Status of the BDC production for LAMPS

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(KRISS)

LAMPS Workshop
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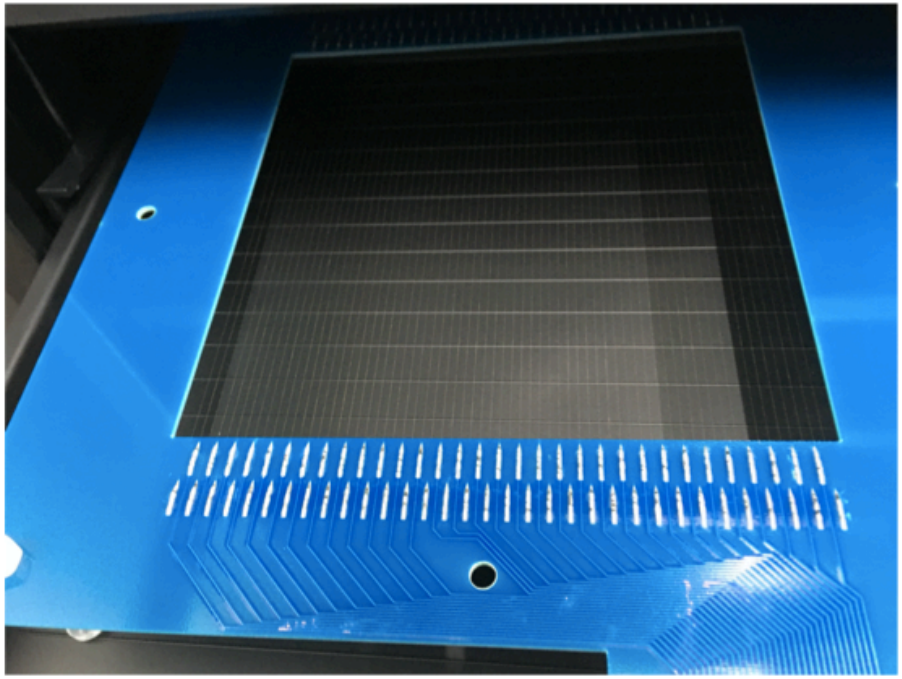
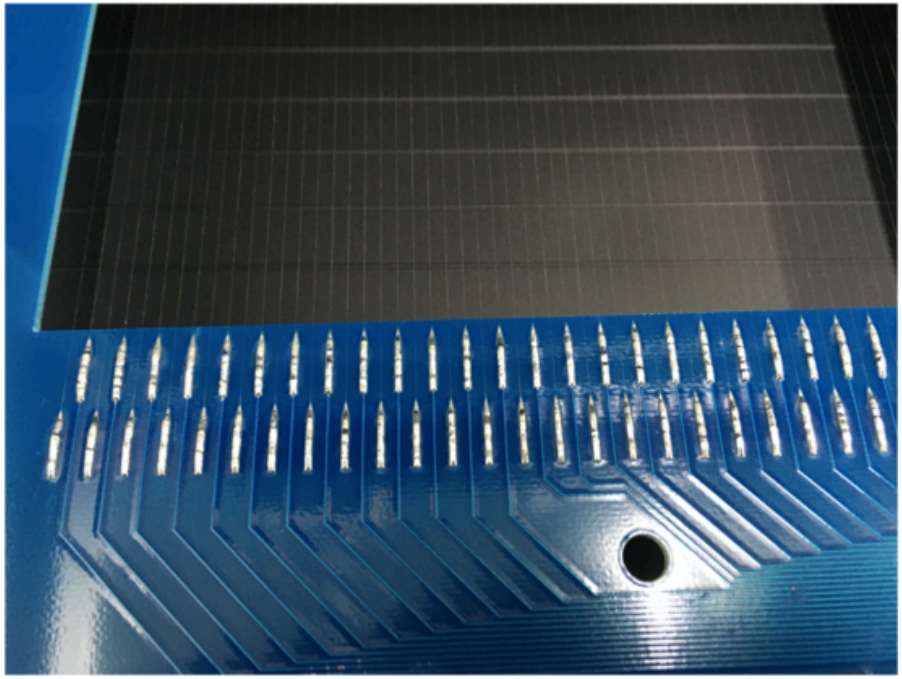
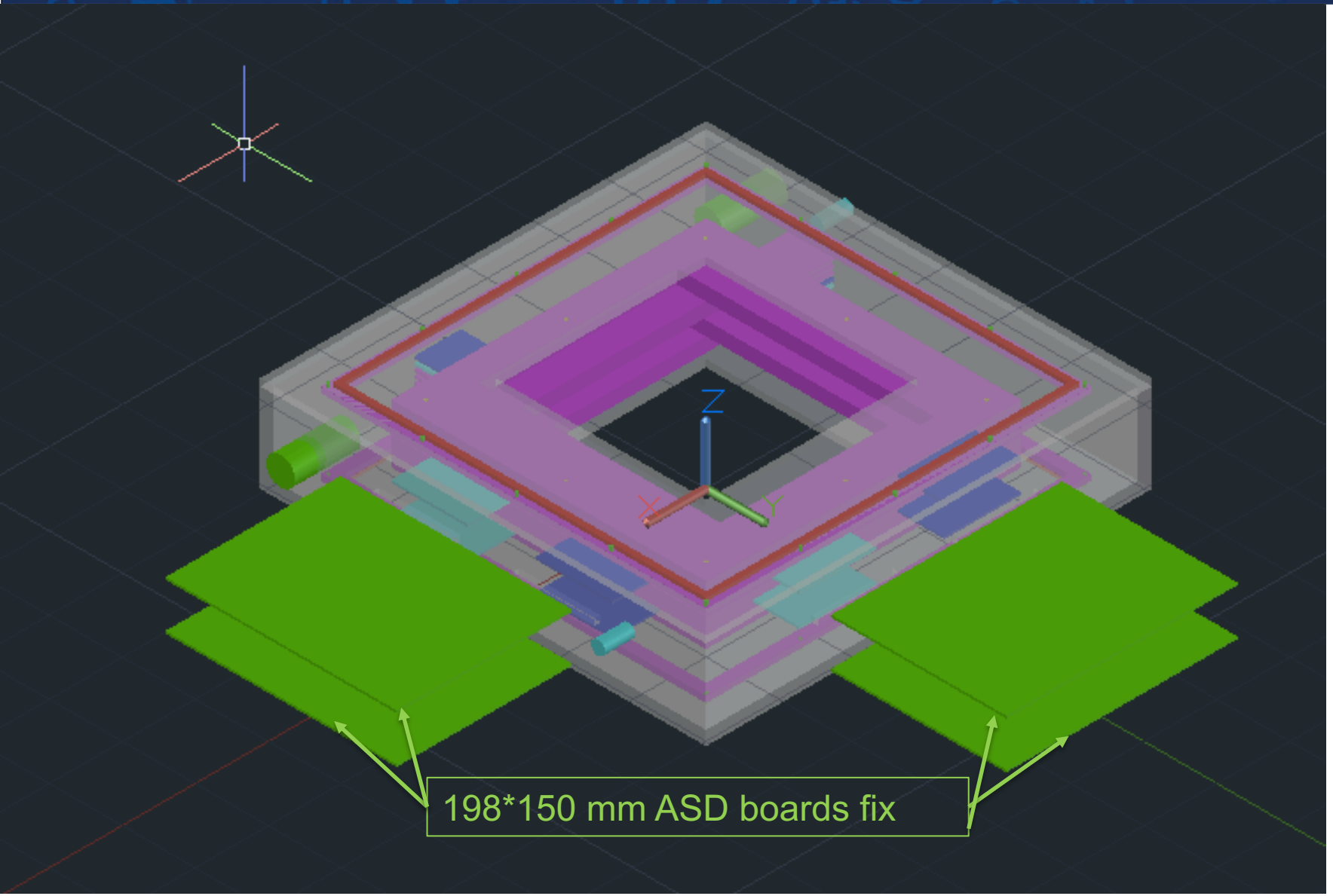
NEWS – 4 anode plane wiring is done

