Present Status of KOTO

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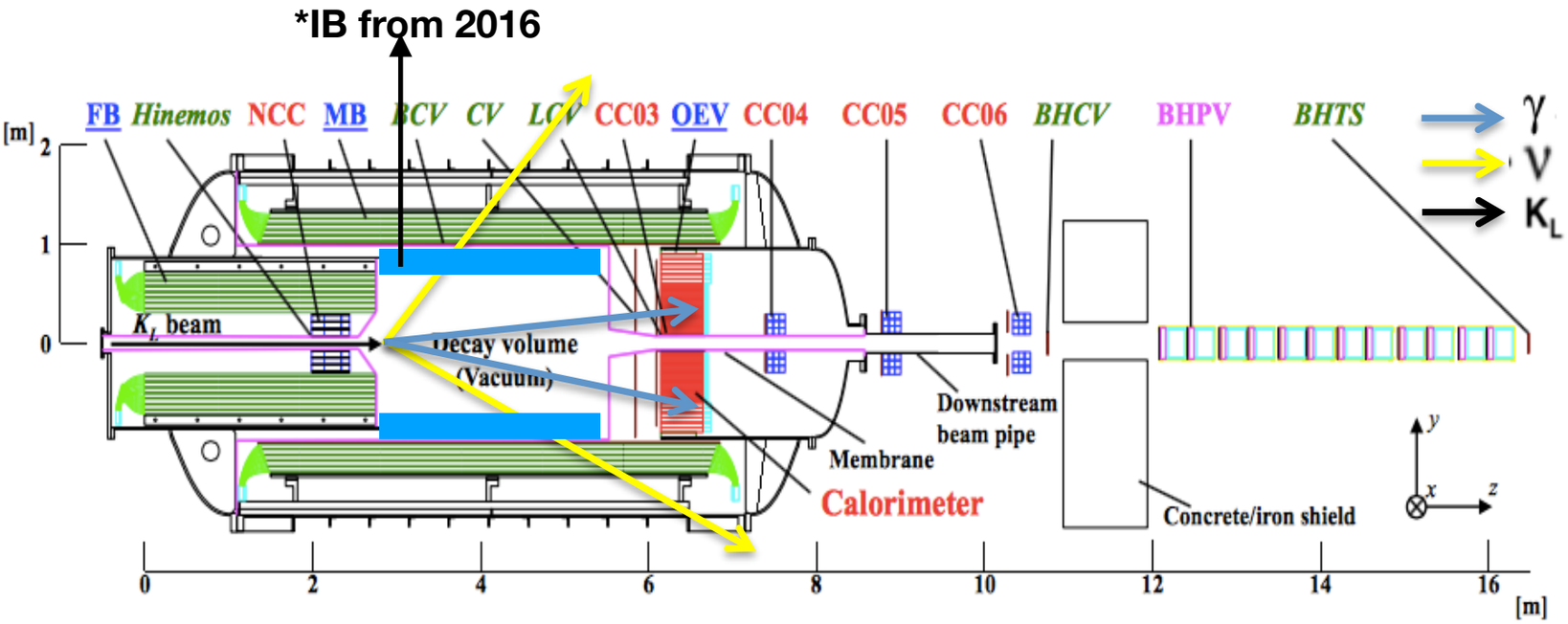
for the KOTO Collaboration

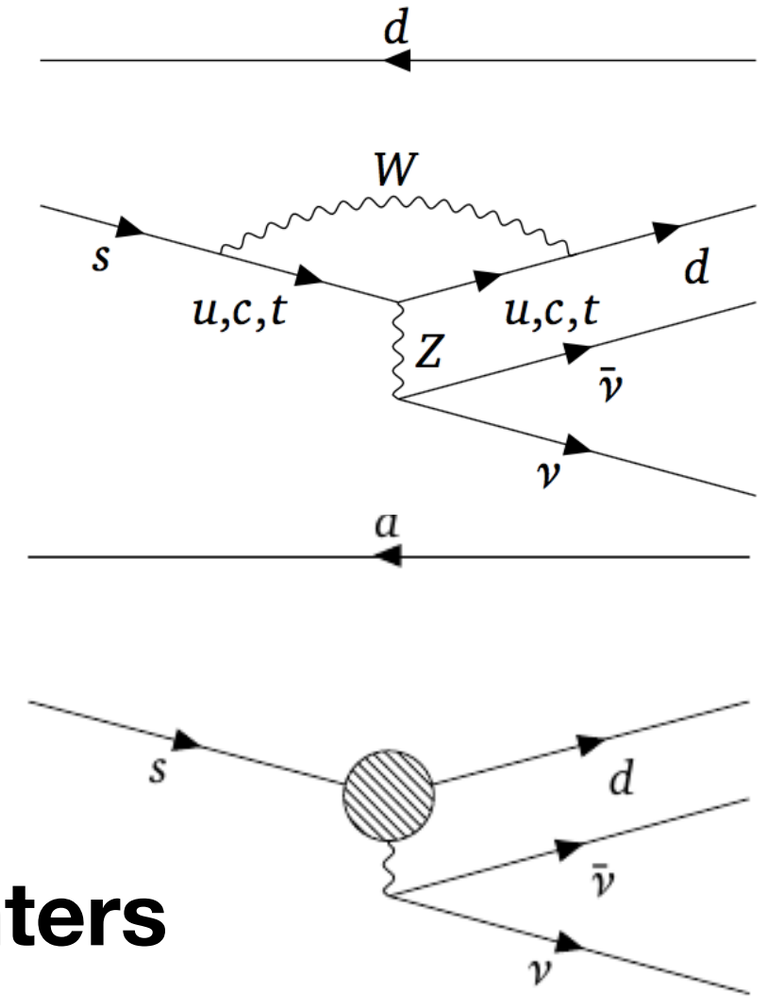
2018 KPS Spring Meeting

J-PARC KOTO Experiment

$Br(K_L \to \pi^0 \nu\bar{\nu}) = (3.0 \pm 0.3) \times 10^{-11}$ **predicted by S.M.**

