Building and Structure for 4 Stacks of MRPC

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Multigap Resistive Plate Chamber (MRPC)

- Detect muons for tracking
- Resistive Plate : glass
- Making multigap using fishing line and spacer

Process of picking up signals

① Cosmic muons hit gas molecules

↓

② An electron is emitted from a molecule and moves along the electric field

↓

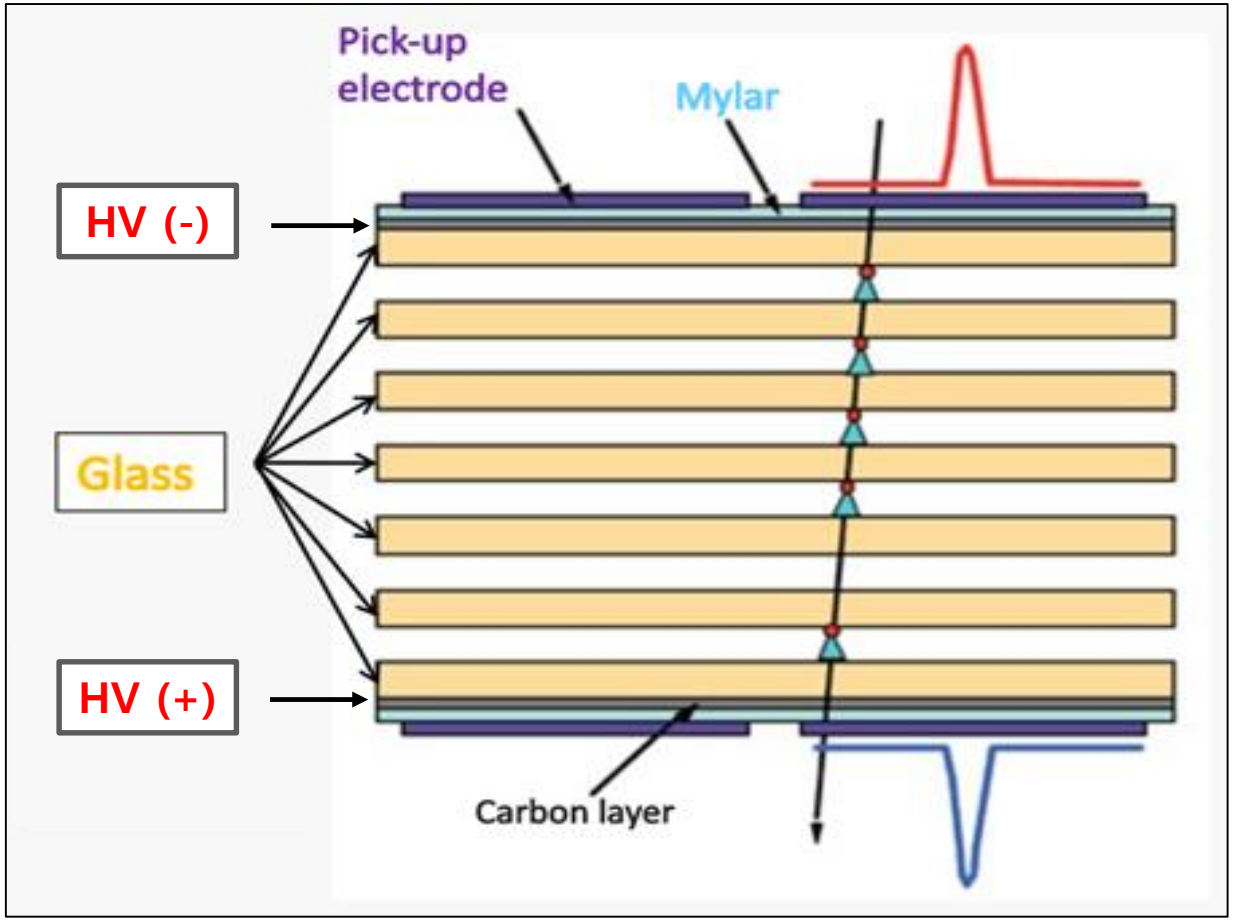
③ An emitted electron hits a molecule

↓

④ The second electron, which is emitted from the molecule, repeats this (electric avalanche)

↓

⑤ The signal is amplified by avalanche process and picked up by strips on the PCB



1. Structure

MRPC has **symmetry structure** centered on the strip plate

2. Dimension

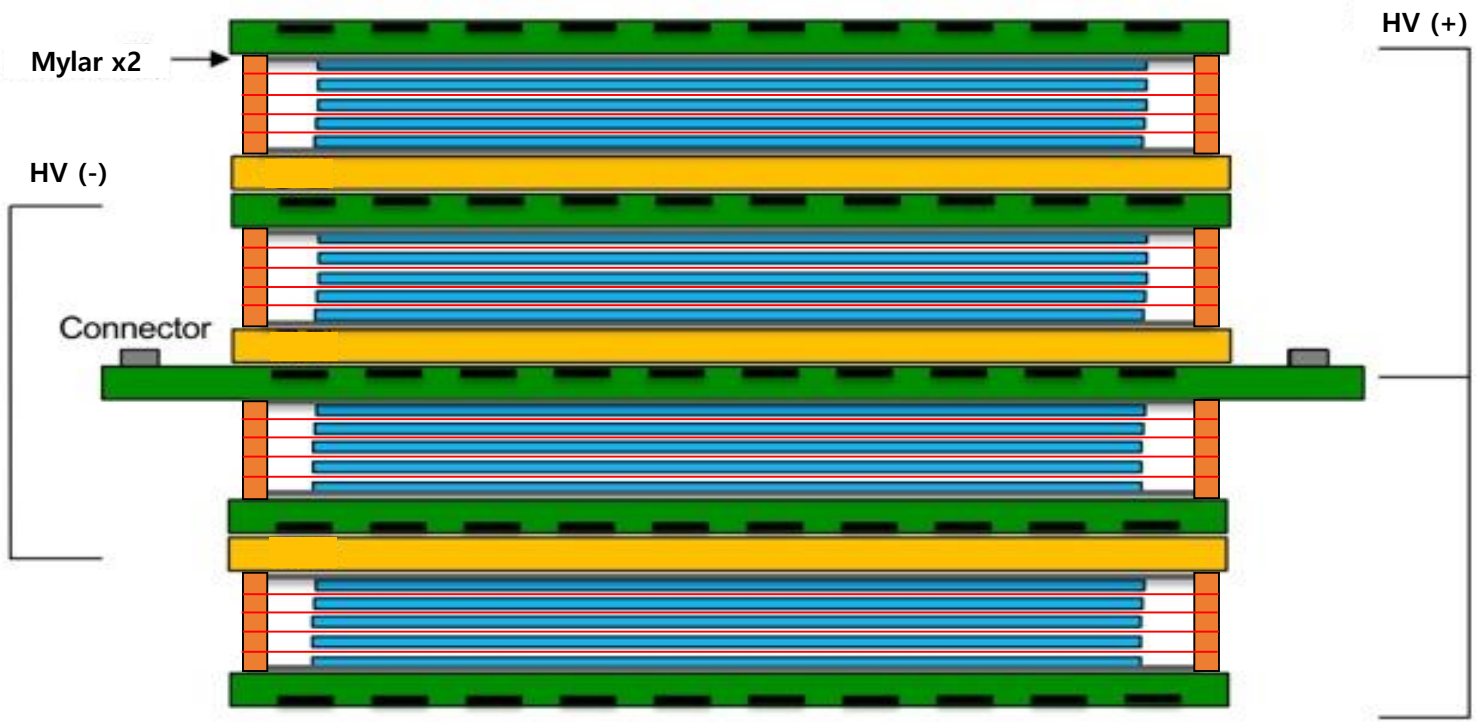
- Gap size
  1st chamber : 0.25mm
  2nd chamber : 0.30mm

