

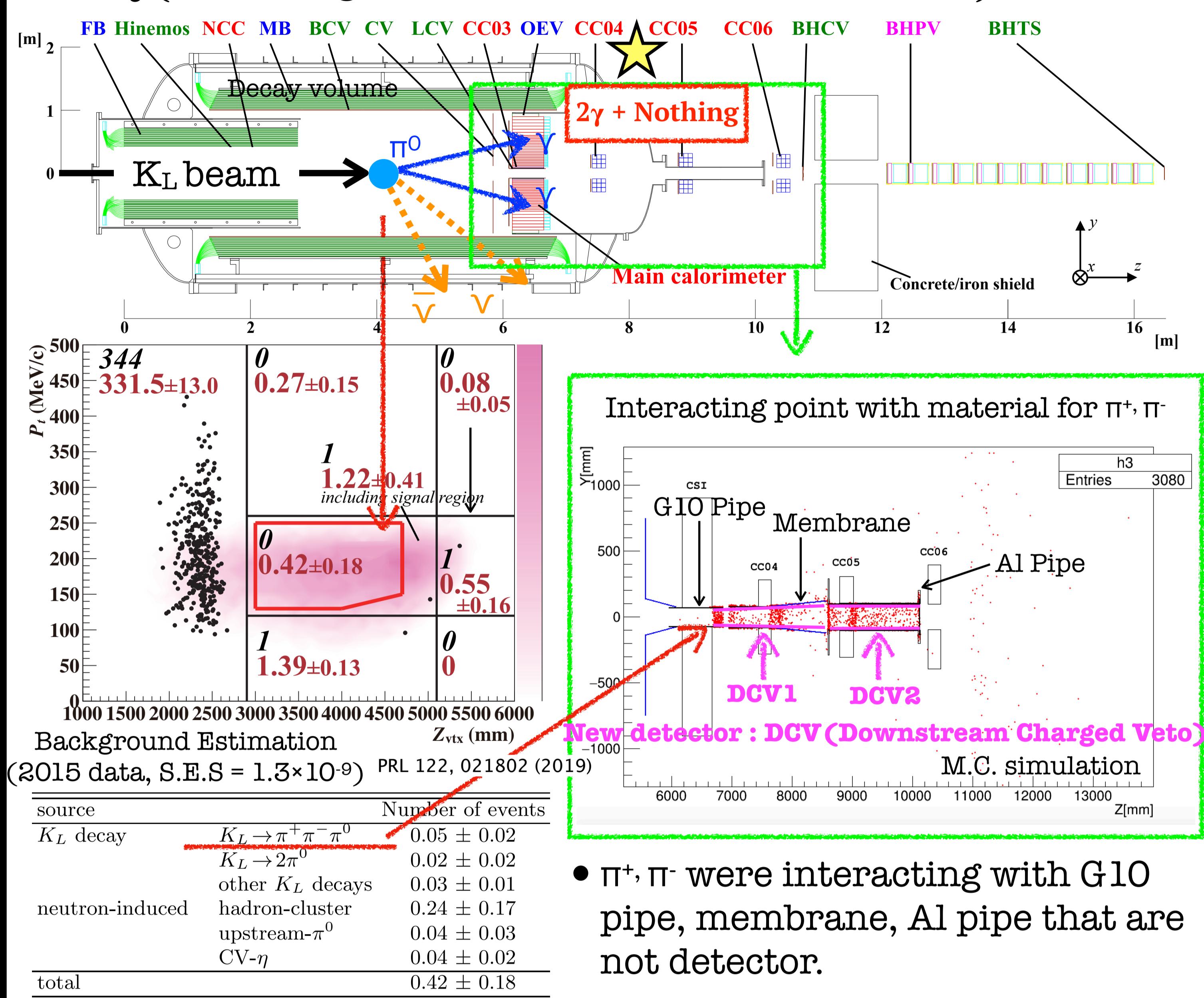
A new charged particle detector for KOTO experiment at J-PARC