- Hard work by Jaein and Piljun, with many advice from Sanghoon Hwang (KRISS)
- About 3 weeks for 4 anode planes wiring
- Cleaning is done, waiting for chamber assembly





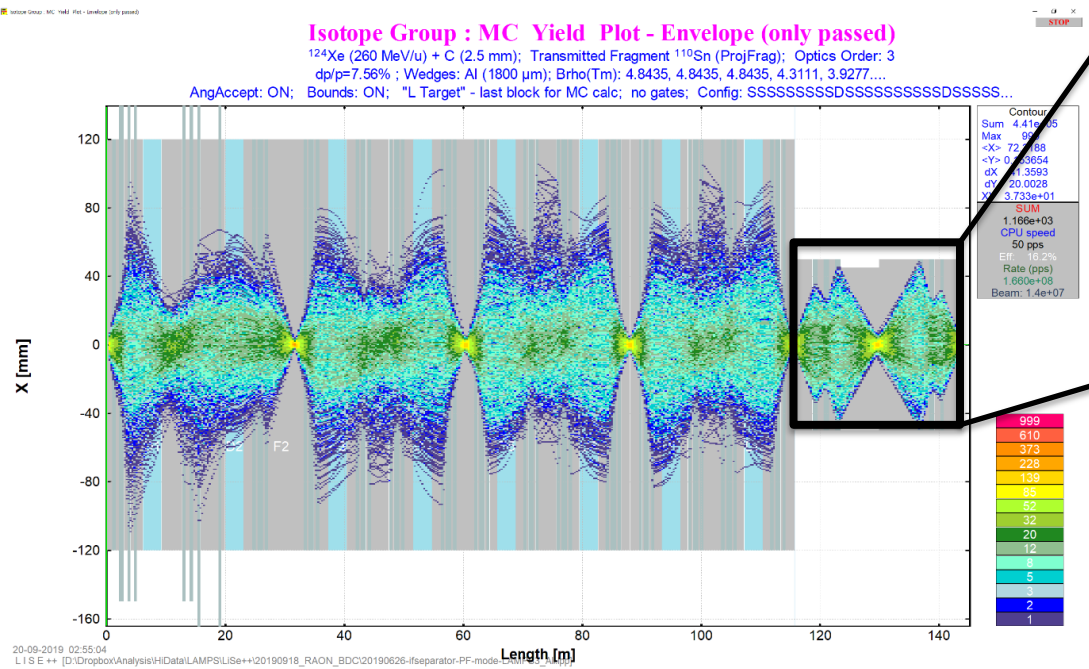
BDC design (preliminary)