- Stack size
  1st chamber : 3.35mm
  2nd chamber : 3.55mm

- Total chamber size
  1st chamber : 13.4mm
  2nd chamber : 14.2mm

3. HV (High Voltage)

3 positive and 2 negative voltage are applied



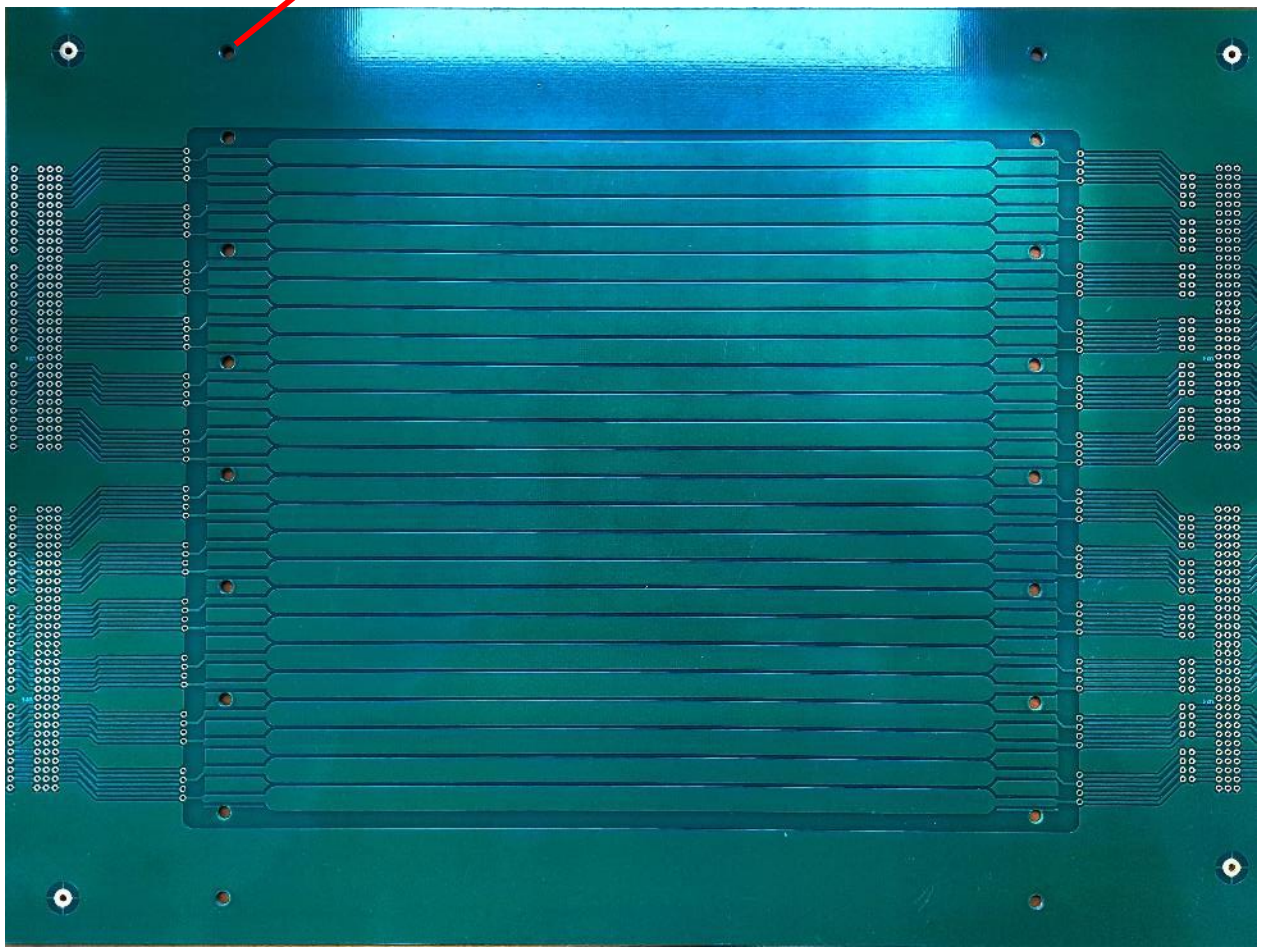
Material	Thickness	One stack
PCB (Blank)	: 1.6mm	x 2 = 3.2mm
Glass	: 0.33mm	x 5 = 1.65mm
Mylar	: 0.175mm	x 4 = 0.7mm
Fishing line	: 0.25mm (1st)	x 4 = 1mm (1st)
	: 0.30mm (2nd)	x 4 = 1.2mm (2nd)
Screw (M4)		Total : 3.35mm (1st) 3.55mm (2nd)

