# Gating GEM HV driver and $LaBr_3$ Readout with MPPC

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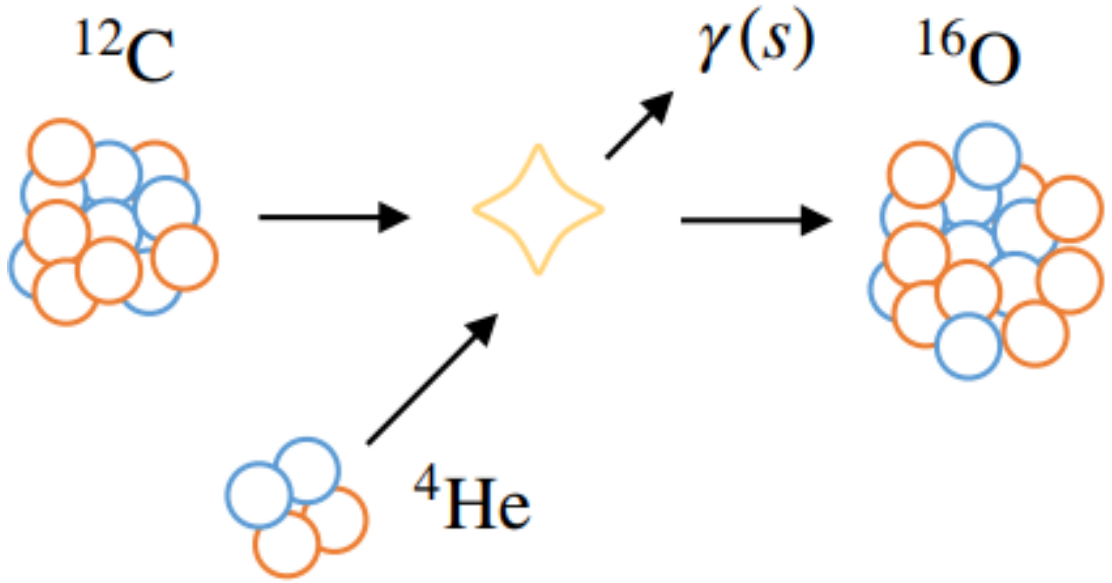
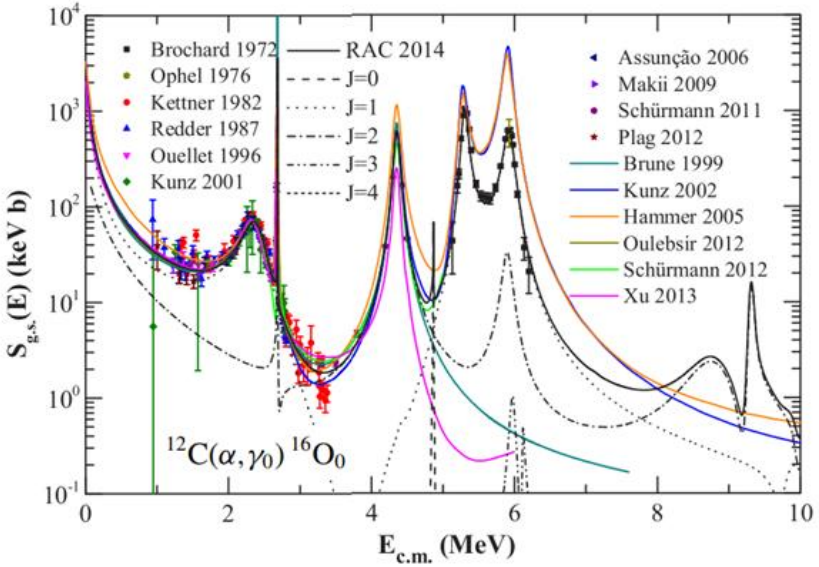
# COREA Experiment