HongMin KIM for the KOTO Collaboration, recenter@naver.com

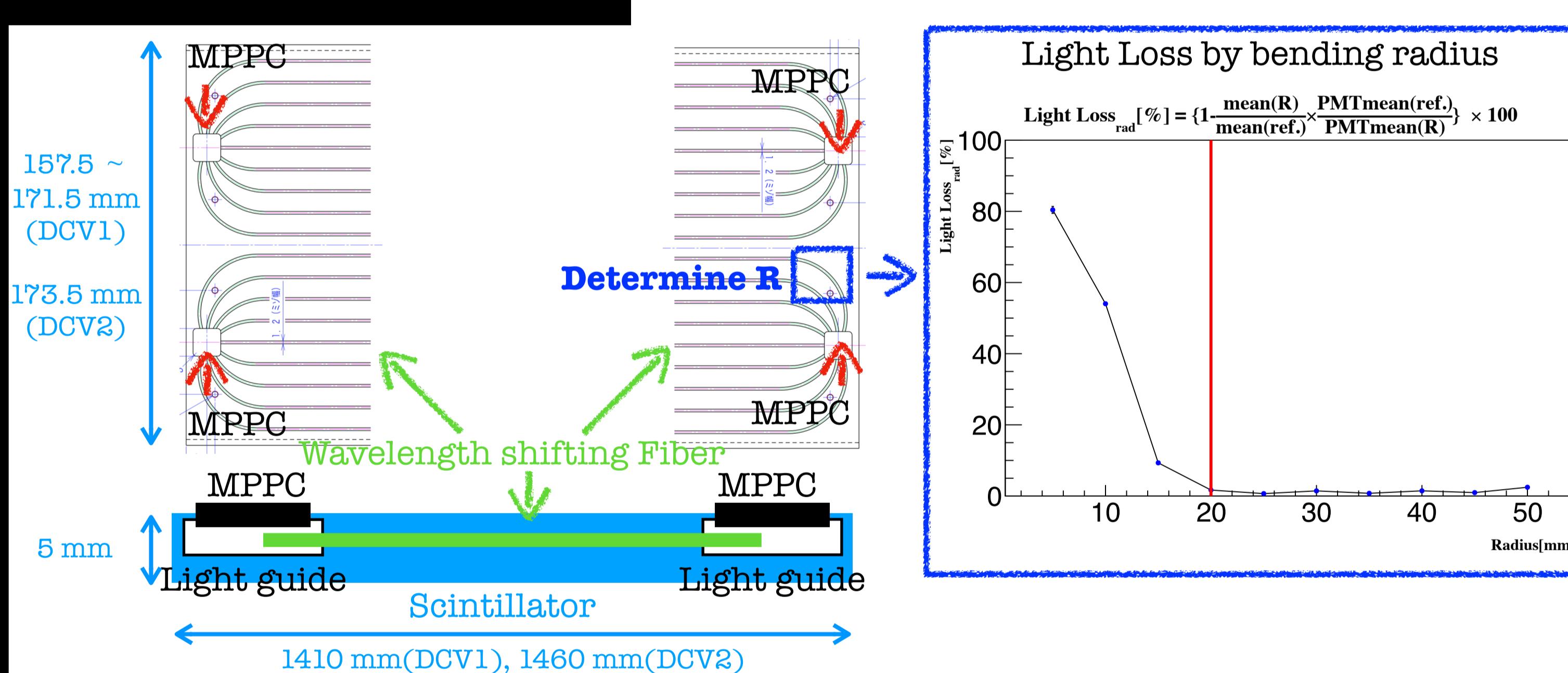
0. Motivation

- The KOTO Experiment at J-PARC is searching for the $K_L \rightarrow \pi^0 \nu \bar{\nu}$ decay (Branching ratio : 3.0×10^{-11} in Standard Model).



- The number of $K_L \rightarrow \pi^+ \pi^- \pi^0$ decay mode event can be reached about 2 at the S.M. sensitivity.
- A new detector** to prevent charged pions from interacting with dead materials
- Due to very limited space, a new scheme of light collection has been implemented.