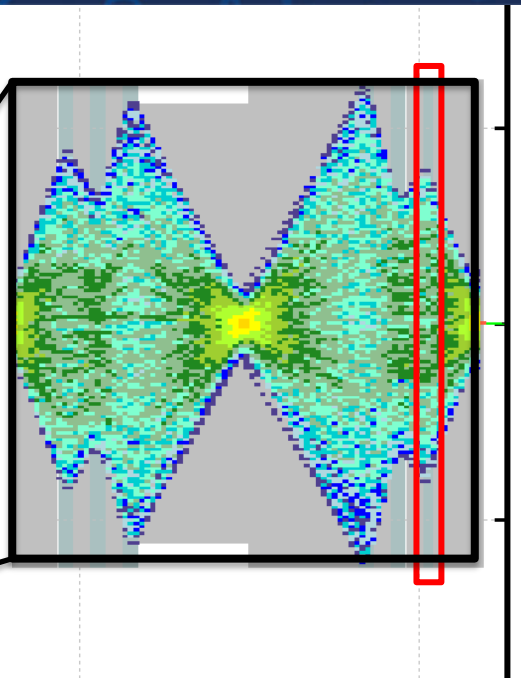


Reminder for active area determination

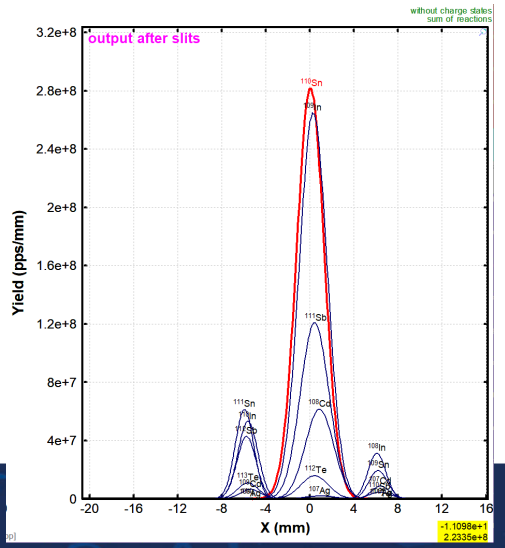
- **Beam study with Lise++**

^{124}Xe (260 MeV/u) Beam and ^{14}C target





Beam size at L-Target (x)
: ± 4.2 mm



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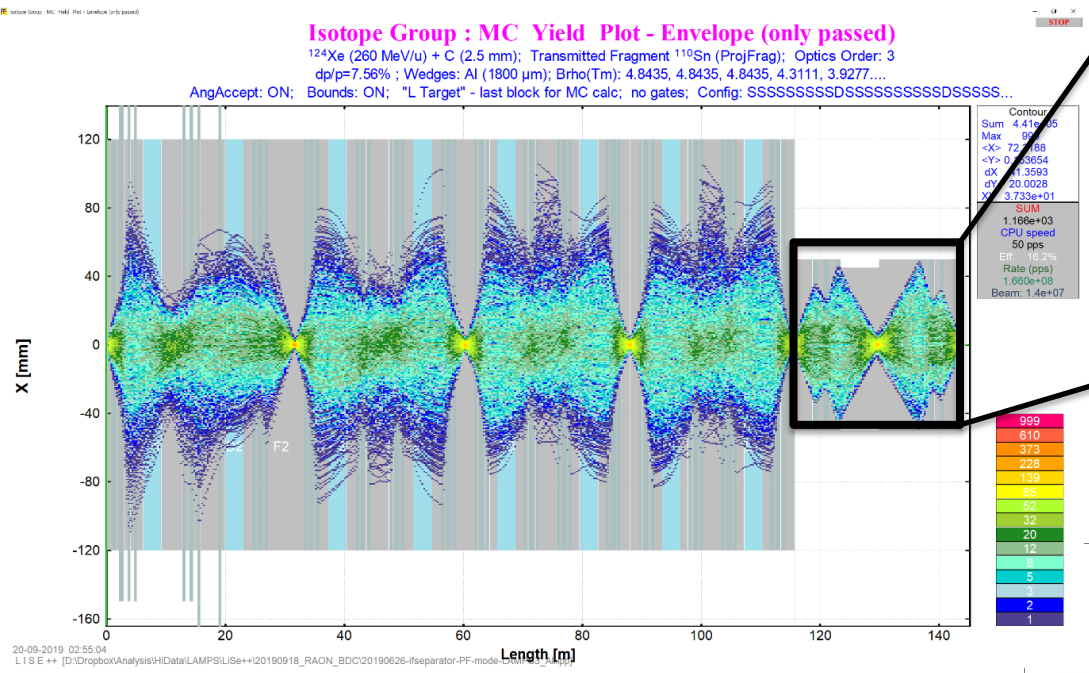
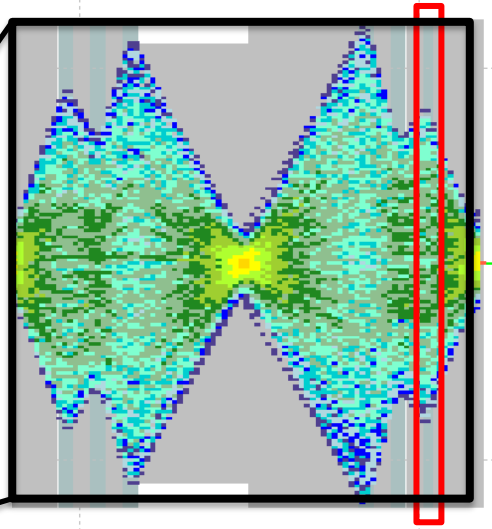
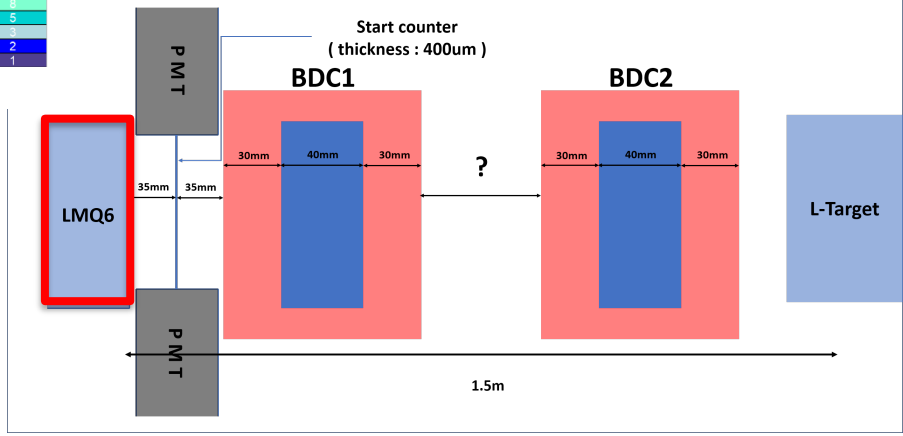