## Physics motivation

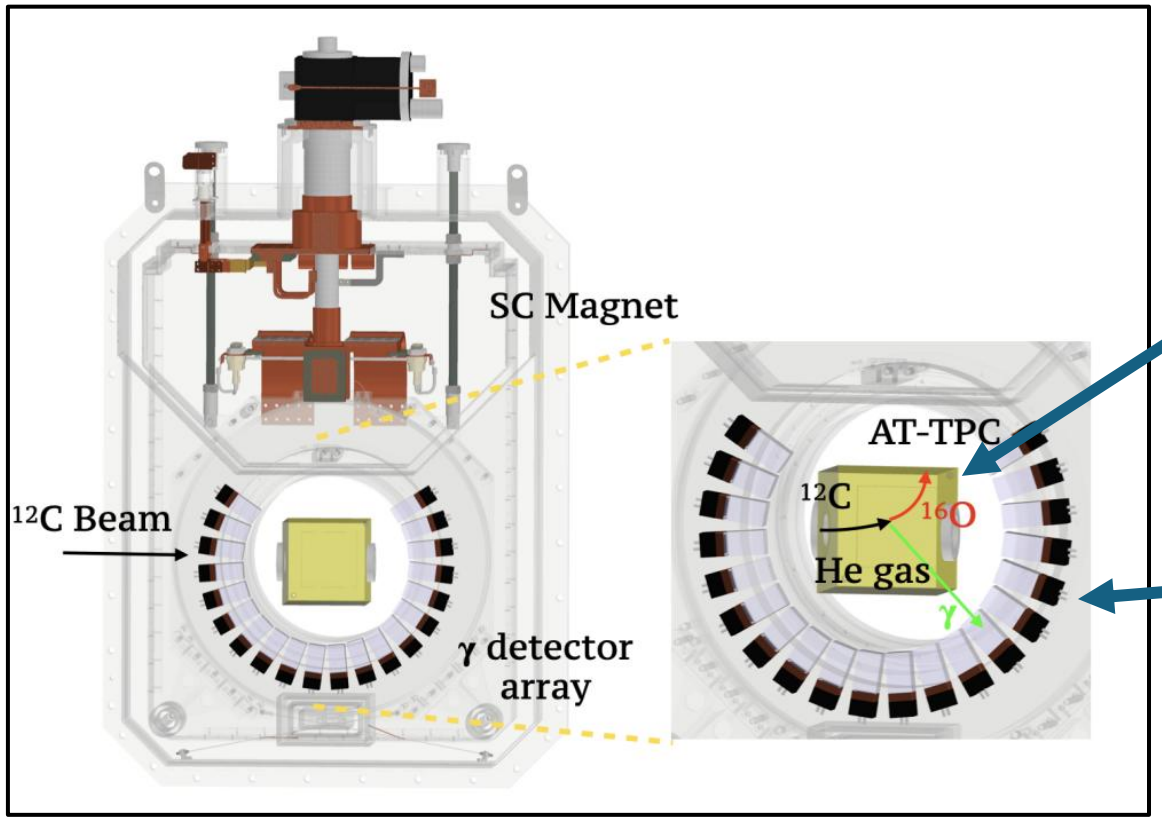
**COREA: Carbon Oxygen Reaction Experiment with Active-target TPC**