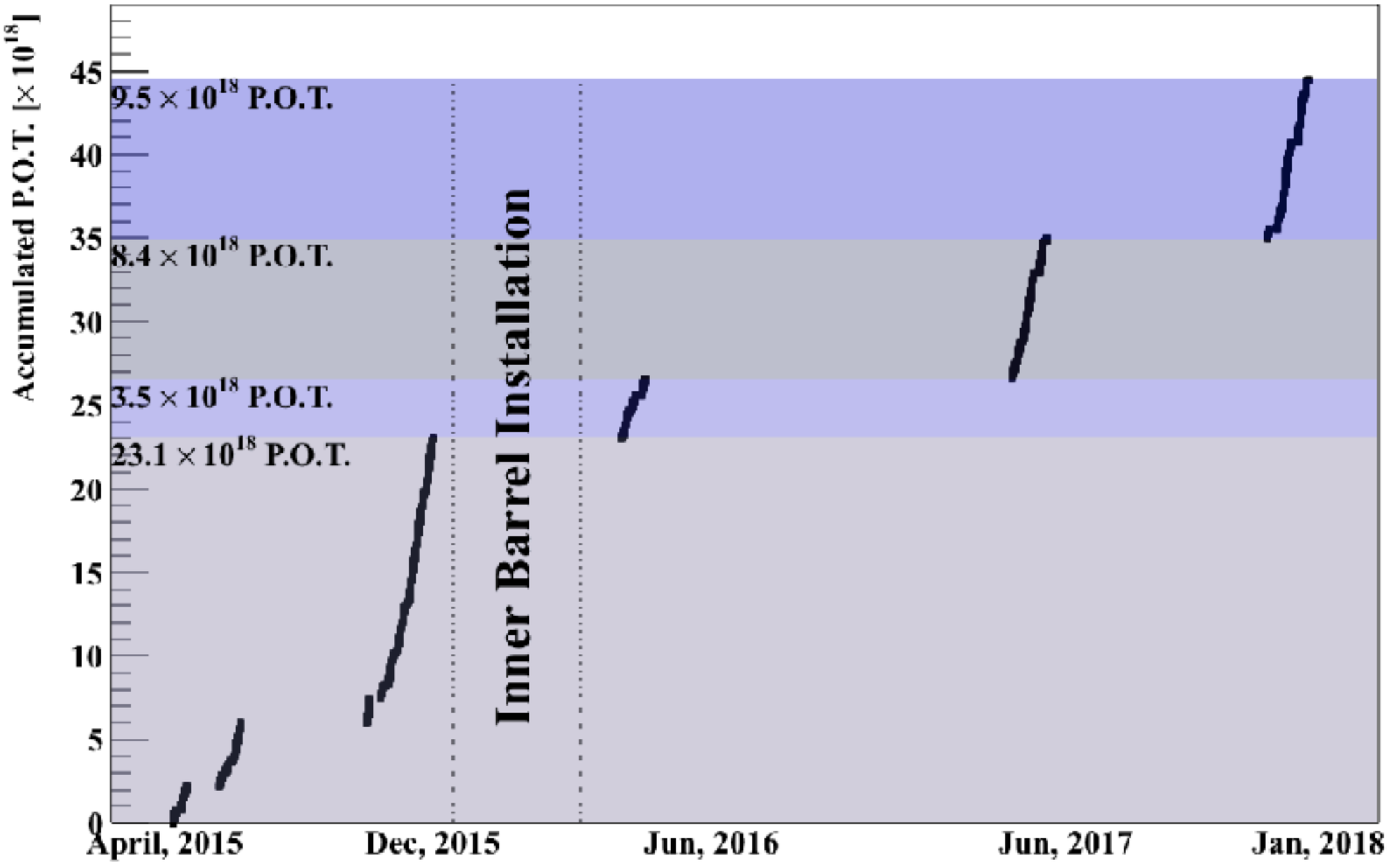
Clean mode to explore the New Physics





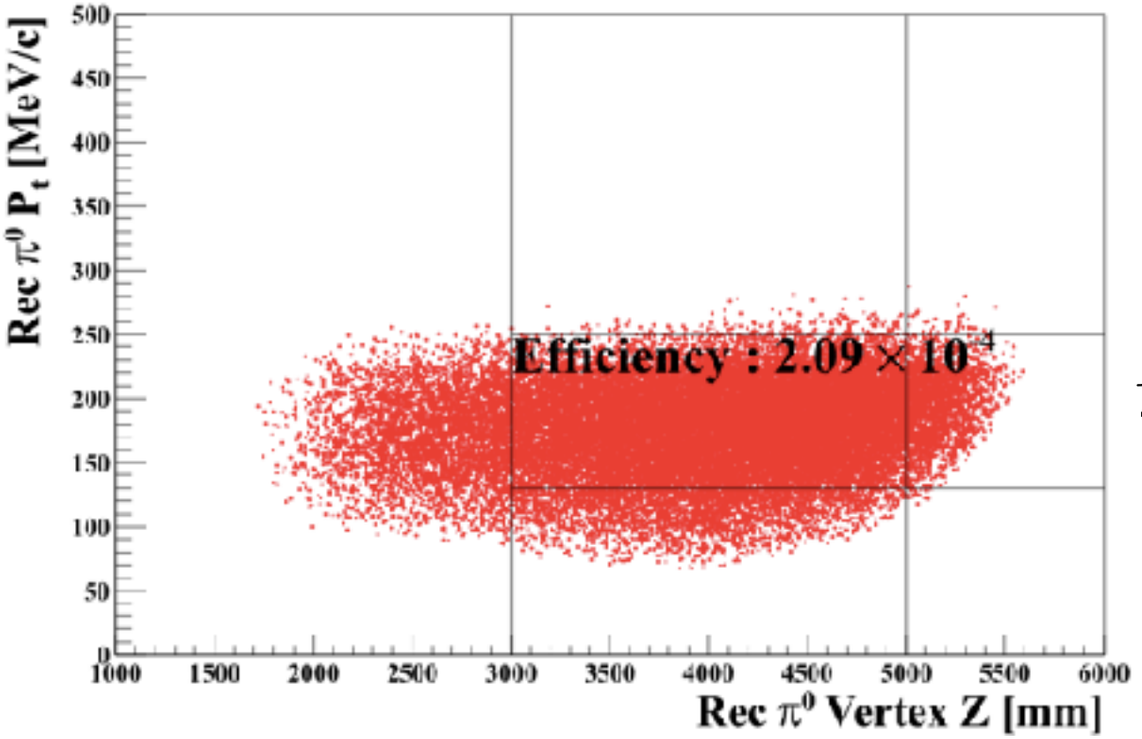
CsI Calorimeter and Hermetic Veto Counters