Materials

- PCB
  : 260mm x 266mm x 1.6mm x4(pieces)
  : 362mm x 266mm x 1.6mm x1(piece)
- Blank PCB
  : 260mm x 266mm x 1.6mm x3(pieces)
- Fishing line
  : 0.25mm (for 1st chamber)
  0.30mm (for 2nd chamber)
- Screw (M4)
  : 30mm(length) x 9(pieces) x 2(sides)
- Urethane
- Glass
  : 220mm x 240mm x 0.33mm x8(pieces)
- Mylar
  : 224mm x 261mm x 0.175mm
- HV line
  : carbon tape + copper tape
  + electric wire(soldering)
- Spacer
  : Mylar + Double-sides tape(x2)
  220mm x 8(pieces) x 2(sides)
- Gas tube
  : 2.05mm x 600mm x 8(pieces) x 2(sides)
- Paint + Methanol

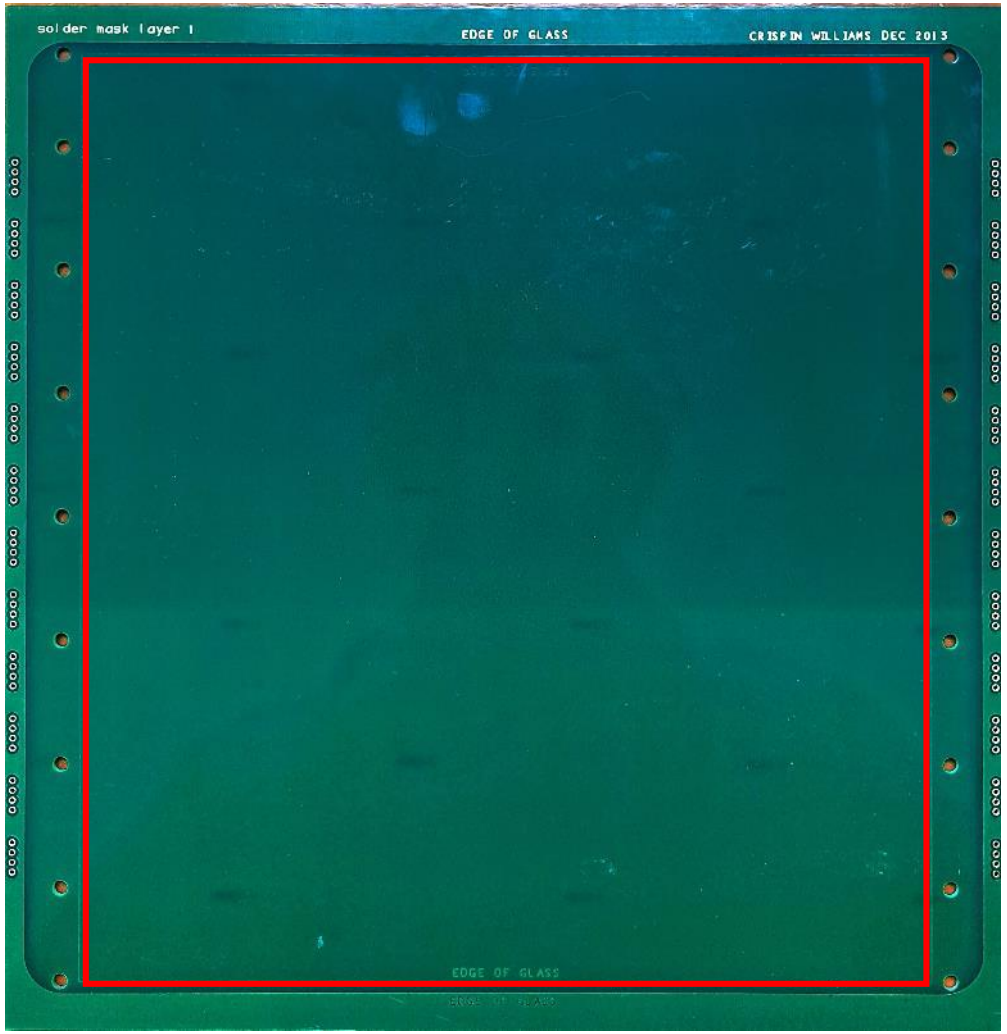
PCB - Strip side

Strip side of middle PCB attach to blank PCB for symmetric structure
Strip width : 7mm
Space width between strips : 1mm



PCB

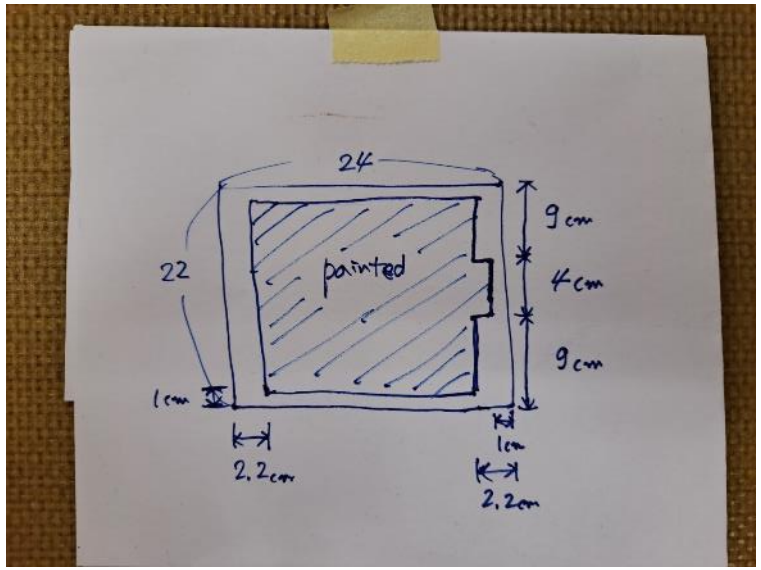
Active area: 220mm x 240mm



Glass – Painting (outer glass)