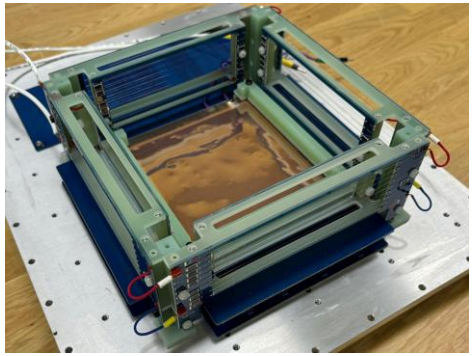



# COREA Experiment

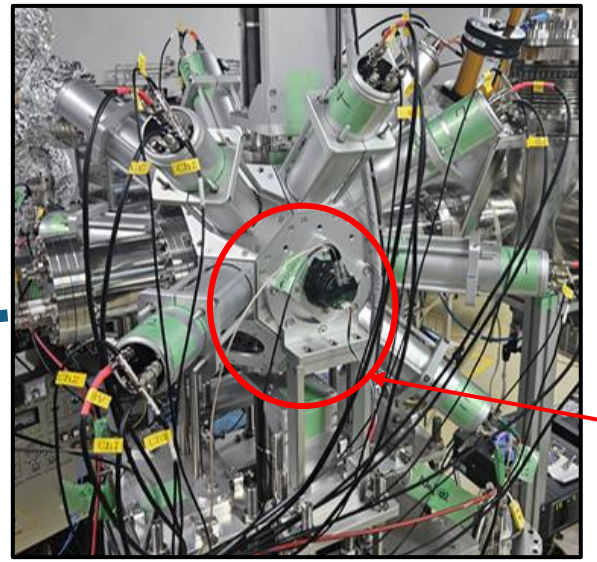
## COREA experiment detector setup




Detector setup



aTPC



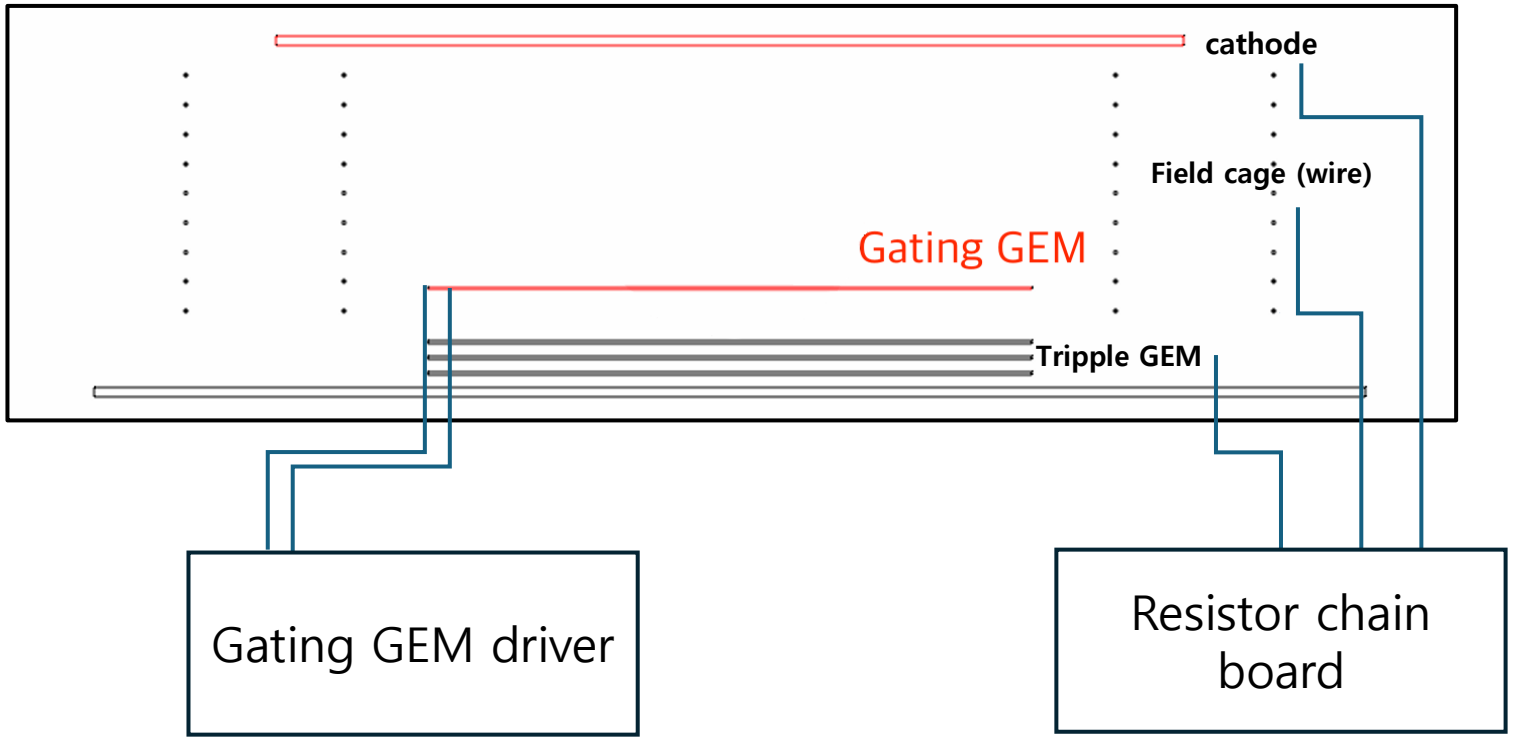
$LaBr_3$ + MPPC

$LaBr_3$ detector array
(HANUL Ball)