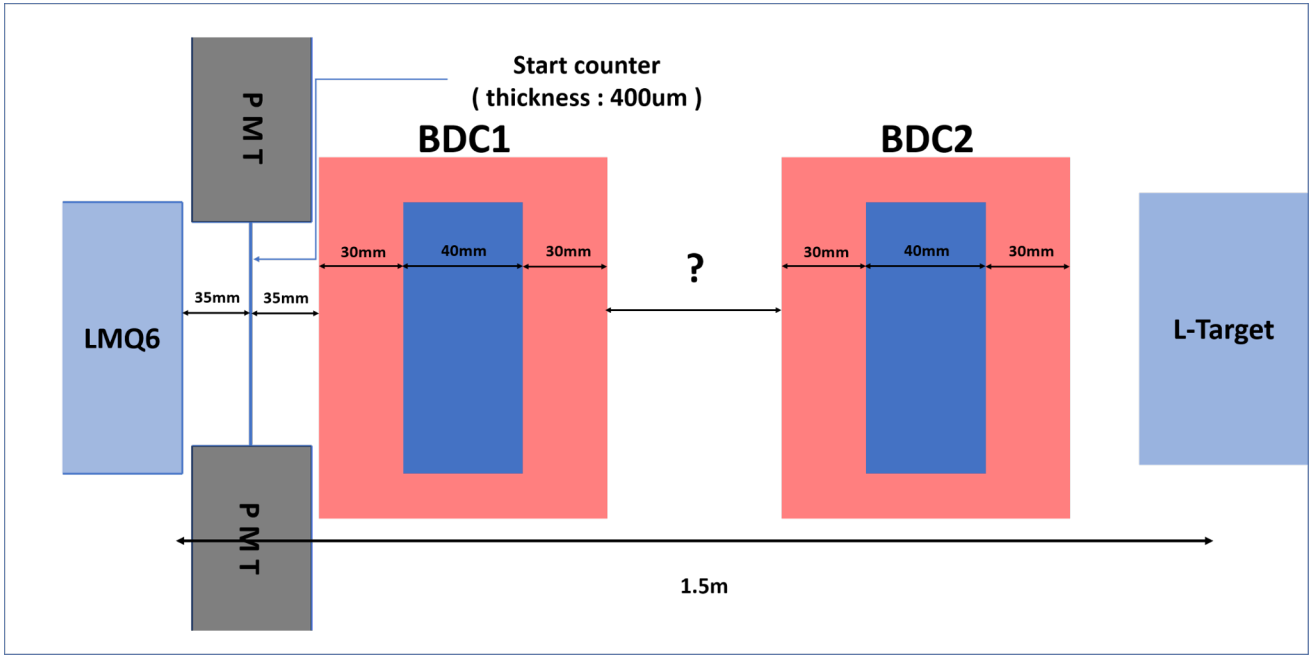
Question : estimated beam size at BC position?