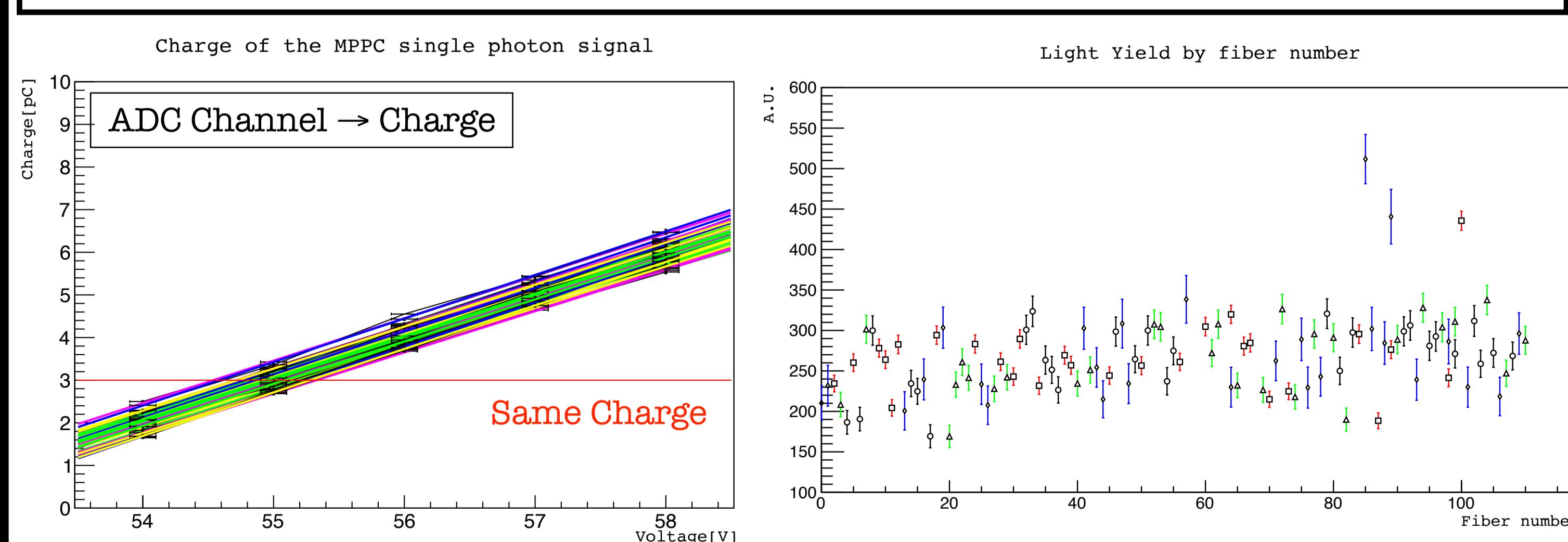
1. Scheme of DCV



- The fiber goes side by side into the light guide.
- MPPCs are attached to the surface of the scintillator.
- The minimum radius of 20 mm was determined to bend the fiber.