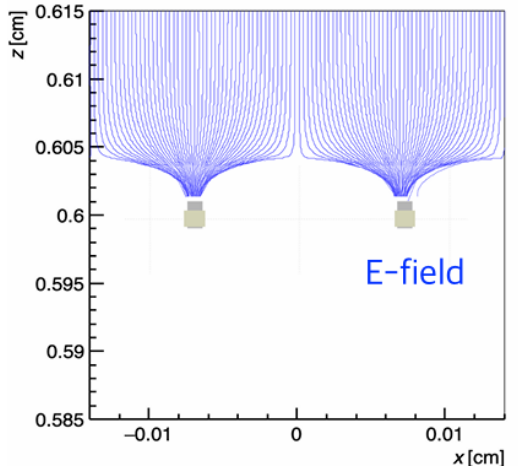
# aTPC gating system

## Configuration of aTPC gating system

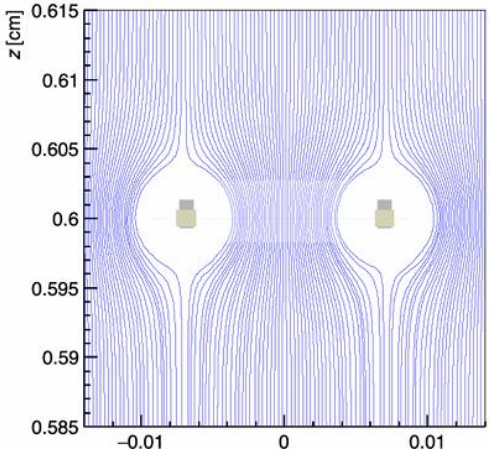
**aTPC, inside of chamber**




**close**




**open**



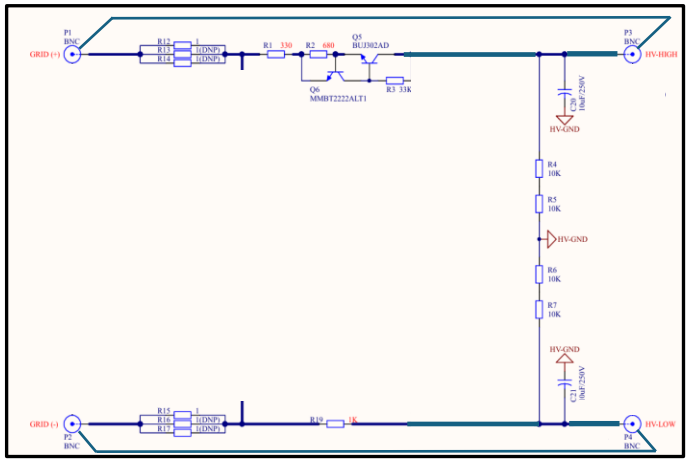
# TPC gating GEM driver

## Circuit diagram / operating method

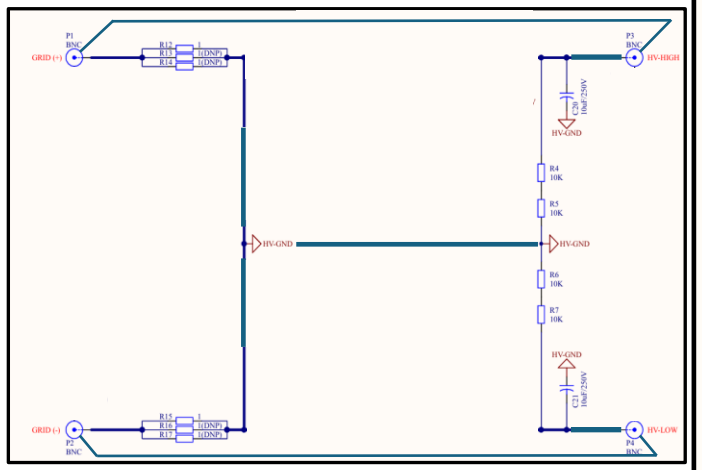
1. The circuit determine the output voltage by using **two input voltage rails and the mid-point Voltage** between 2 inputs.

2. NIM signal drives **four MOSFETs**, thereby switching the voltage through to the output.

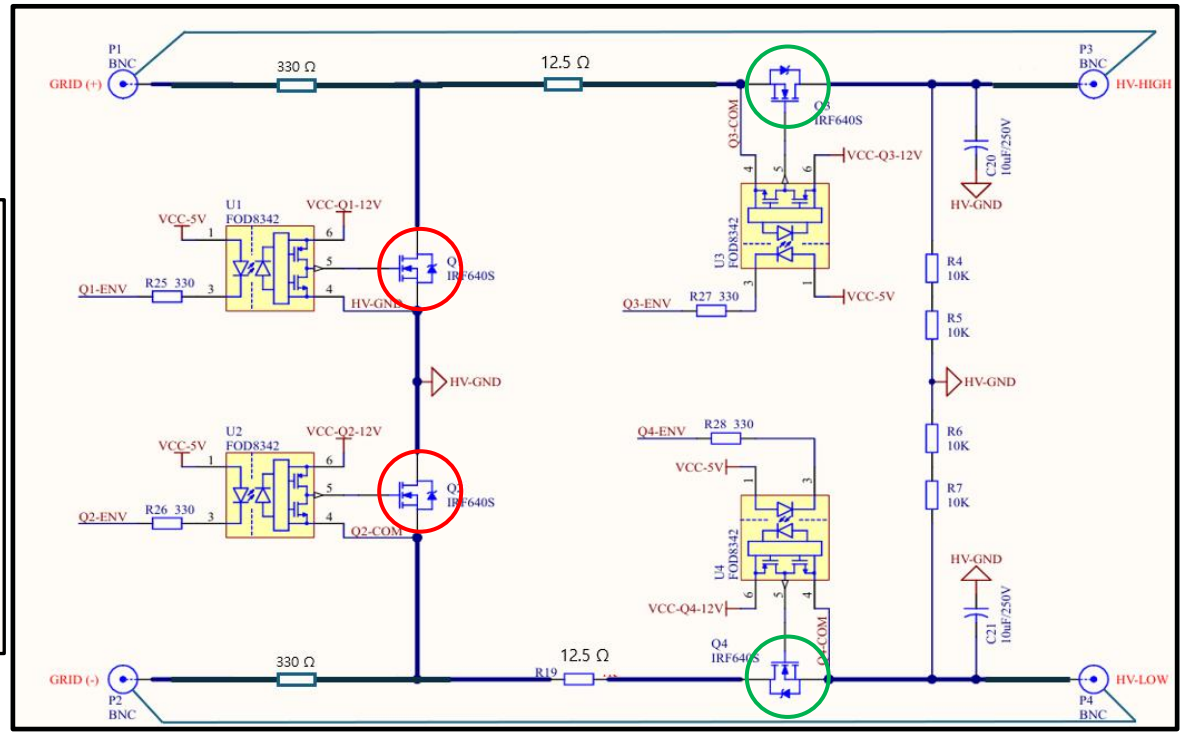
3. A photocoupler disconnect the **HV section** (~2000 V) and the **NIM-signal section** (~ -1 V).