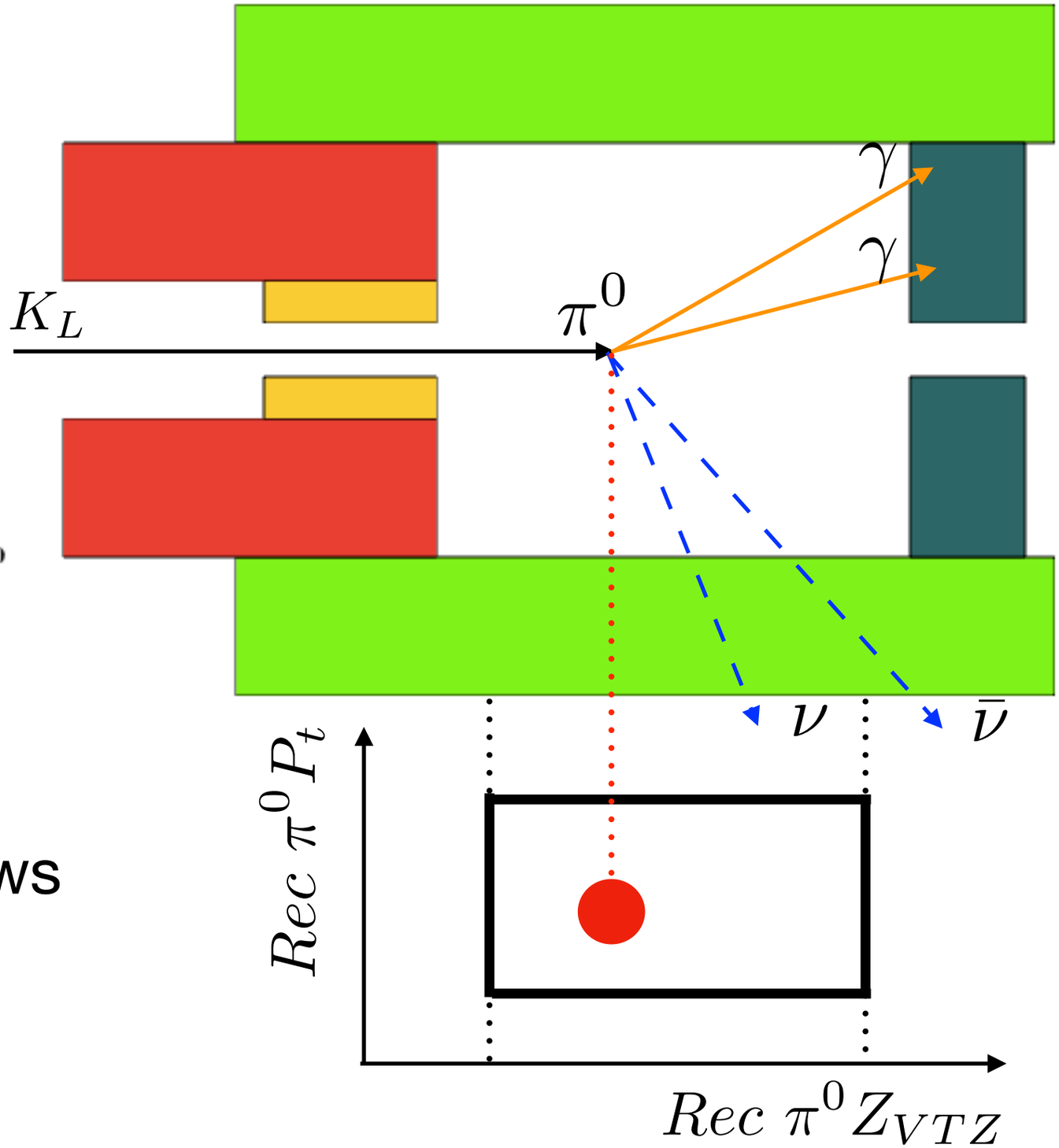
Accumulated Data



- P.O.T.(Proton On Target) $\propto$ number of incident kaons
- Total statistics will allow us to break Grossman-Nir bound

Definition of Signal





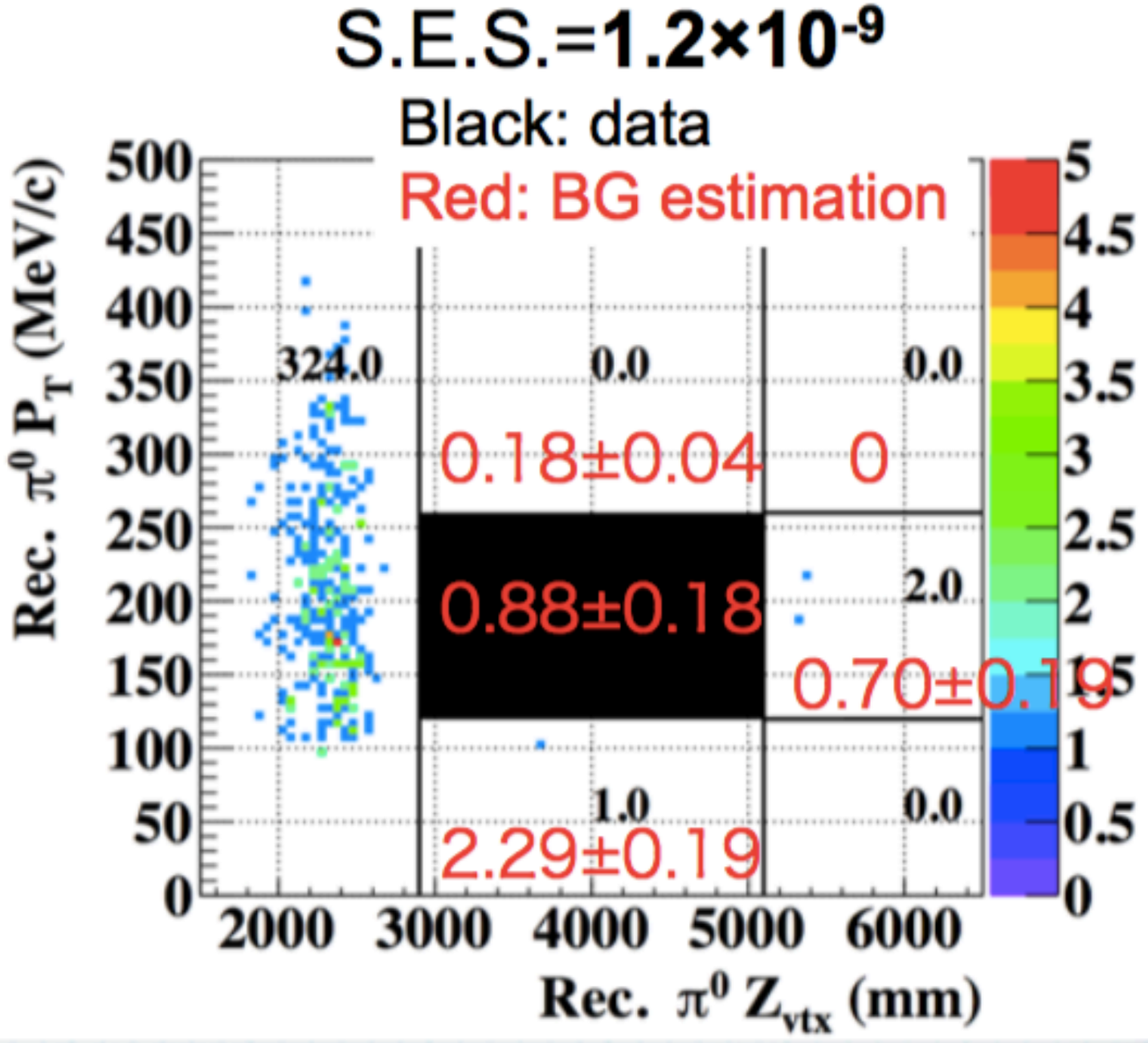
- A pair of neutrinos with transverse momentum allows the neutral pion to have transverse momentum.

Background Estimation of 2015 Data

2018 PAC meeting

	New
KL->2pi0	0.07±0.07
KL->pi+pi-pi0	0.18±0.05
NCC	0.13±0.07
Hadron cluster	0.26±0.08
CV-pi0	<0.14
CV-eta	0.05
KL->2gamma	0.02±0.02
KL->3pi0 fast	<0.01
Masking Ke3	<0.094
Masking K3pi0	0.17±0.12
Sum	0.88±0.18