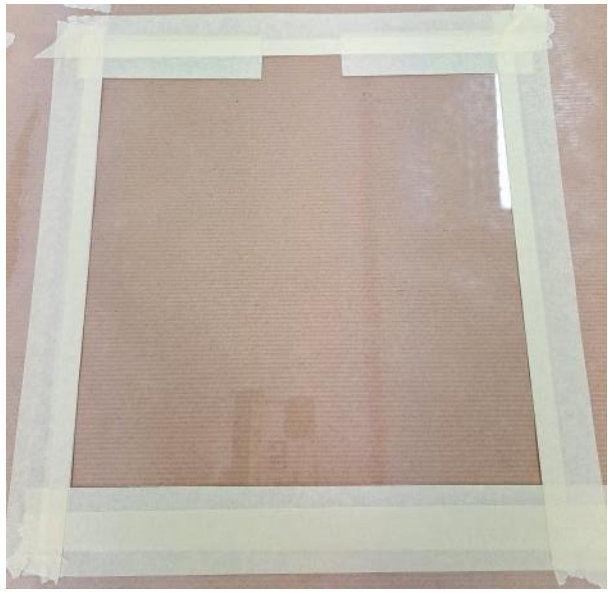
Procedure

1. **Design how to paint, where to paint**
2. Masking with yellow tape
3. Painting with roller
4. Spraying urethane
5. Check resistance



Procedure

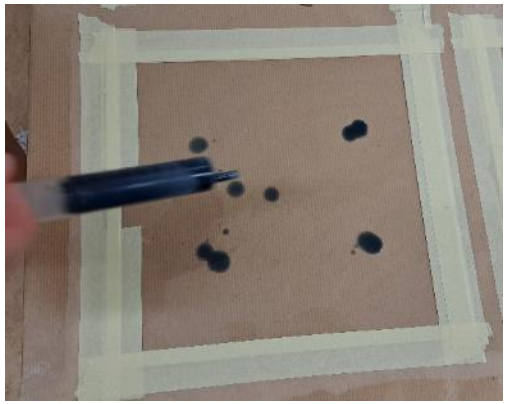
1. Design how to paint, where to paint
2. **Masking with yellow tape**
3. Painting with roller
4. Spraying urethane
5. Check resistance

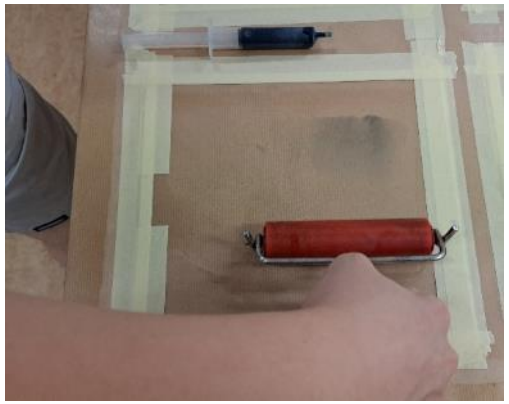


Glass – painting (outer glass)

Procedure

1. Design how to paint, where to paint
2. Masking with yellow tape
3. **Painting Uniformly with roller**
   (Mix paint and methanol in 1:1 ratio)
4. Spraying urethane
5. Check resistance





Procedure

1. Design how to paint, where to paint
2. Masking with yellow tape
3. Painting with roller
4. **Spraying urethane**
5. Check resistance

Procedure

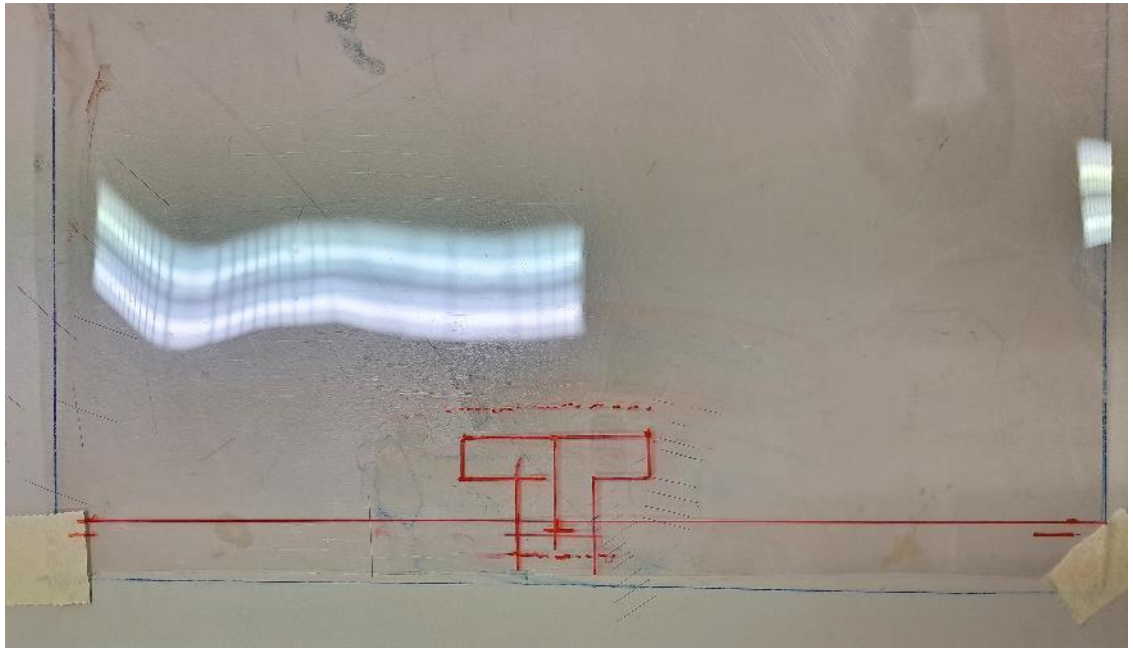
1. Design how to paint, where to paint
2. Masking with yellow tape
3. Painting with roller
4. Spraying urethane
5. **Check resistance**
   (Uniformly around **1MΩ**)