**Closed state**

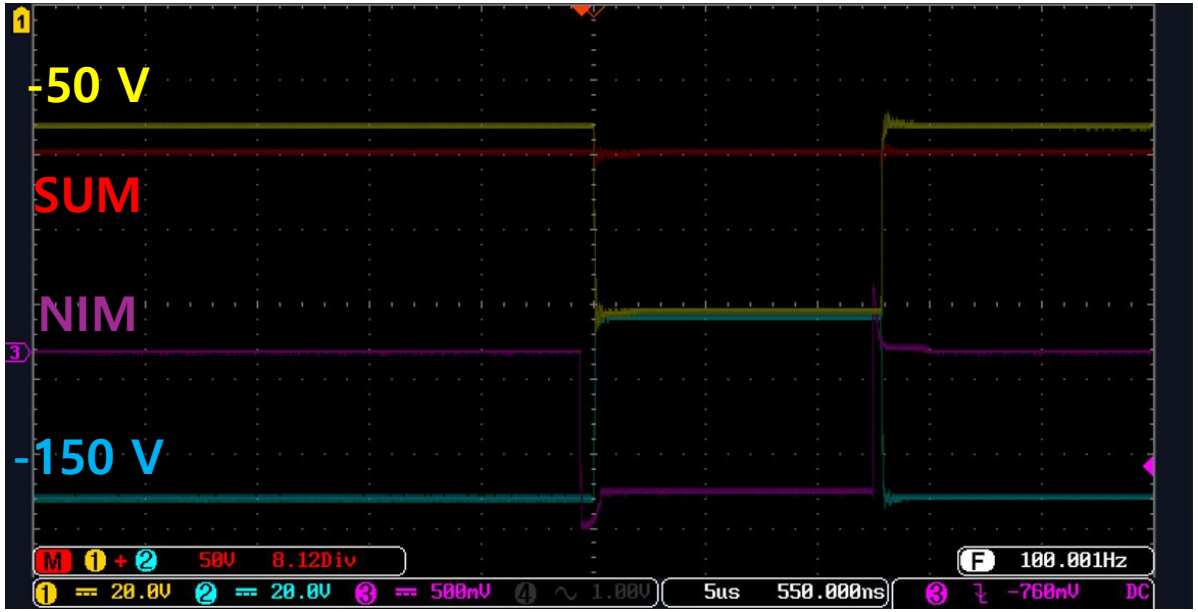


**Opened state**



# TPC gating GEM driver Test

## Test with real Voltage




**Gating driver signal**


**Opening**


**Closing**

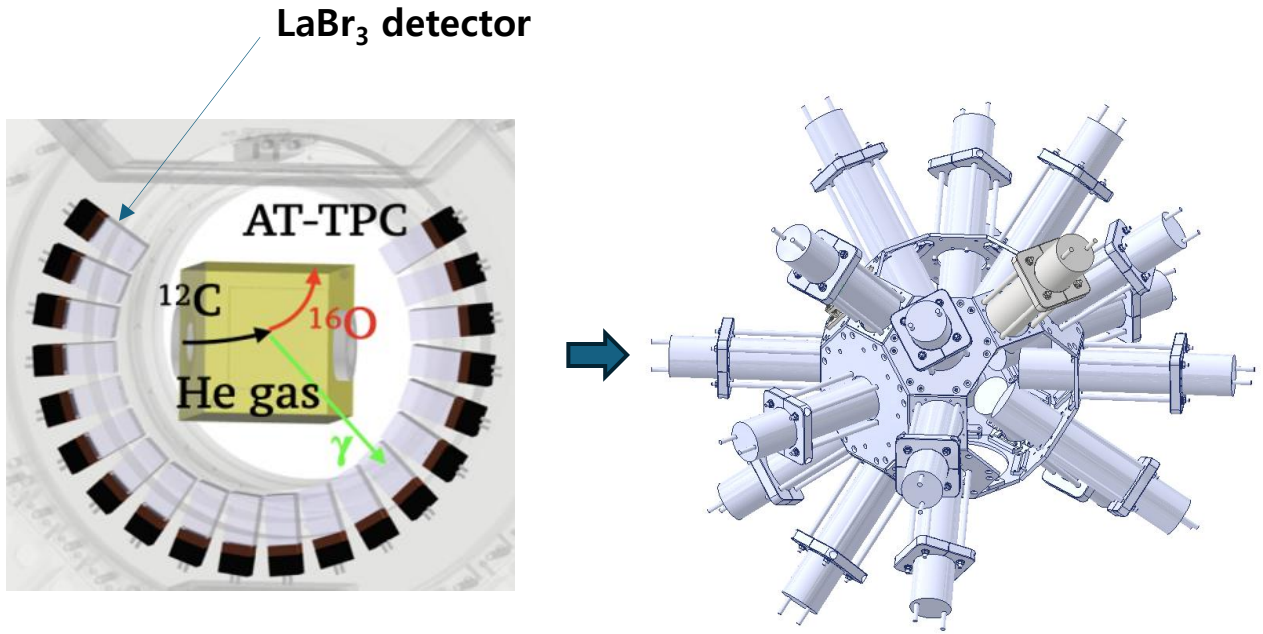
- At low voltage (- 50 V, - 150 V), gating driver shows good performance.