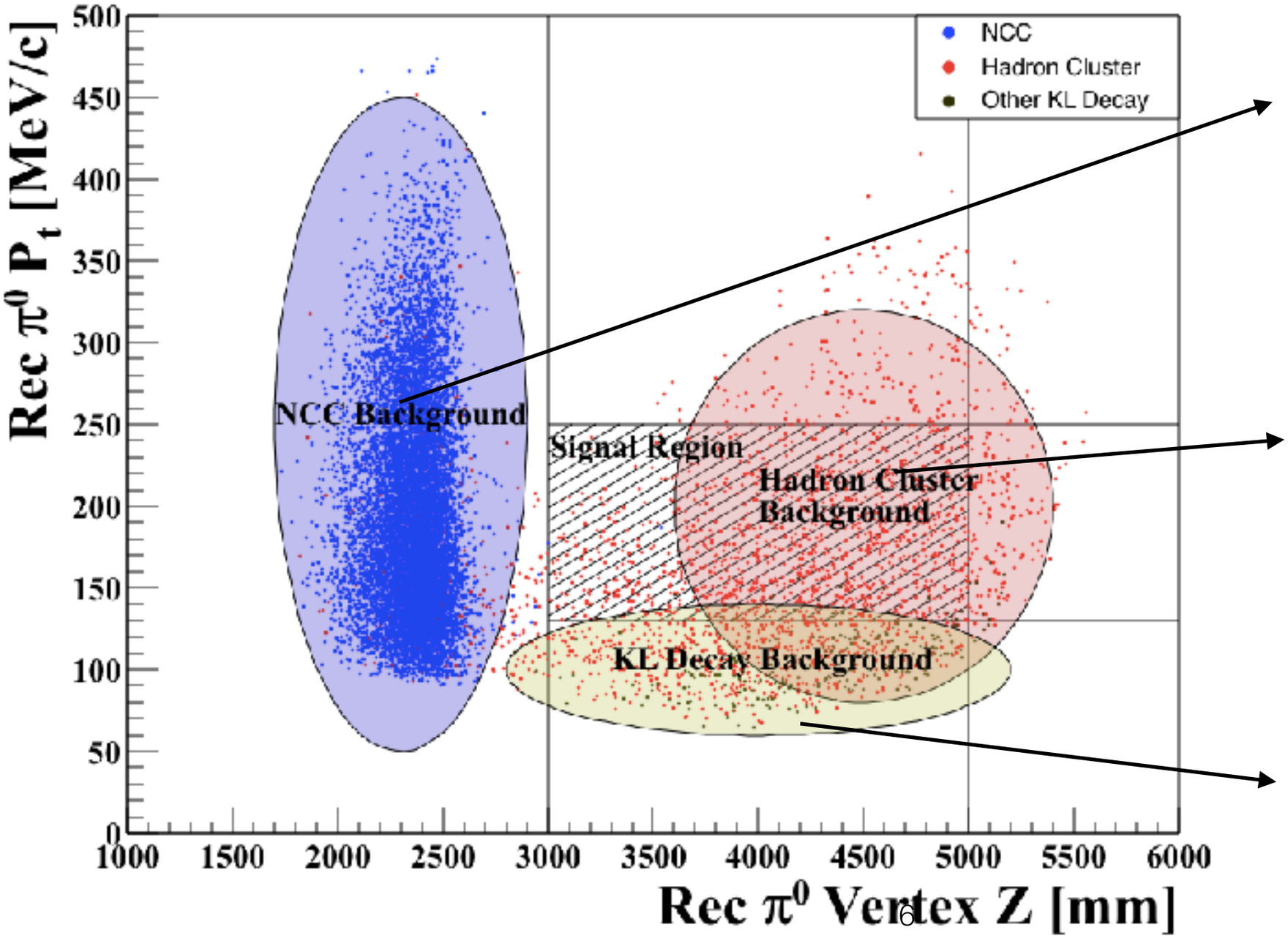
Orange : M.C. simulation
Orange+Blue : M.C. simulation with data-based normalization
Blue : Background estimation using special data

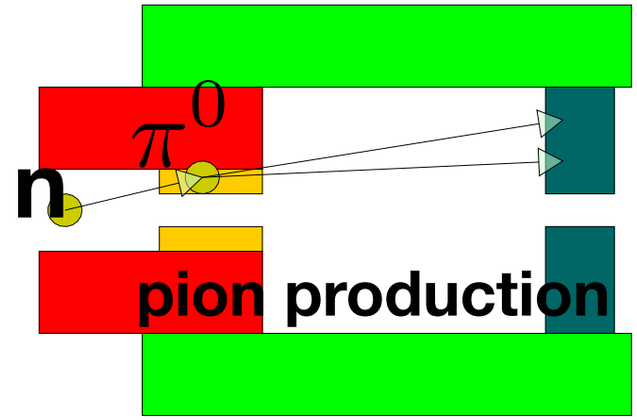


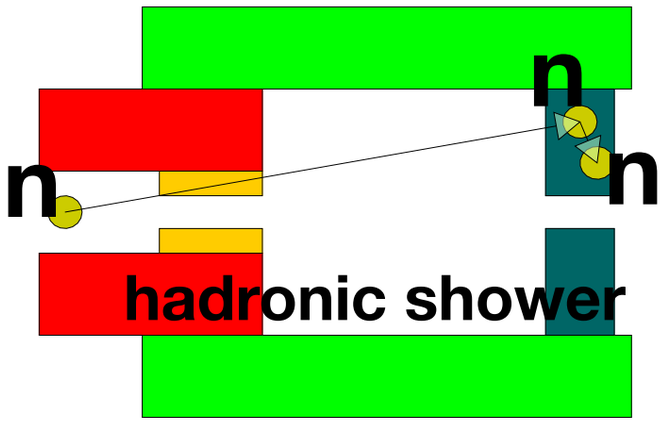
- Signal box will be open in this June.

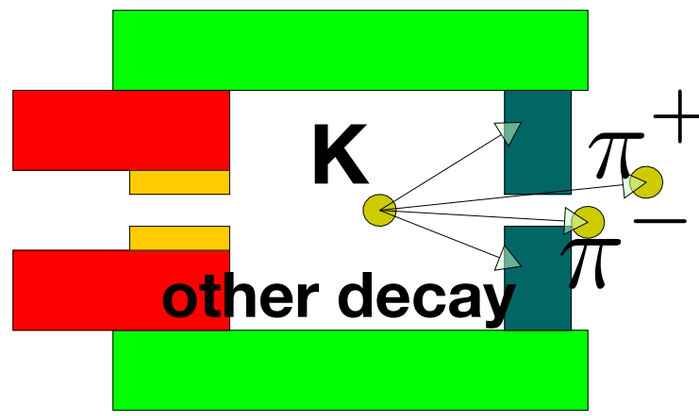
Sources of Backgrounds

- Background estimation for understanding remaining events around signal box.