2. Fabrication Process

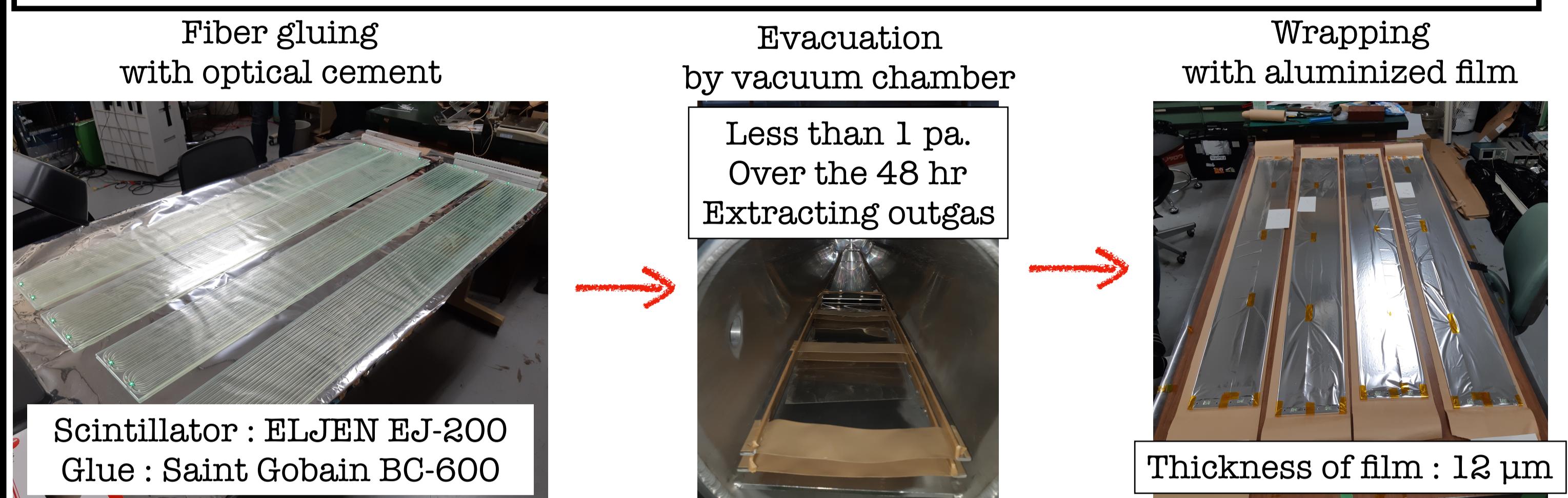
MPPC Gain Measurement & Fiber Test



- We used the MPPCs from HAMAMATSU S13360-6050PE.
- MPPCs were each connected by U.FL Cable(1.32φ)
- Using 430 nm LED, we measured the MPPC single gain.
- MPPCs were grouped into four with the same operating voltage.
- We used the fiber from Kuraray Y-11(1 mm)
- LED light(430 nm) was injected from one side and the light yield was measured with MPPC from the other side.
- We chosen the fiber from the highest value of light yield.