  **(opening 200 ns, closing 300 ns)**
- At high voltage, voltage was applied to the driver without any issues.

→ **After connecting gating GEM, we will check the result again**

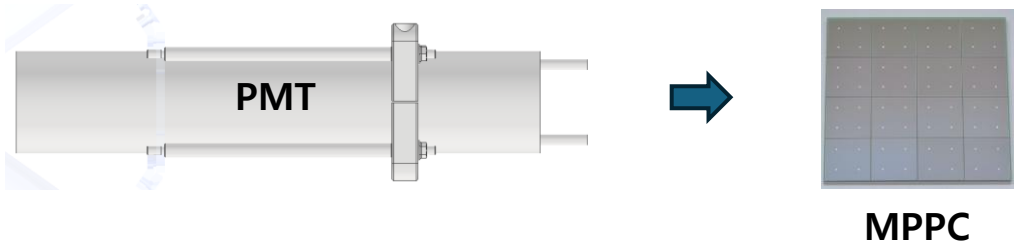
# $LaBr_3$ Readout with MPPC

# $LaBr_3$ detector with MPPC readout board

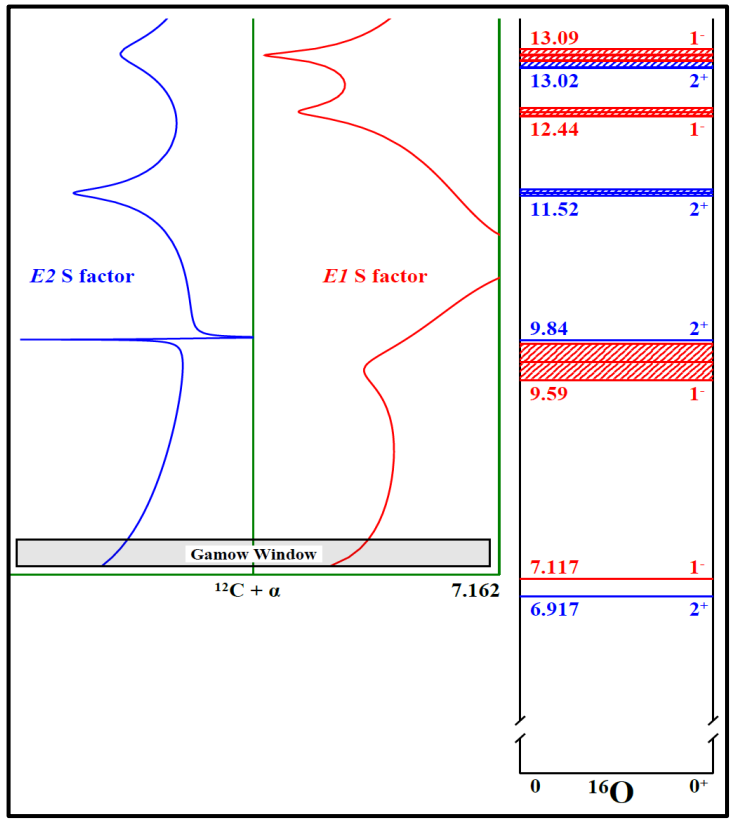
## Explain




-> For working in magnetic field, MPPC should be used.