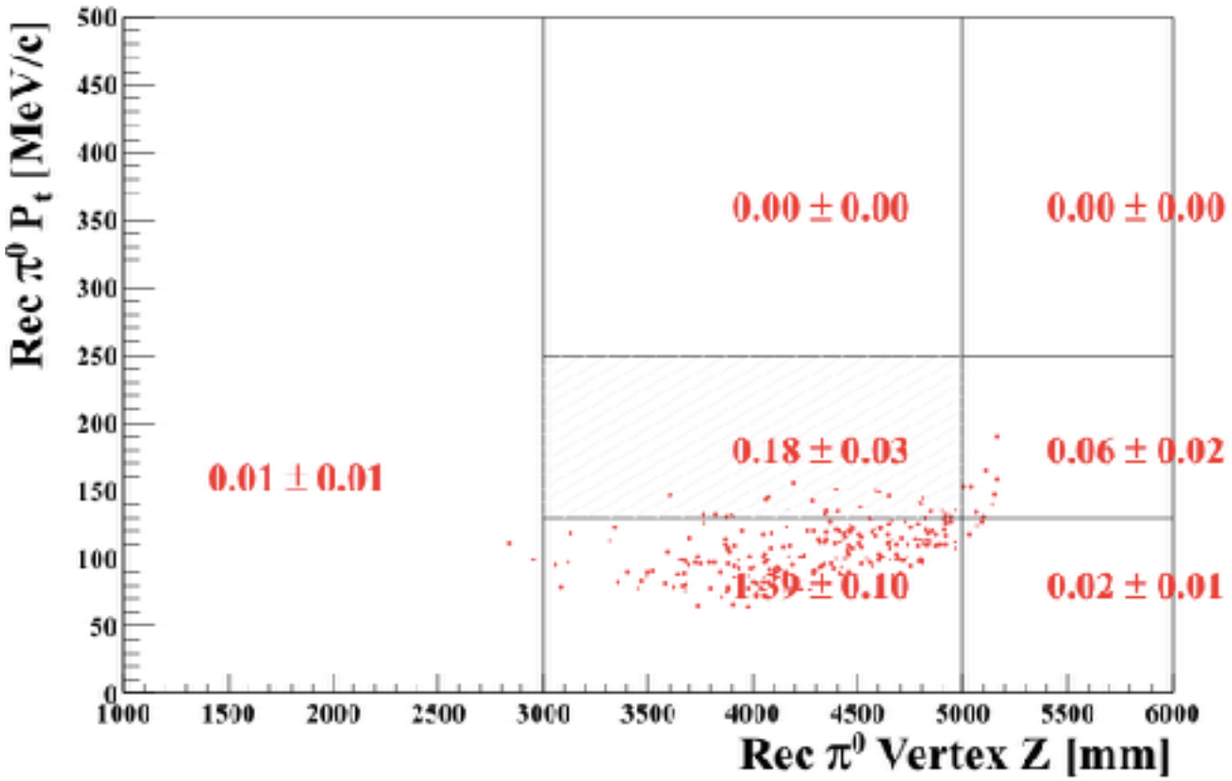


Current Issues of KOTO

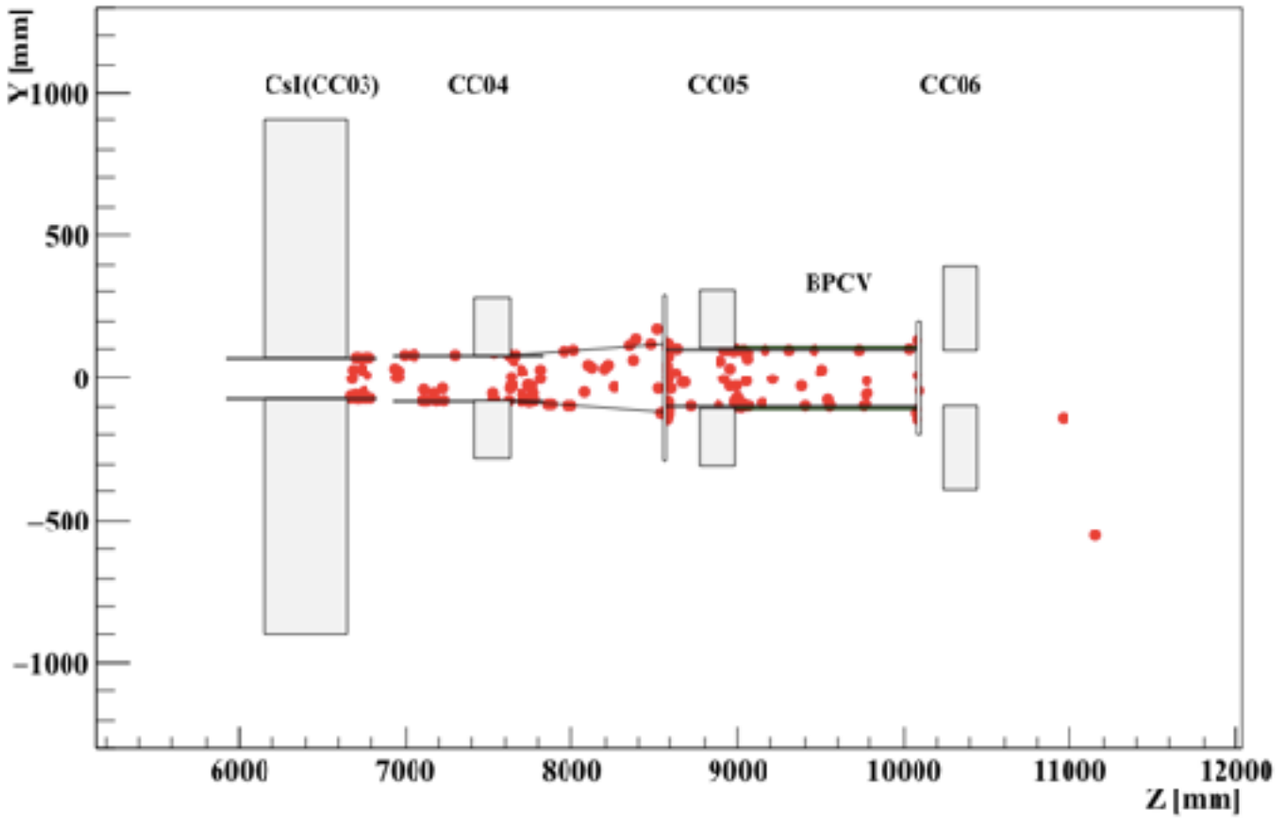
- Background from $K_L \to \pi^+\pi^-\pi^0$ decay mode
  - Installation of new detector at downstream
- Hadron cluster in CsI Calorimeter
  - Installation of front-end readout for CsI Calorimeter
- Pion production at NCC
  - Special data collections for the study.