Mylar

Mylar has 2 types

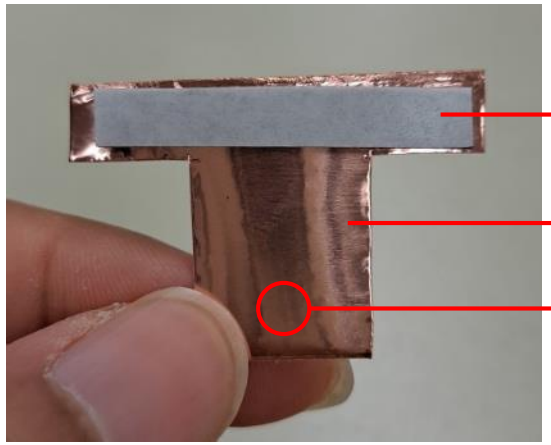
- Rectangular mylar
  - Protecting PCB from HV
  - Cover the active area of PCB

- Mylar without HV connection area
  - As a spacer for HV connection
  - Cut out HV connection area from Rectangular mylar



HV Cable

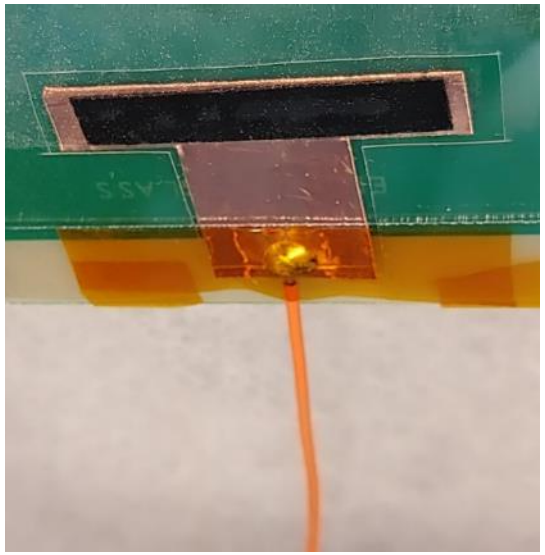
Thickness of carbon tape + copper tape
= thickness of mylar



Carbon tape

Copper tape

Soldering point



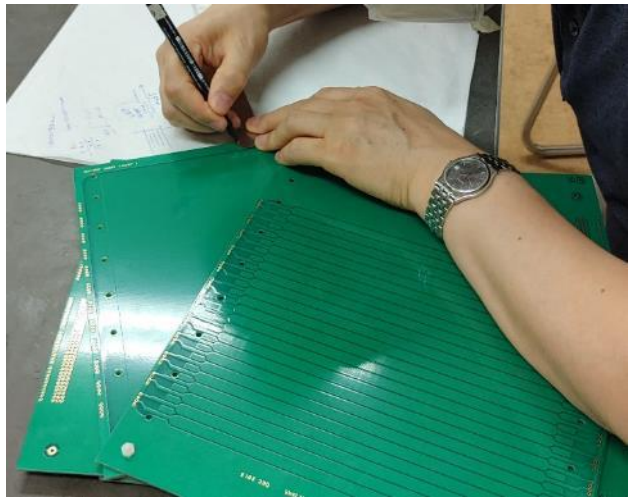
Spacer

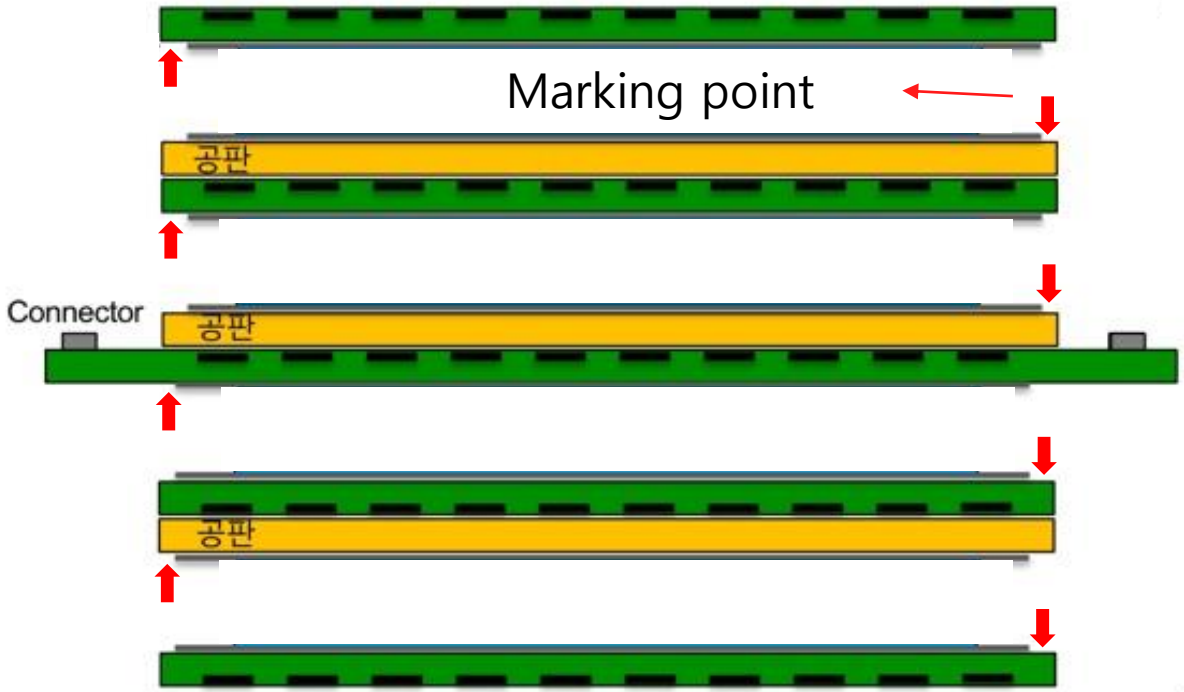
Thickness of mylar + 2 double sided tapes
= thickness of fishing line