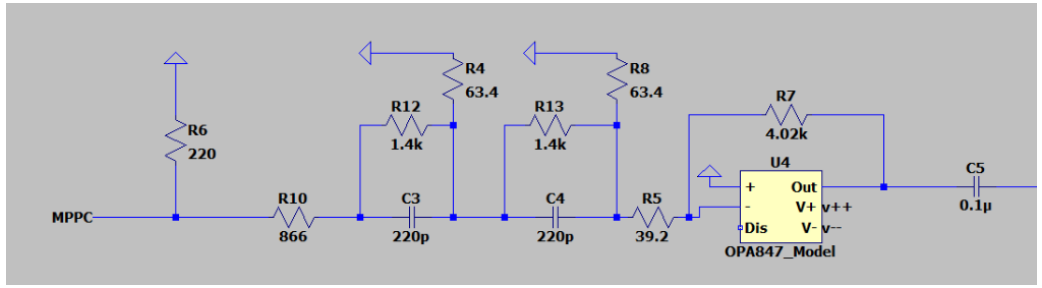



MPPC



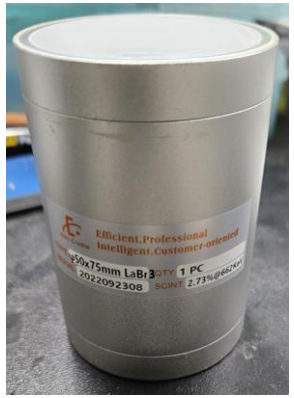

-> Dynamic range should be over 10 MeV

# $LaBr_3$ detector with MPPC readout board
## structure

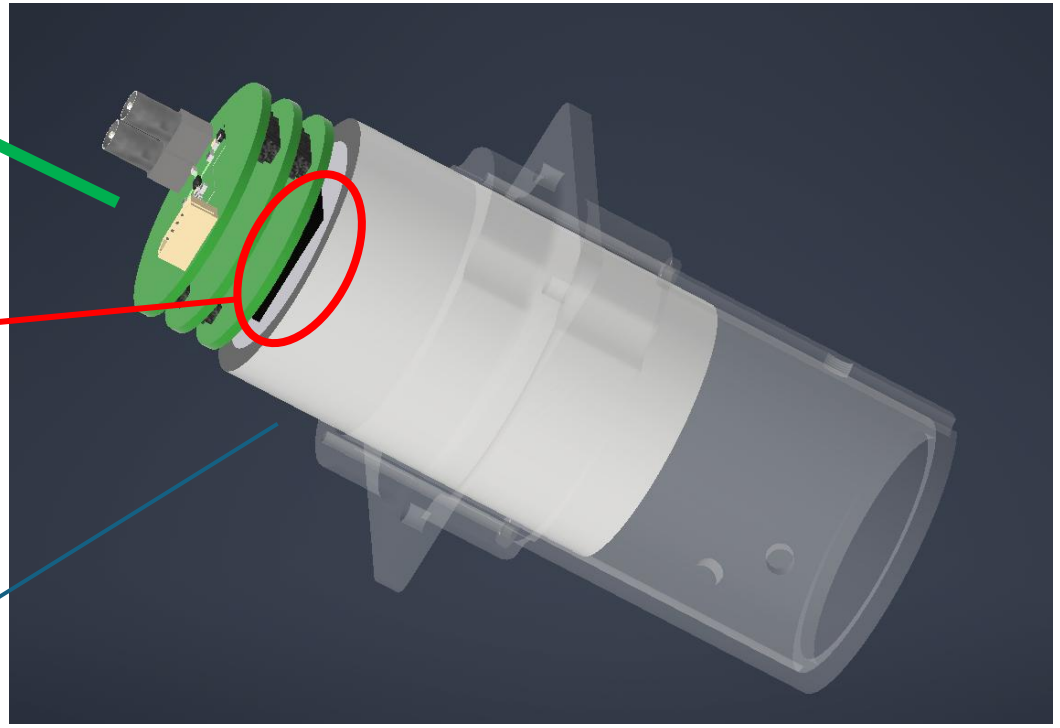



Readout circuit

4×4 MPPC



$\Phi 50 \times 75$ mm $LaBr_3$



**Structure of $LaBr_3$ detector 1 segment**

# $LaBr_3$ detector Test

## About the pulse shape and dynamic range

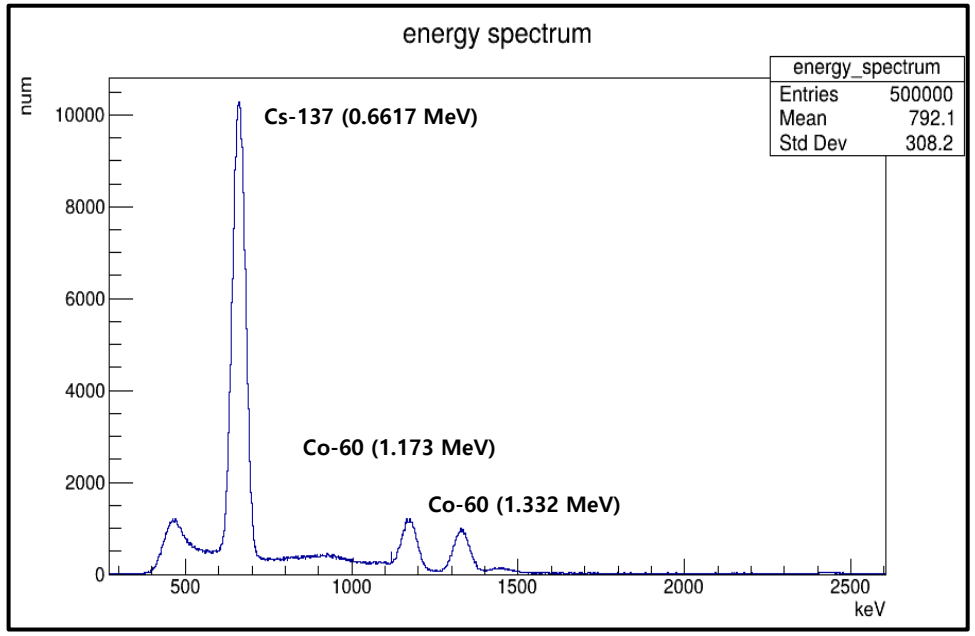
- The signal was shaped to **150 ns** pulse width.
- Assuming a linearity between the incident energy and the pulse height, the circuit can cover energies up to around **31 MeV**.

| Source | Pulse height | Energy |
|---|---|---|
| Cs-137 | 32 mV | 0.6617 MeV |