$K_L \to \pi^+\pi^-\pi^0$ Background

Normalized to 2015 Data

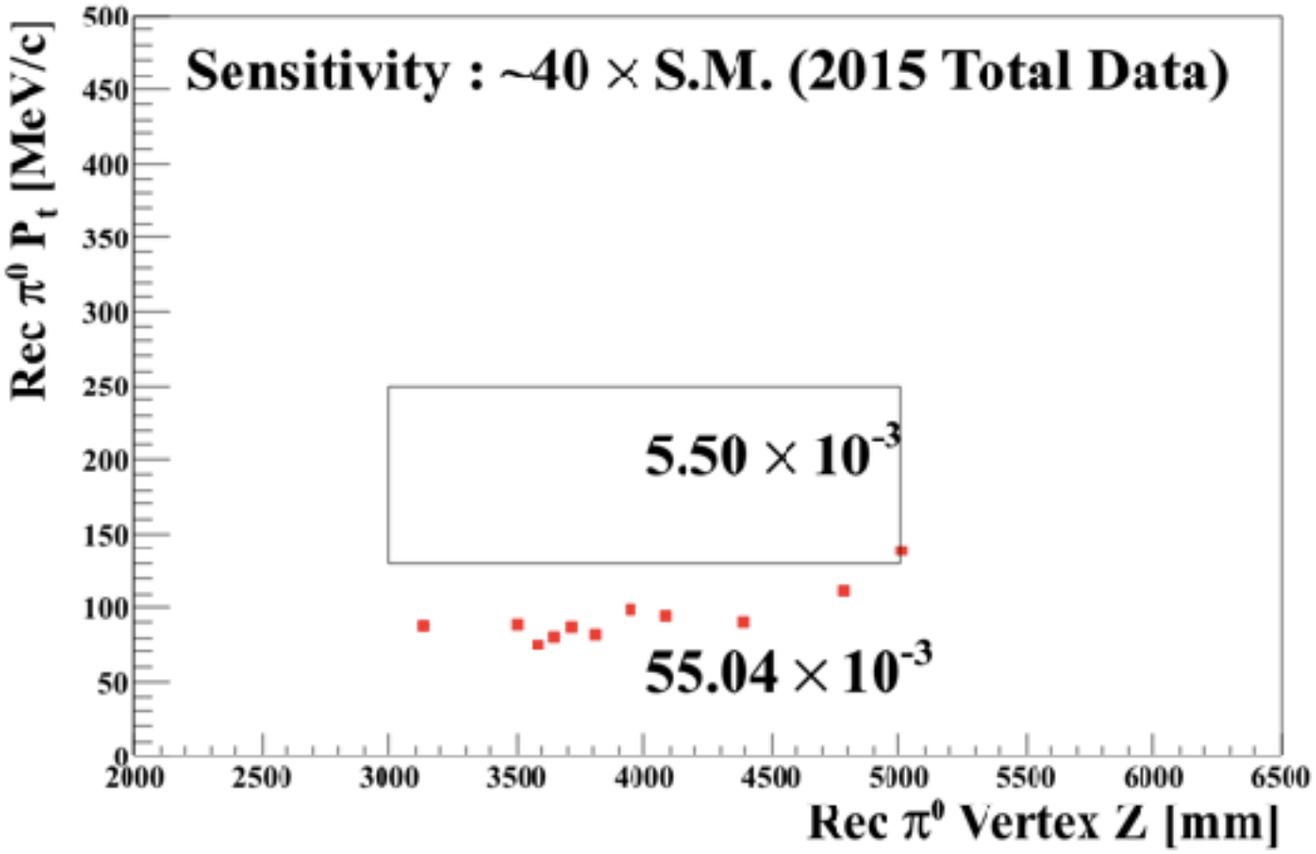


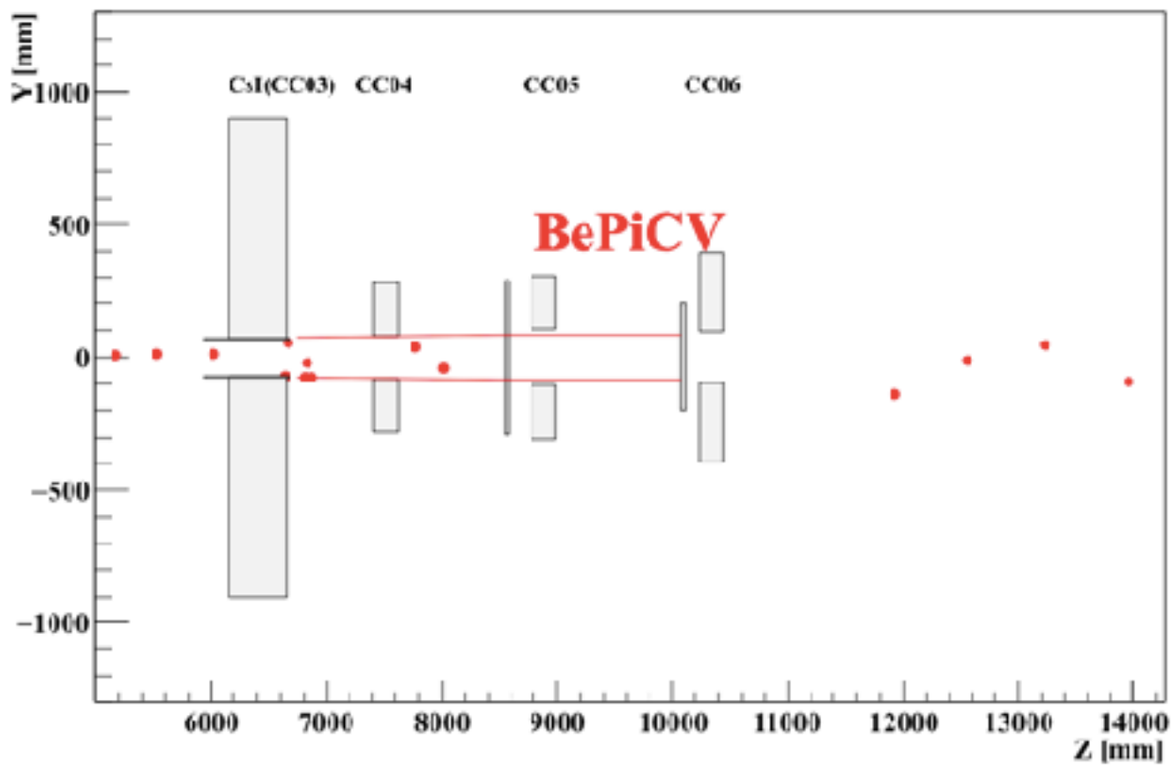
Interaction Points of charged pions



- Backgrounds come from dead material at downstream.
  - Beam pipe with active material will be installed(BePiCV)

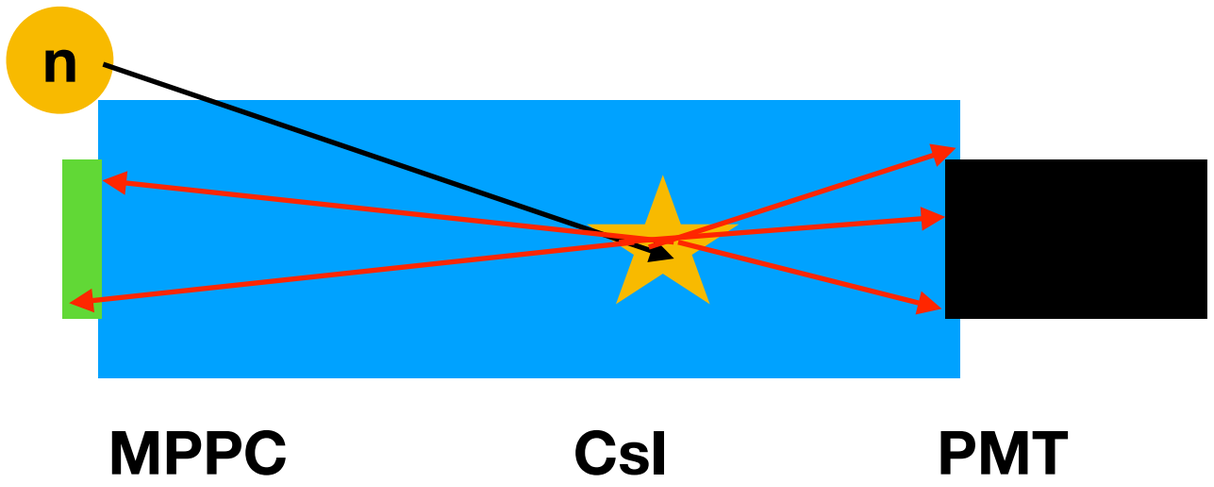
Status of BePiCV
(Beam Pipe Charged Veto)

