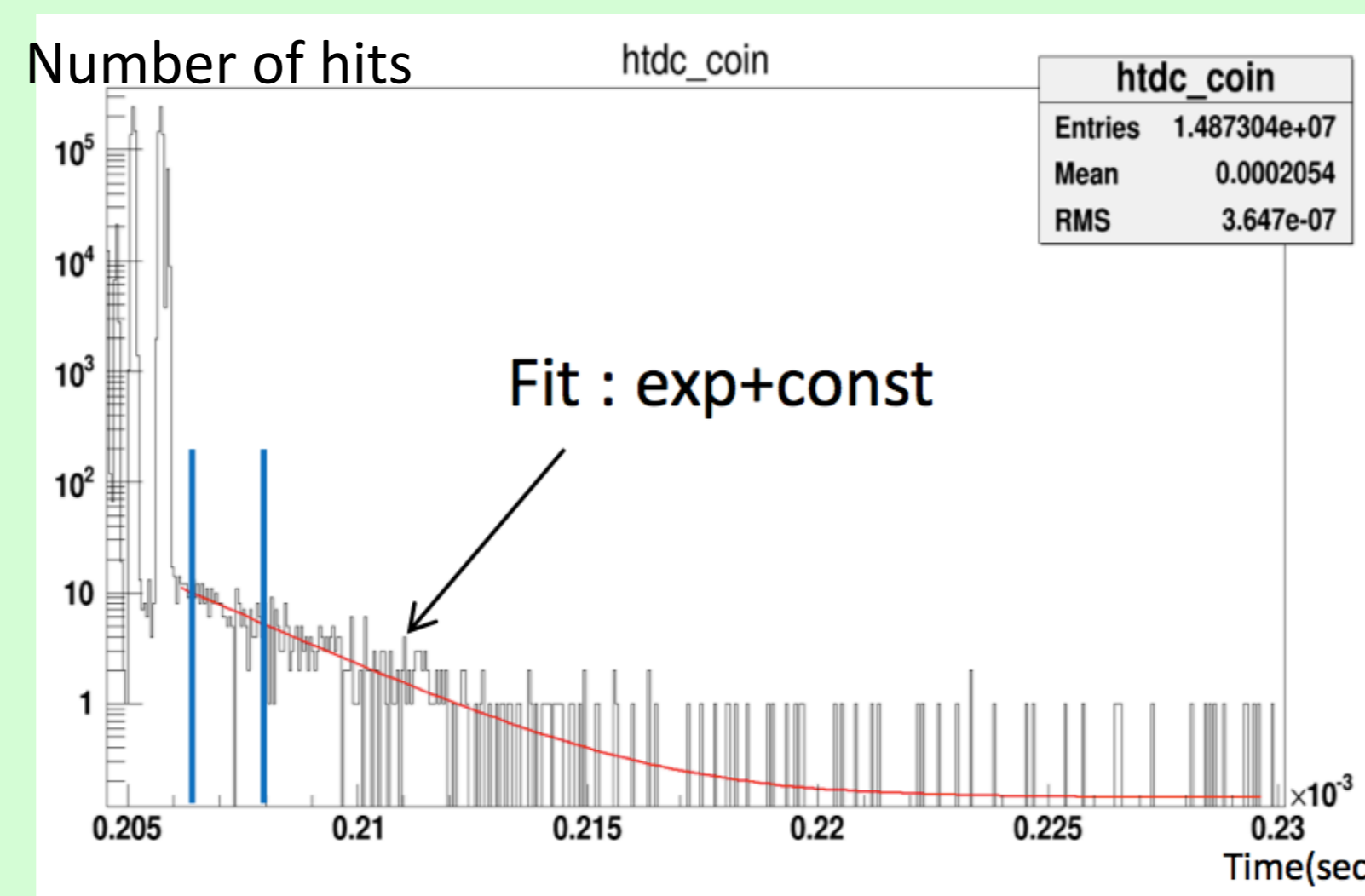
AP background isn't able to be distinguished by measurement time or momentum measurement.