| Co-60 | 65 mV | 1.332 MeV |
| | | |
| Saturation | 1500 mV | Around **31 MeV** |

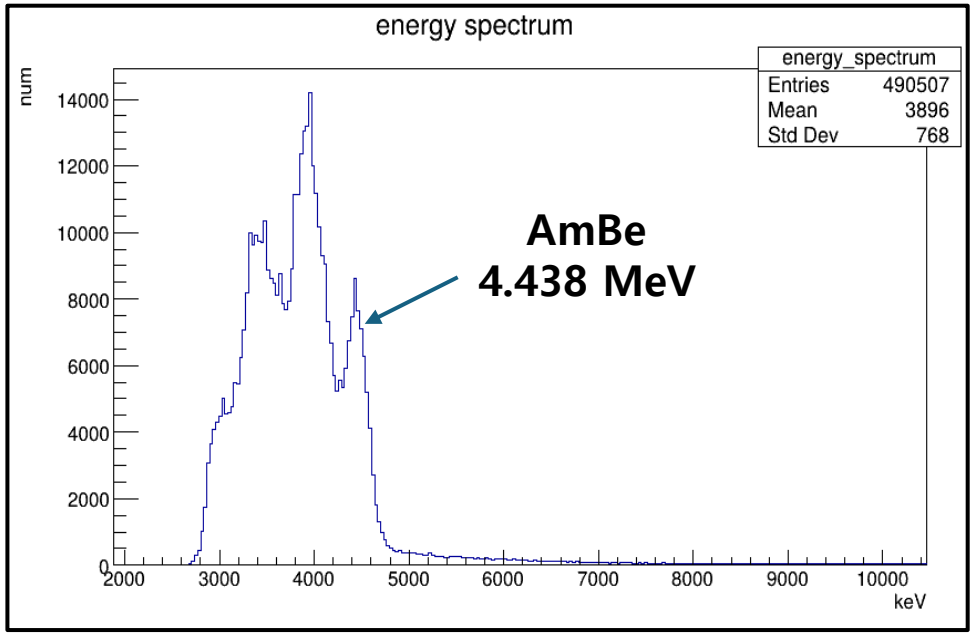

**MPPC signal / Maximum height case**

# LaBr3 detector Test
## with source

- Energy spectrum of LaBr3 detector with **Cs-137, Co-60** and **AmBe** source, using self-trigger.
- $LaBr_3$ detector showed 5 % resolution (FWHM) with AmBe source.




**Cs-137 + Co-60**




**AmBe source**

# Summary

- For COREA experiment, we've developed Gating GEM HV driver circuit and $LaBr_3$ detector readout with MPPC.
- Gating GEM HV driver showed fast switching performance with small noise.
- $LaBr_3$ detector readout with MPPC reached over 10 MeV dynamic range and showed good resolution.