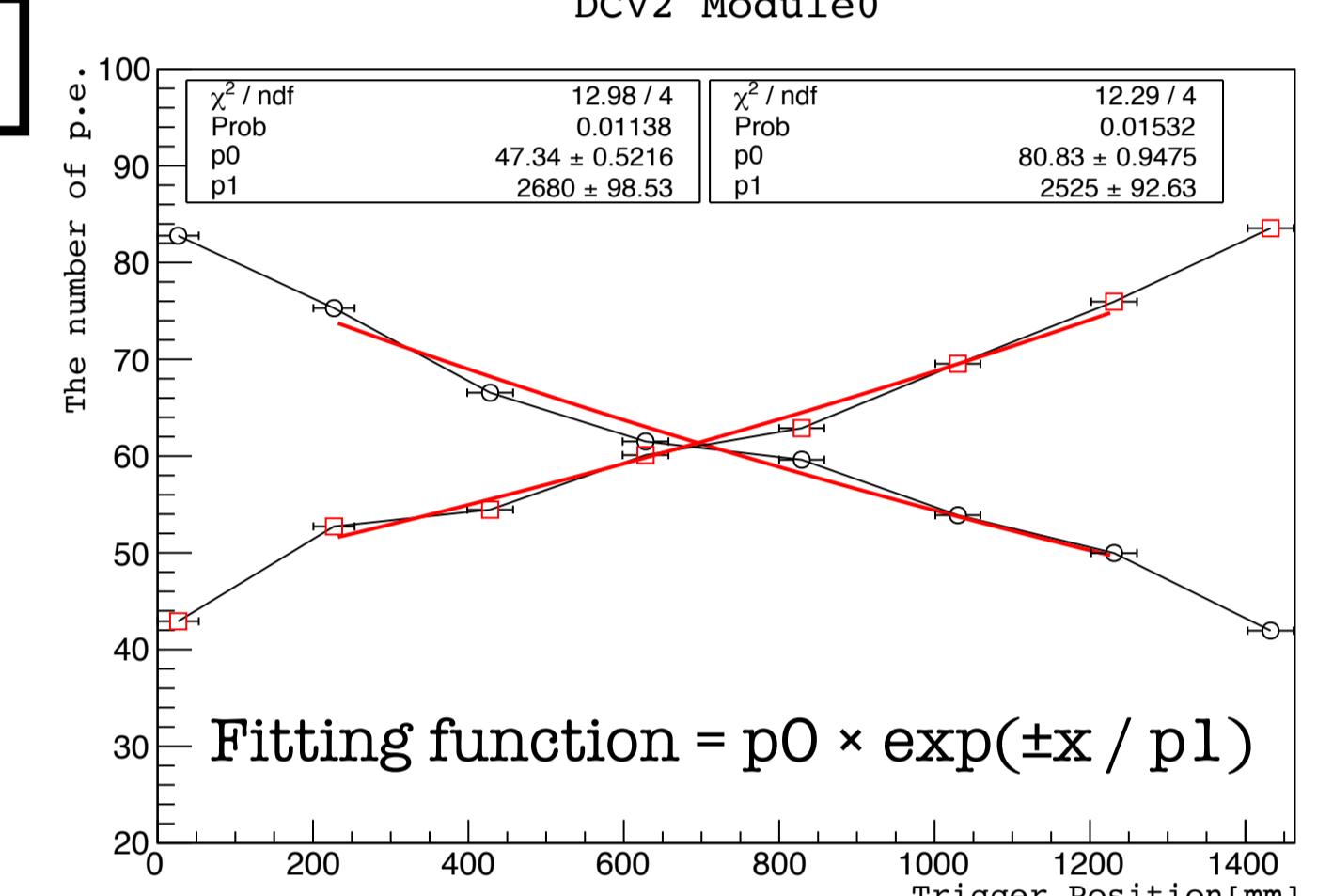
2. Fabrication Process

Making the scintillator pipe

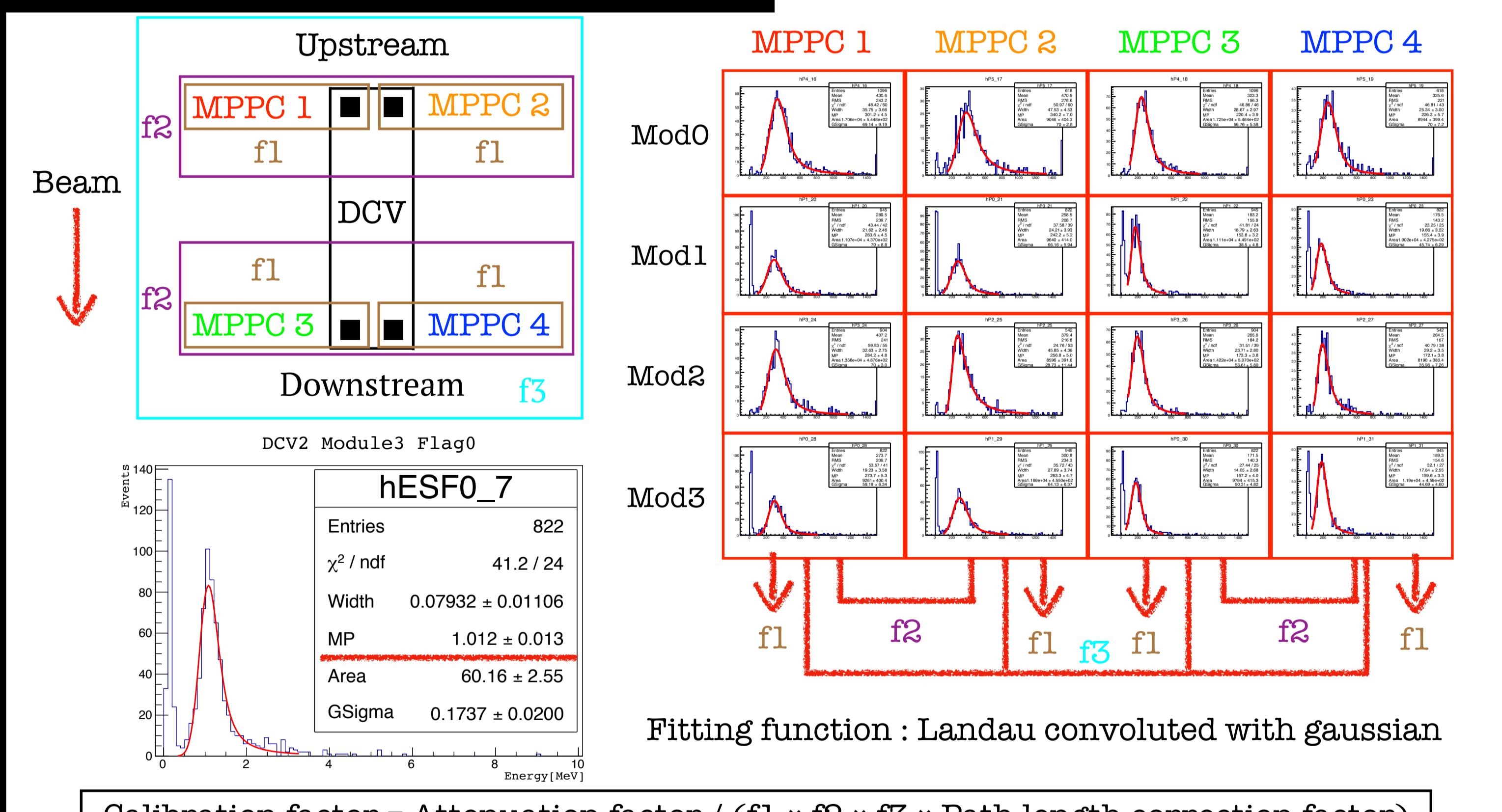


Cosmic ray test

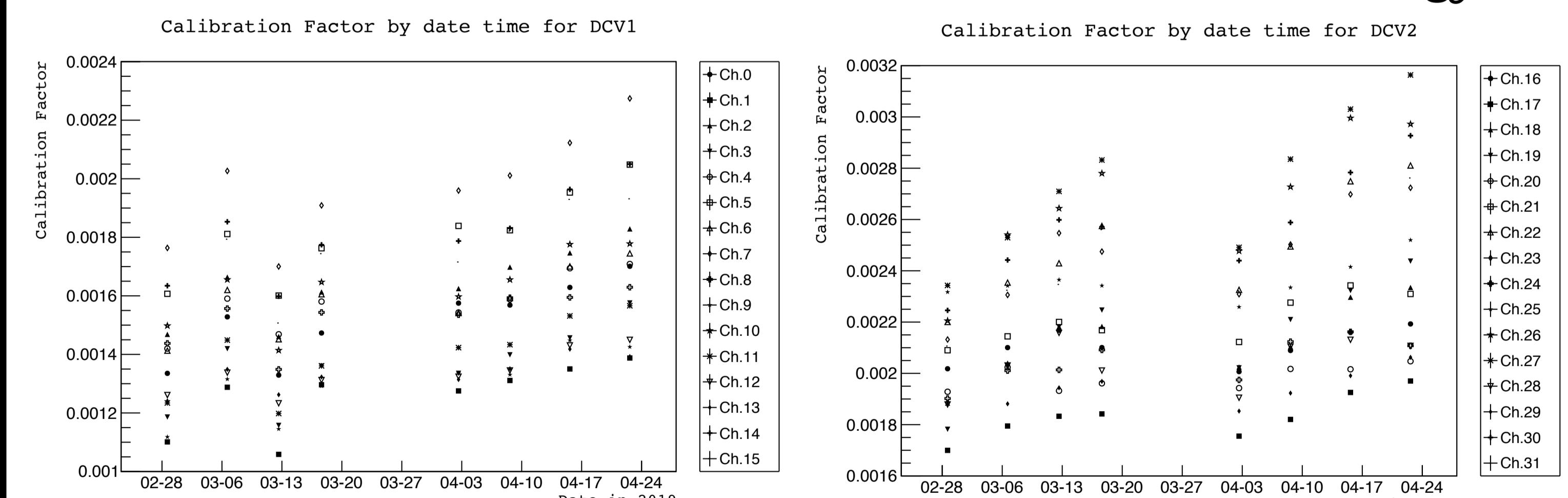
- We measured the P.E. using cosmic ray at 8 trigger positions.
- P.E. for 1 MeV at center point. 60.15(DCV1), 58.62(DCV2)
- Attenuation length 2469.12 ± 660.37 mm(DCV1) 2566.62 ± 664.16 mm(DCV2)



3. Beam Commissioning



- CC04 and CC05 (surrounding DCV) were used as trigger counter to calibrate with cosmic ray.
- Energy calibration was performed from the calculation of normalized factor for each MPPC to the sum of MPPC's energy.



- Analysis is underway to check the cause of the variation of the calibration factor and the stability of the DCV during the beam time.

4. Summary

- To reduce the $K_L \rightarrow \pi^+ \pi^- \pi^0$ background, It is necessary to install a new scintillator detectors(DCV) inside the beam pipe.
- Due to limited space, a new type of light collection is adapted.
- The result of cosmic ray analysis showed DCV got about 60 p.e.
- DCV has been successfully installed at KOTO.
- The calibration of DCV was completed using the cosmic ray.
- Analysis for stability of DCV performance is ongoing.