Mylar Double sided tapes Cutting line

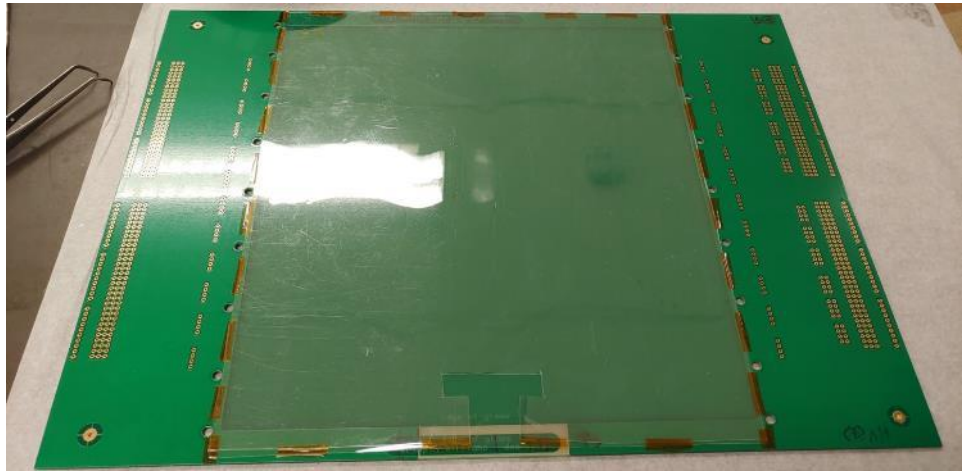
1. Arrange PCB in the order

All PCBs are marked to classify their position to avoid confusion





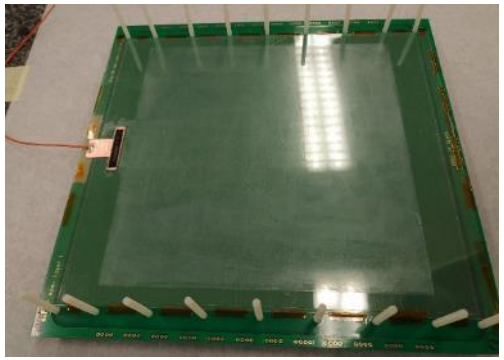
2. Attach mylars to each PCBs



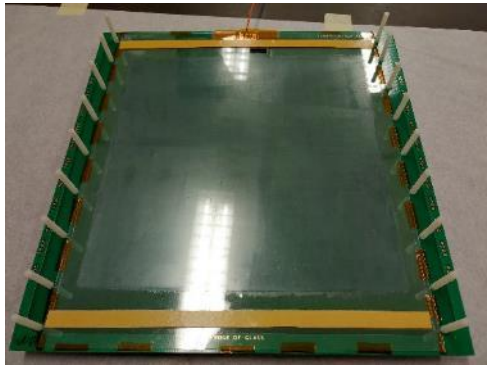
3. Building procedure

- The procedure shows that how to assemble one stack
- We repeated 4 times for building 4 stacks

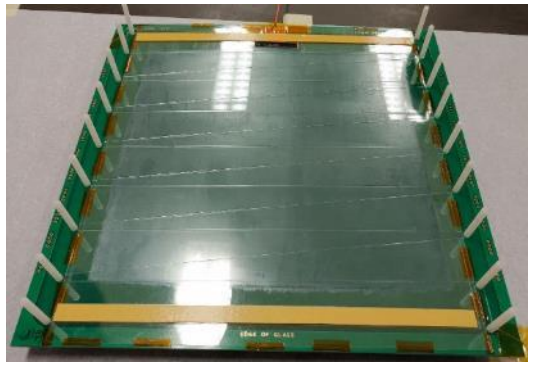
repeat 2 times



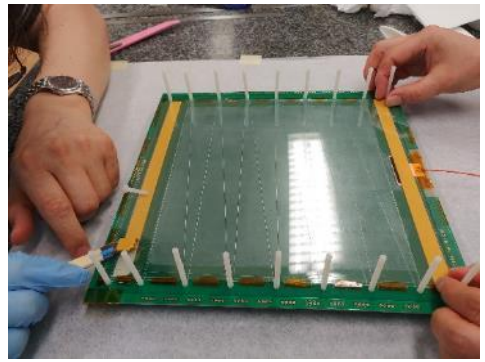
1) attach the outer glass (bottom side)



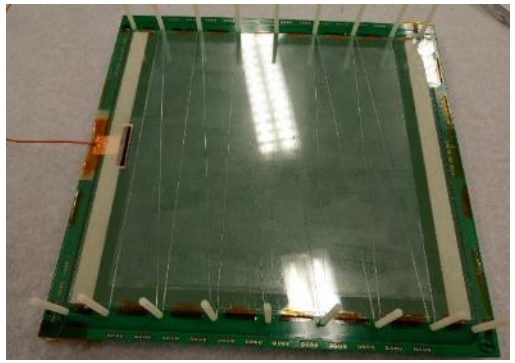
2) attach spacers



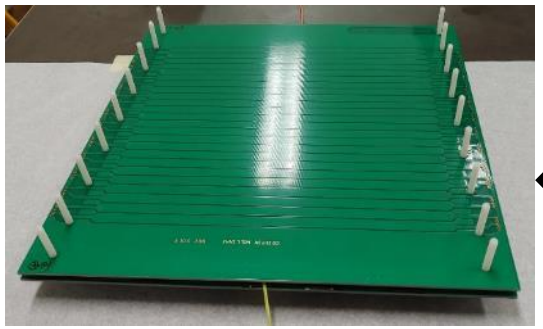
3) wind fishing line (Zigzag)



4) stack the inner glass



5) attach the outer glass (upper side)