- Measurement with **beam loss monitor (BLM)** at RCS tunnel

From the past study,

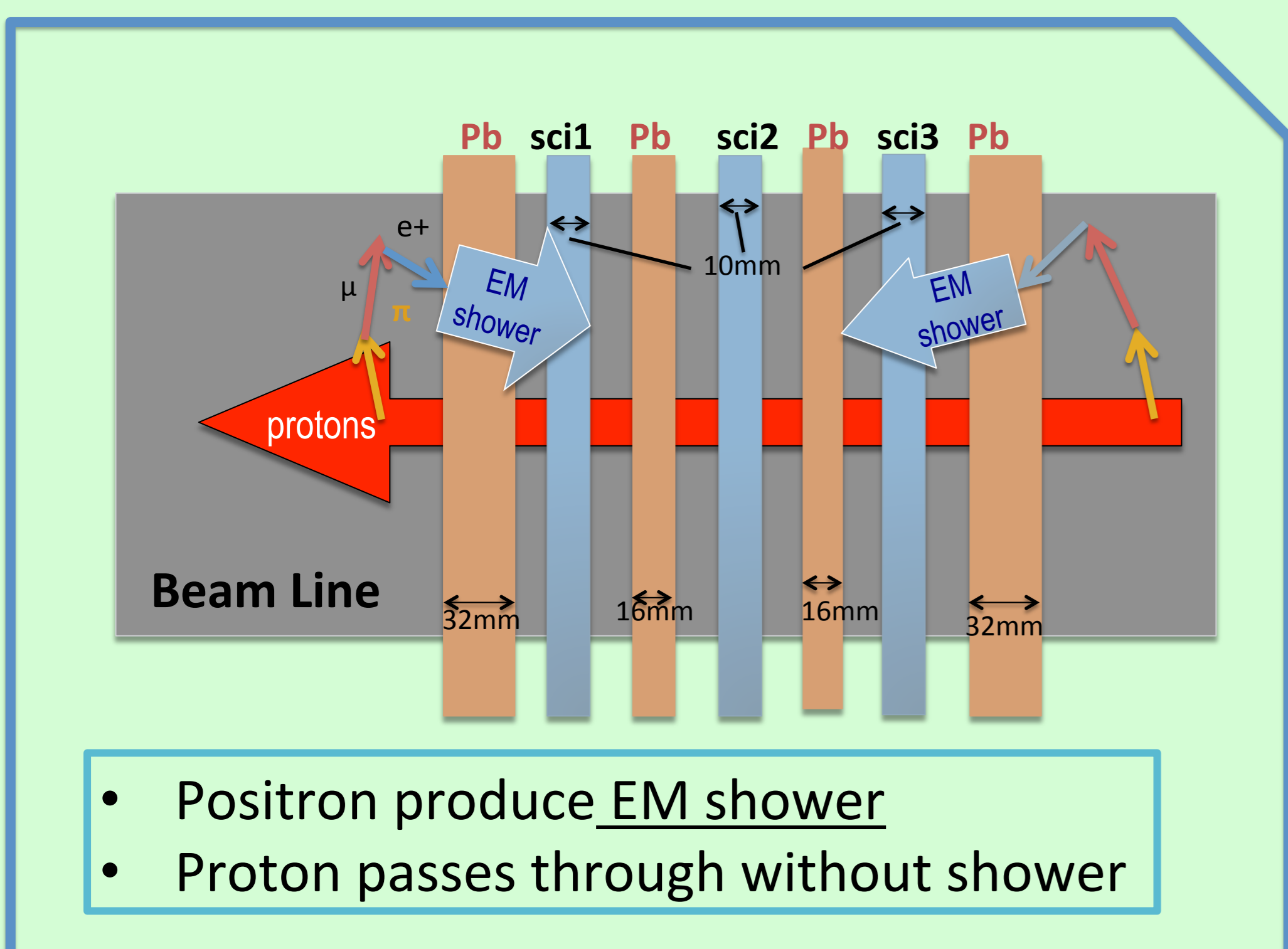
- AP is proportional to hit of this counter
- The coefficient is estimated at ~ 40 by Monte Carlo simulation.
- The rate of AP $< 2.2 \times 10^{-18}$, and AP background < 0.04 event / year
 - It's small enough to treat as background, but not small enough to ignore
- The time spectrum of hit of AP counter could be fitted as **decay of rest muon** (Michel decay: < 53 MeV)
 - possibility that positrons become the background of AP measurement