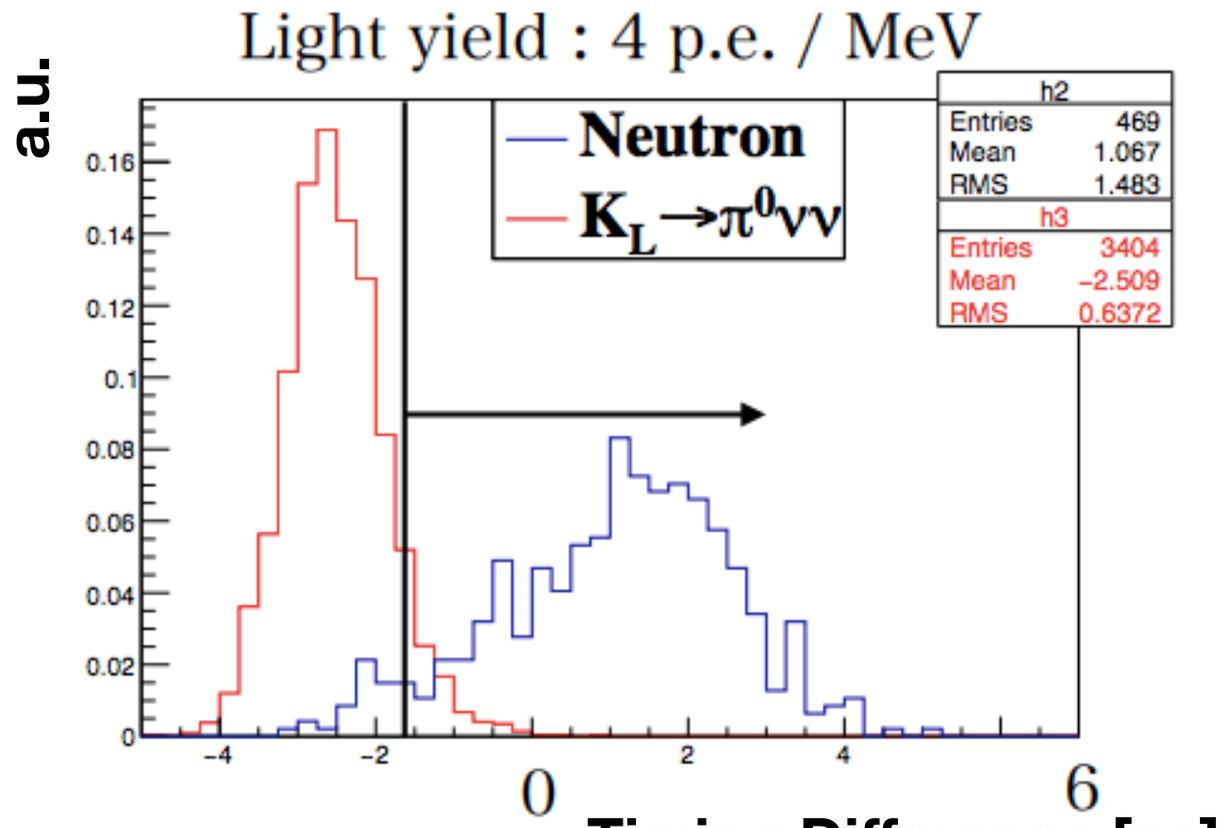


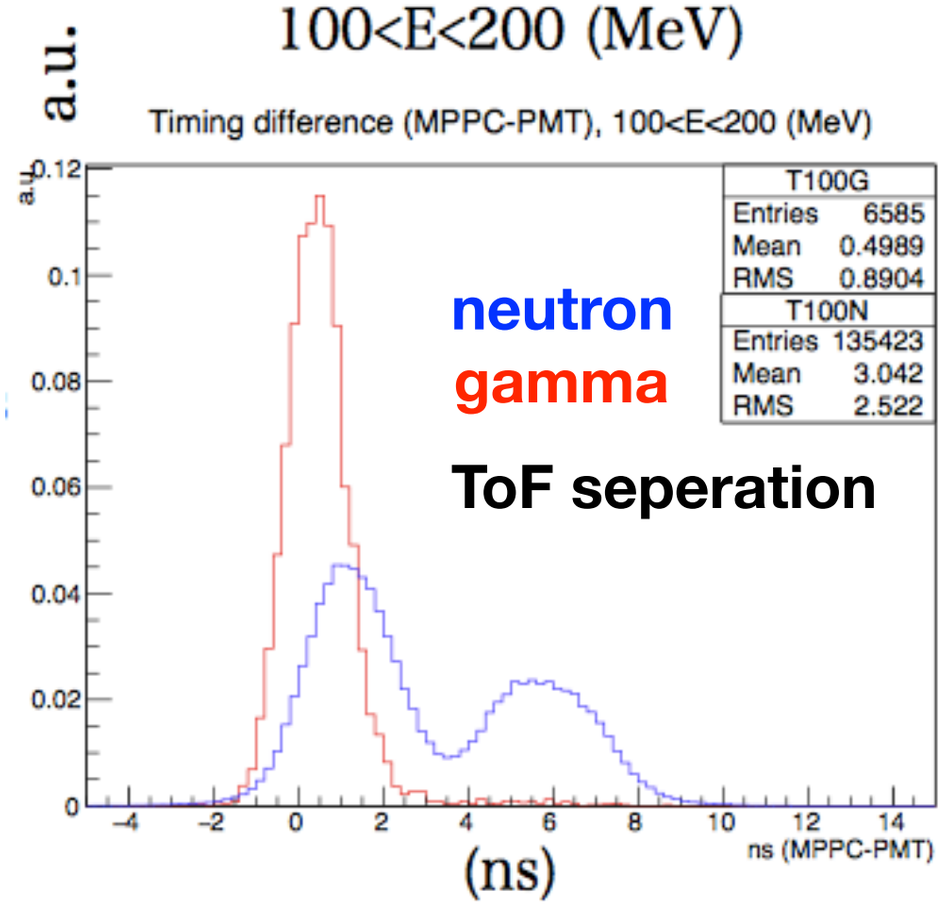


- 5 mm thick and 3.2 m-long scintillator.
- 30 times larger background rejection.

Front Readout of CsI Calorimeter

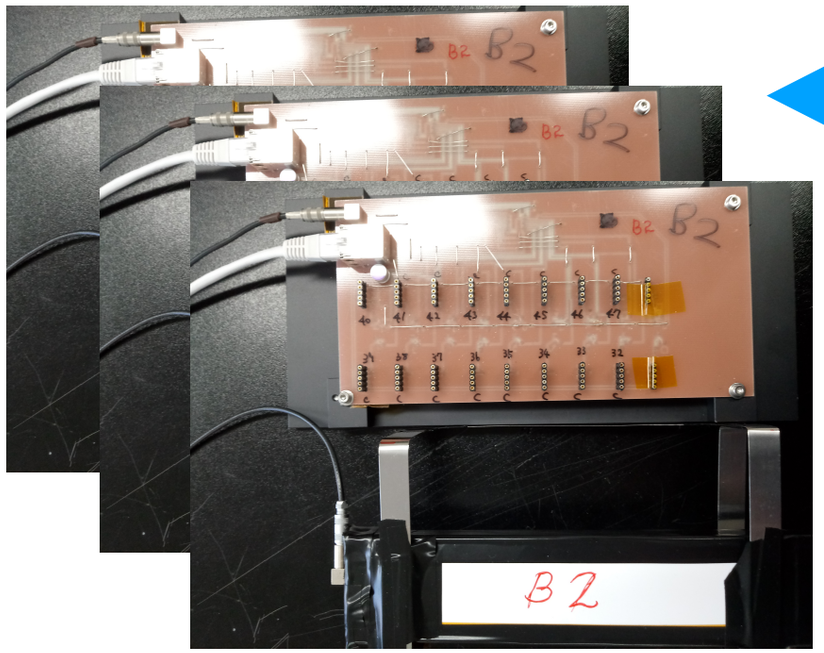




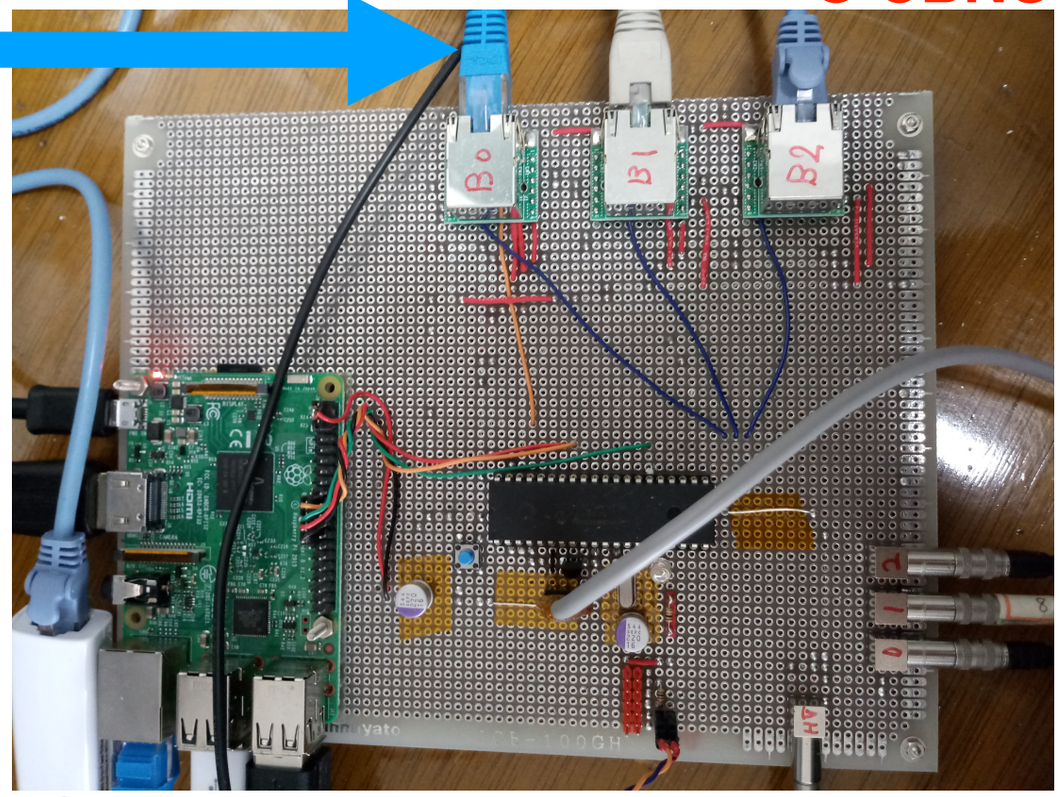


- S13360-6050CS Model
  - 14400 pixels
  - operation on +3V
- 4000 MPPCs
- 8 p.e. / MeV with undoped CsI