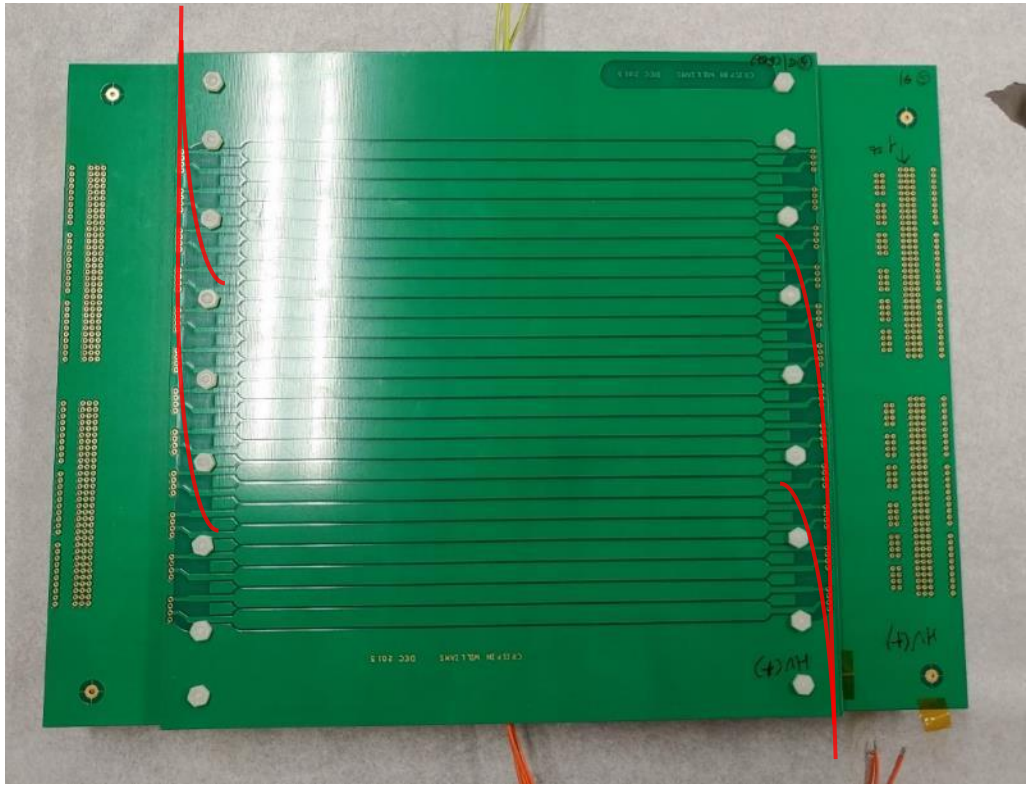


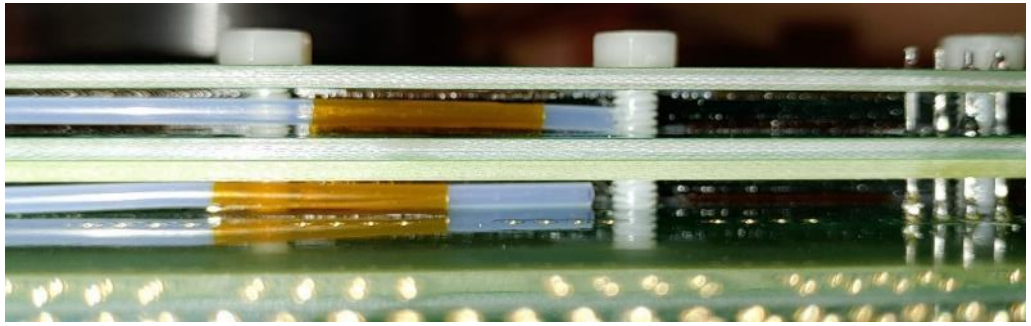
6) assemble the 2nd PCB

- if the last inner glass is assembled, we performed the 5th step

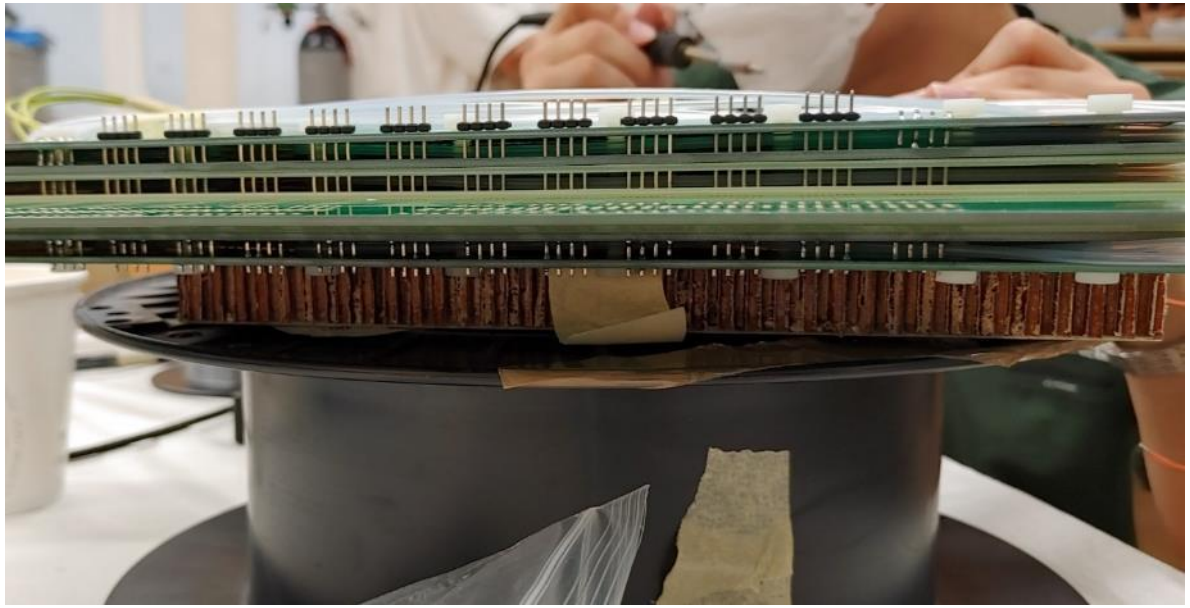
4. Finishing work

- Injecting gas tubes



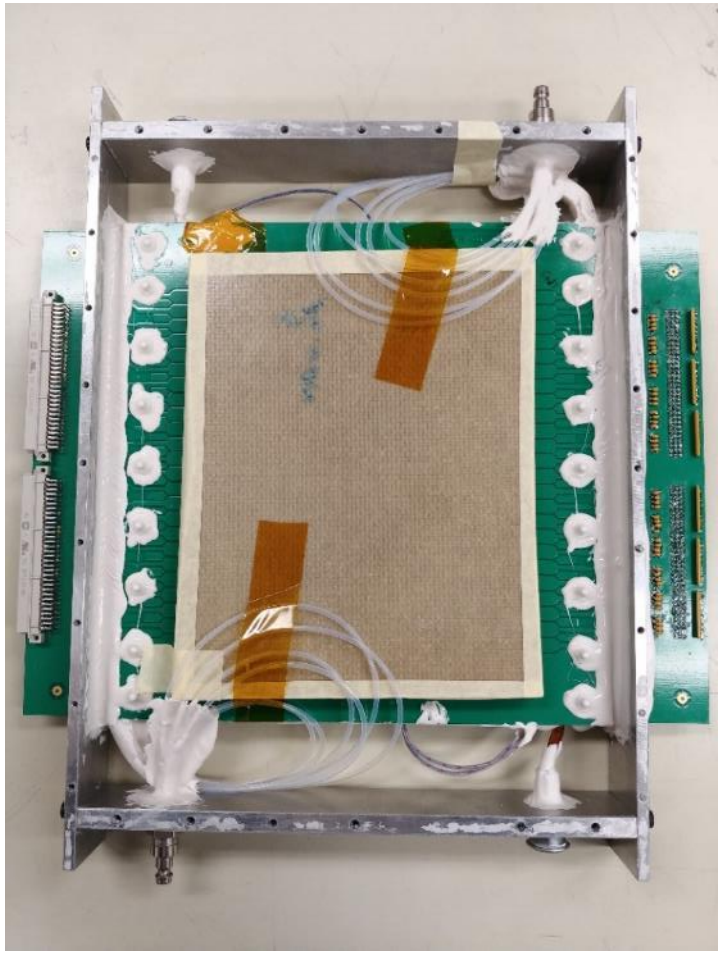


- Using the pins
  for fixing the PCBs and connecting the strips



4. Finishing work

- Sealing with silicone