It will improve AP and positron identification.

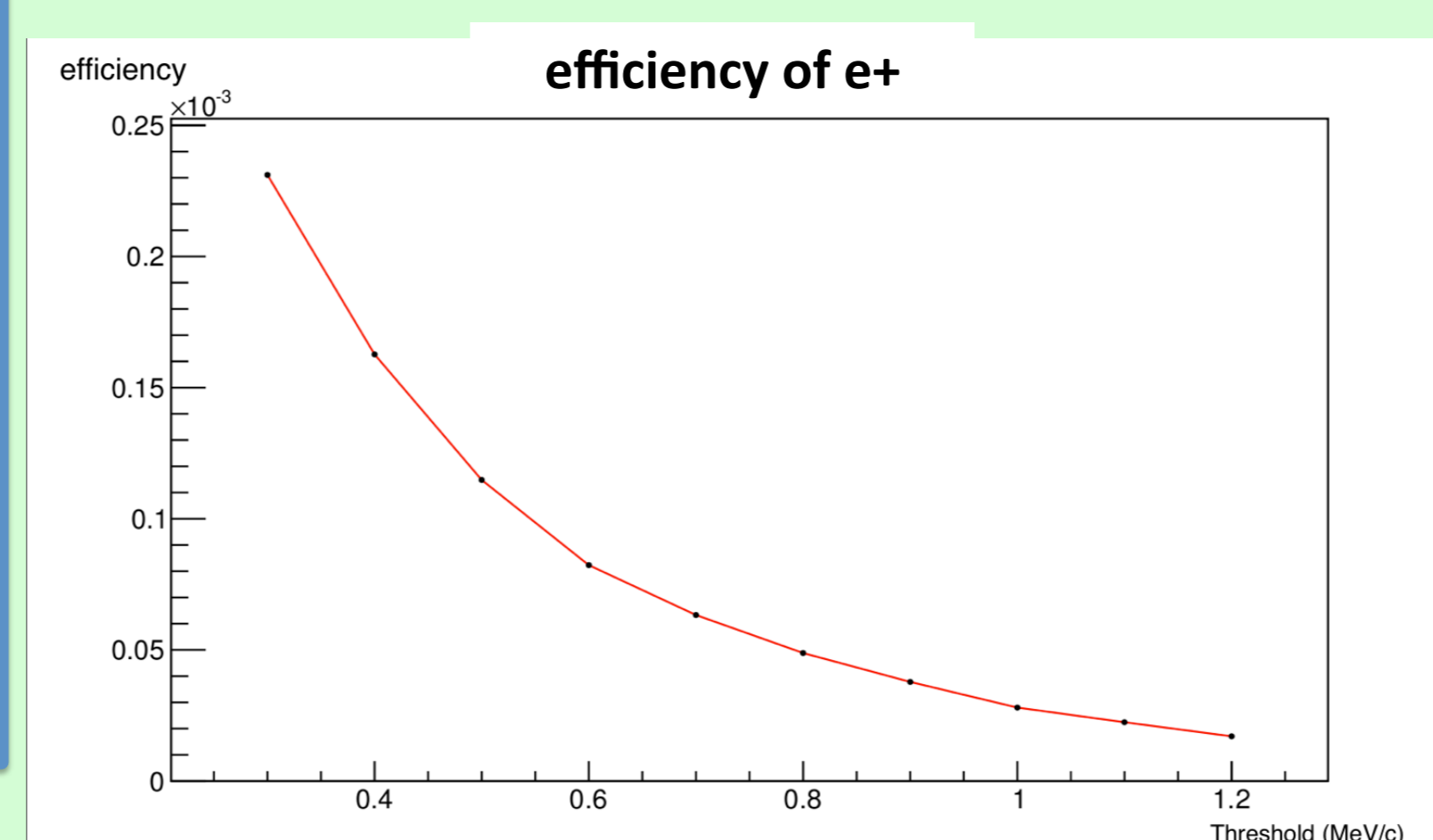
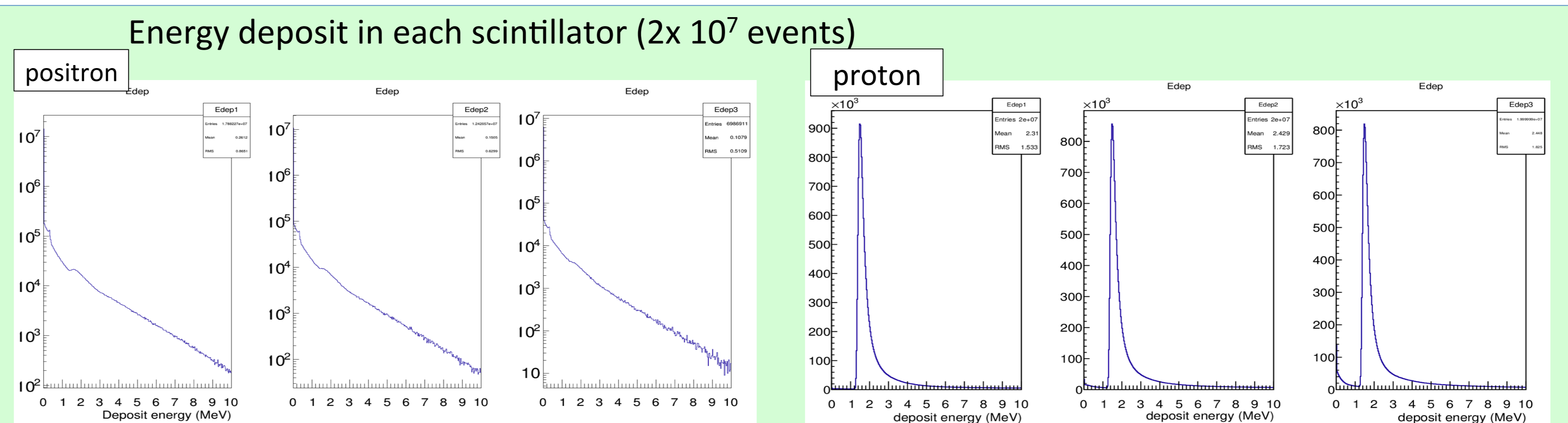