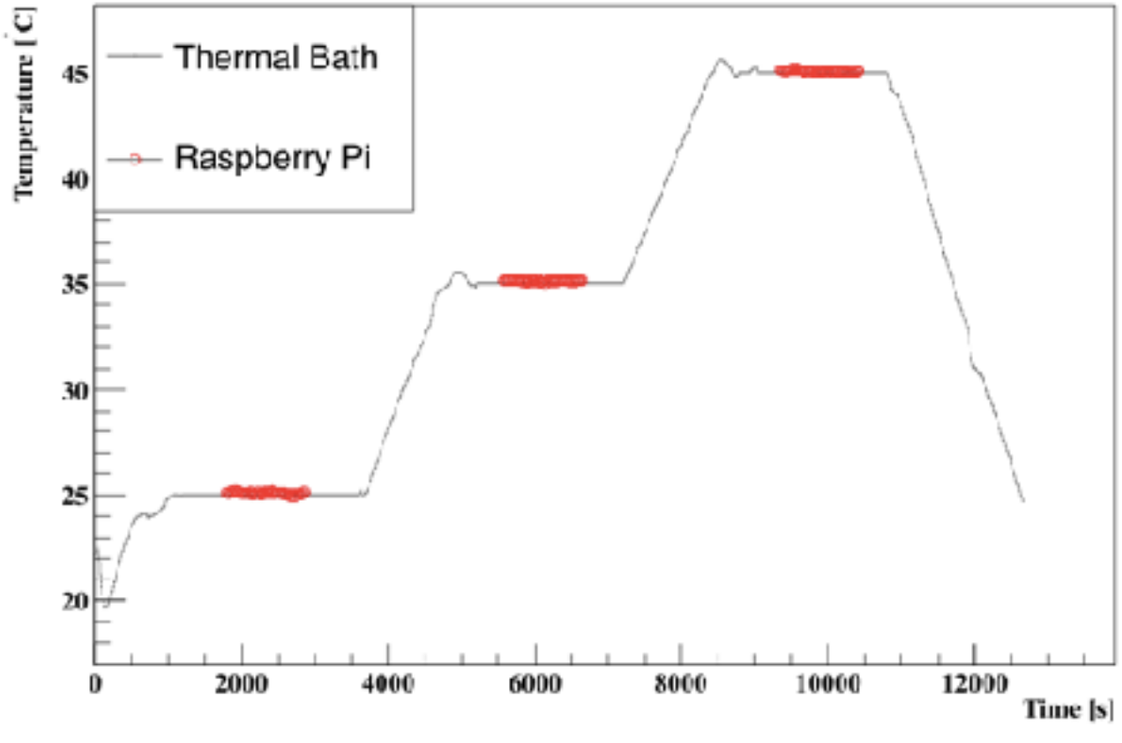
I-V Curve Measurement of MPPCs

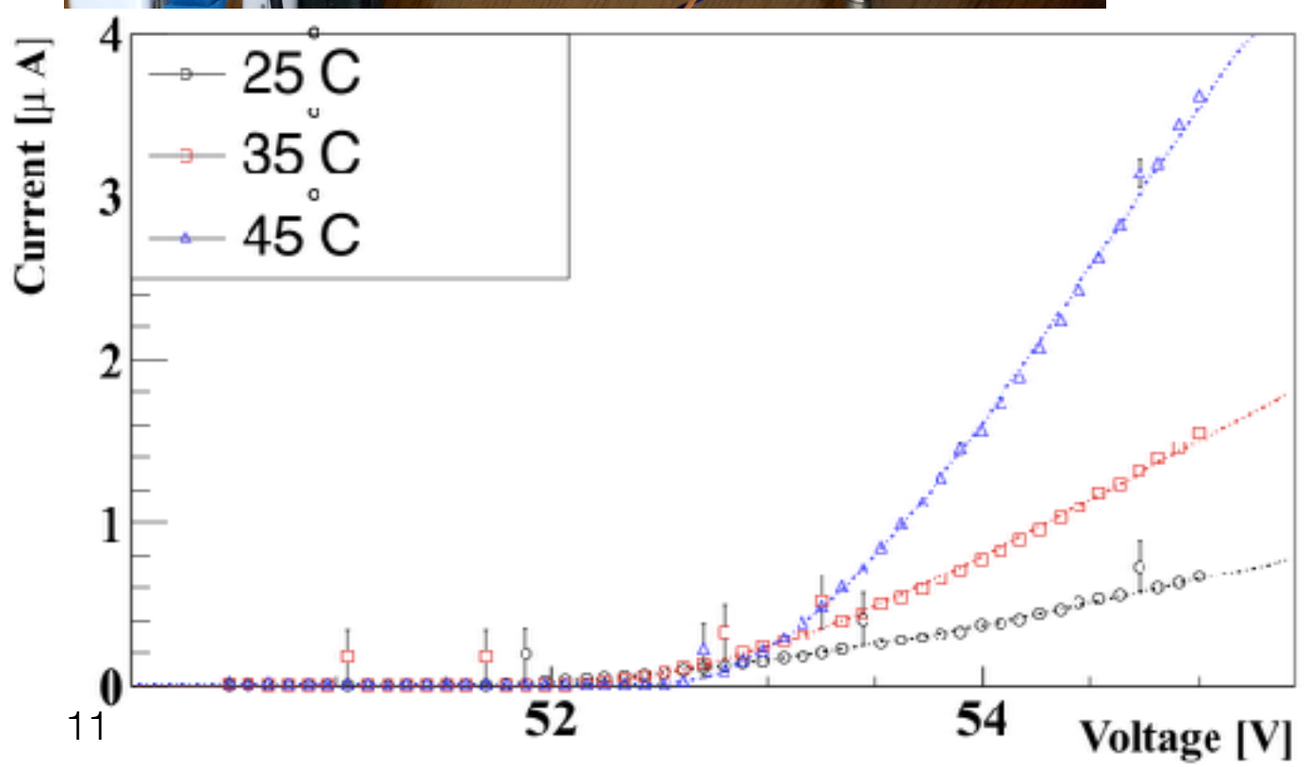


@ CBNU



Temperature Measurement





V_op distribution for ~500 MPPCs

Summary

- With 2015 data, 1.2e-9 single event sensitivity is achieved
  - Signal box will be open in this June.
- The background of $K_L \to \pi^+\pi^-\pi^0$ is estimated to reject up to S.M. level using BePiCV by M.C. simulation
  - Designing for optimization is in progress @ CBNU.
- MPPC on the front side of CsI will reject hadronic shower background.
  - IV curve measurement is ongoing for ~500 MPPCs @ CBNU.