- Connecting each HV cables and Gas tubes

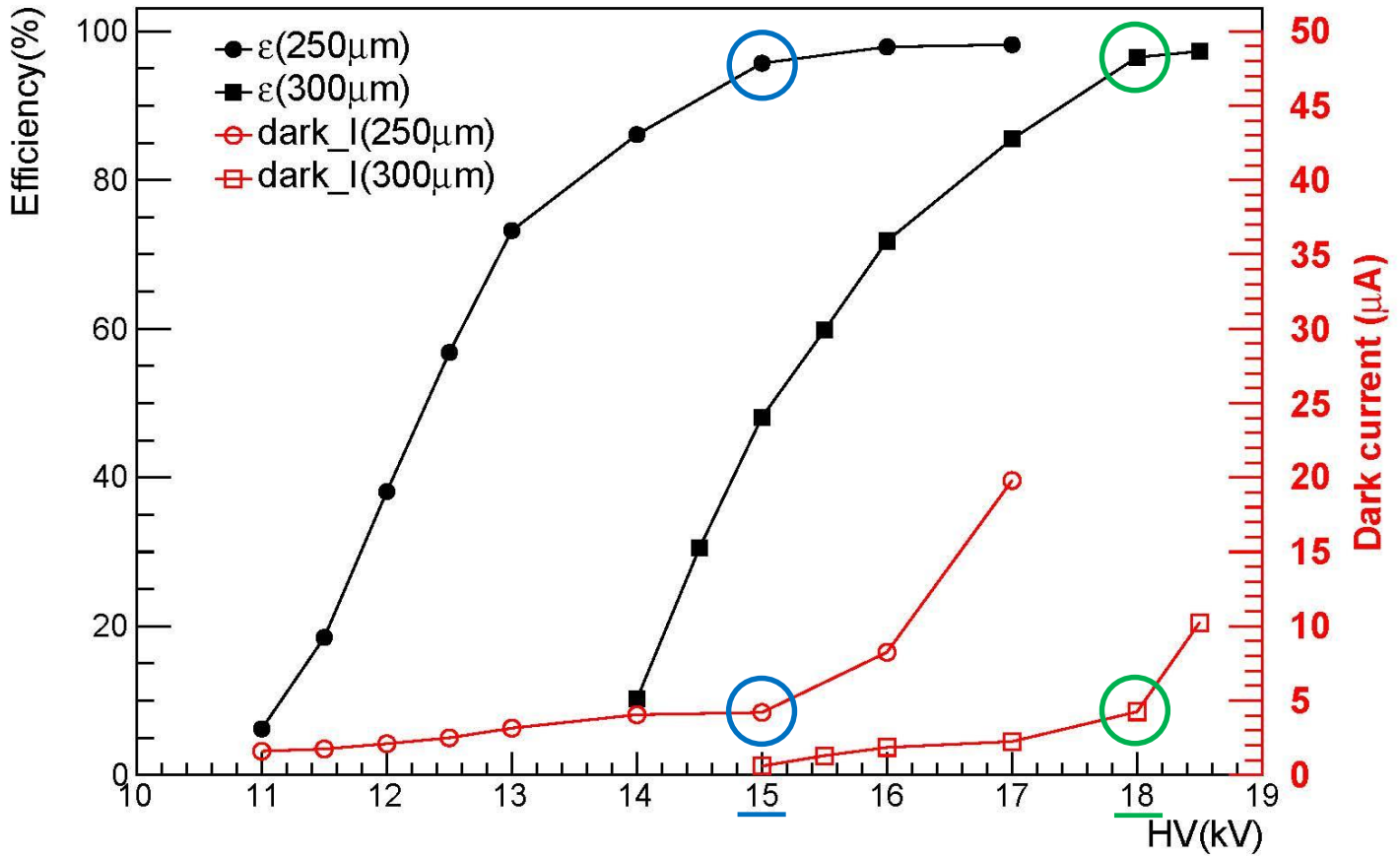


1. Detecting cosmic muons using 3 scintillators

2. Using eco-gas (HFO-1234ze 100%)

3. Operating Voltage
- 250μm Chamber : 15kV
- 300μm Chamber : 18kV

4. Time resolution hasn't been measured yet



PLAN

- Building one more 250μm Chamber
- Measuring time resolution
- Studying cosmic tracking
  with 2 chambers of 250μm using eco-gas
- Analyzing cosmic muon data