Design of New AP Counter

Simulated by G4beamline sandwich calorimeter of plastic scintillators and lead layers.



- Positron produce EM shower
- Proton passes through without shower



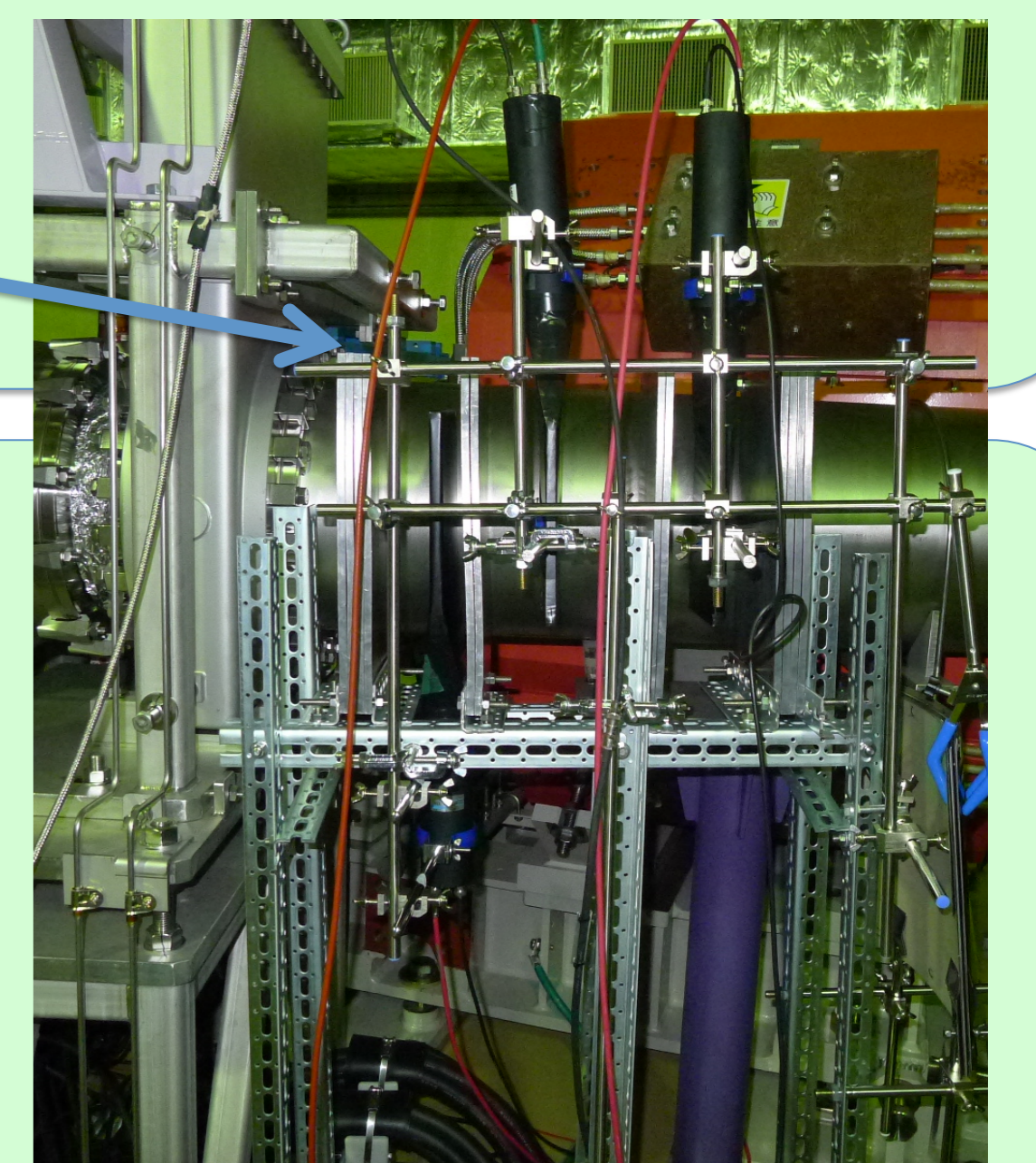
- Positron : Edep < 0.3 MeV in most event
- Proton : Edep > 1 MeV

Coincidence

<- efficiency vs threshold

- Suppression of the Michel electron $\sim 10^{-4}$ (10^{-2} increase)
- Efficiency of 3-GeV proton is ~ 0.95

- Setup was completed
- Taking and analyzing data



Summary

- DeeMe is an experiment searching for muon to electron conversion.
- After Proton background
 - AP rate $< 2 \times 10^{-18}$
 - It's small enough to treat background, but not negligible.
 - Delayed electrons hit the BLM
- New AP counter can decrease Michel e+
 - Suppression of e+ will be $\sim 10^{-5}$
 - Installed in RCS
 - Analyzing the data