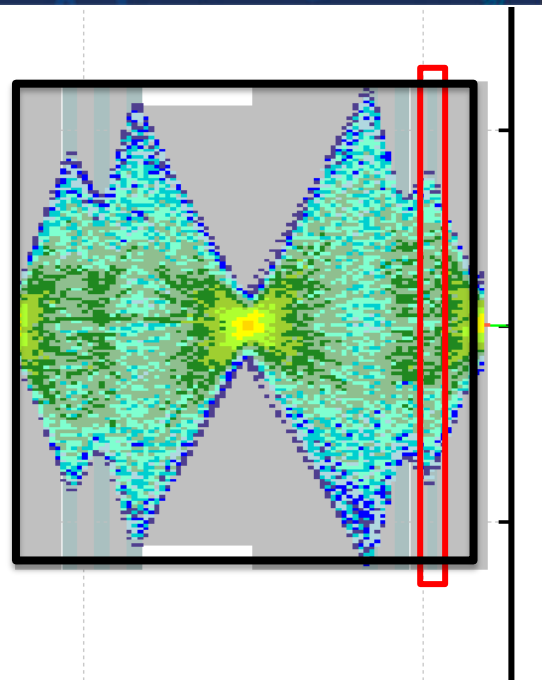
Last quadrupole magnet before BDCs



Reminder for active area determination

- **Beam study with Lise++**

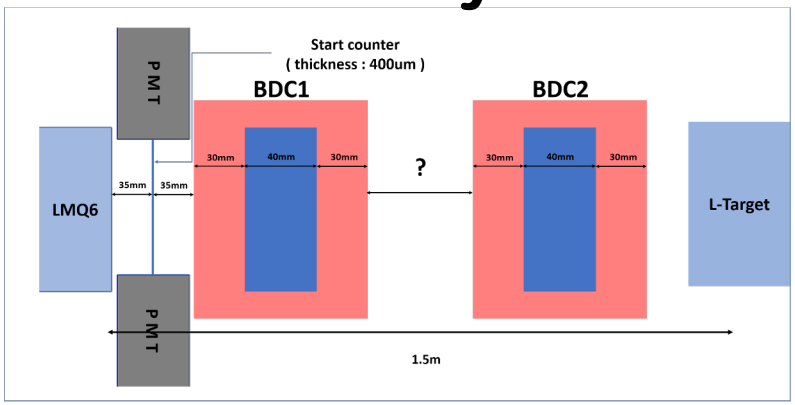


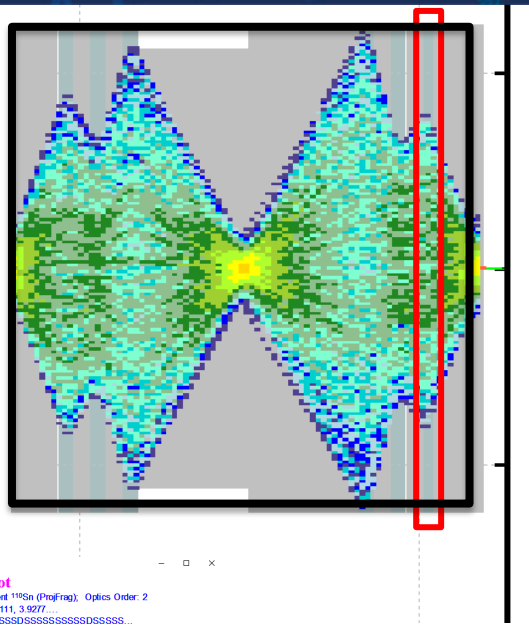


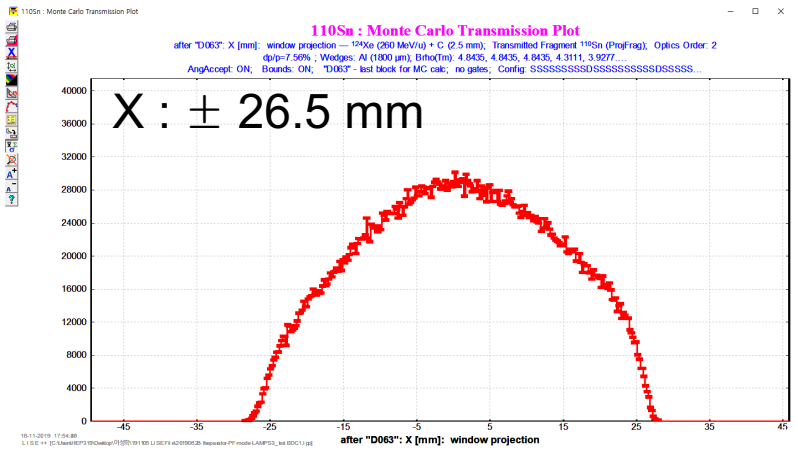
  - Assumption
    - Start counter doesn't effect much to the beam size (ignorable, except the thickness)
    - BDC (active area) is located away from last LMQ6, 100 mm and further

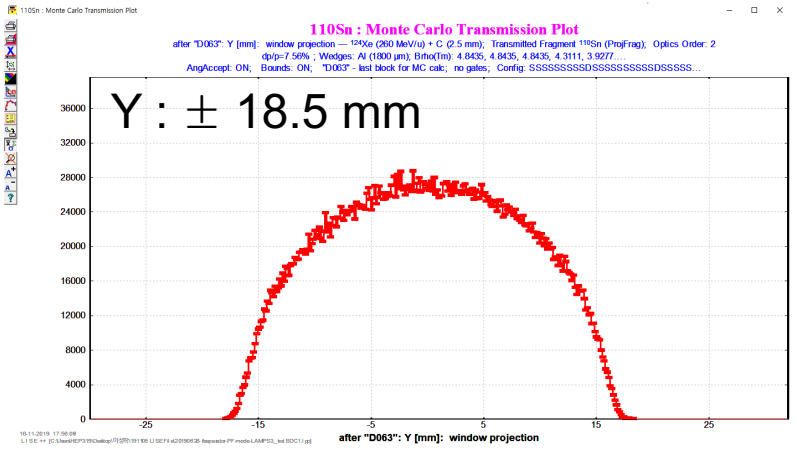
Reminder for active area determination

- **Beam study with Lise++**





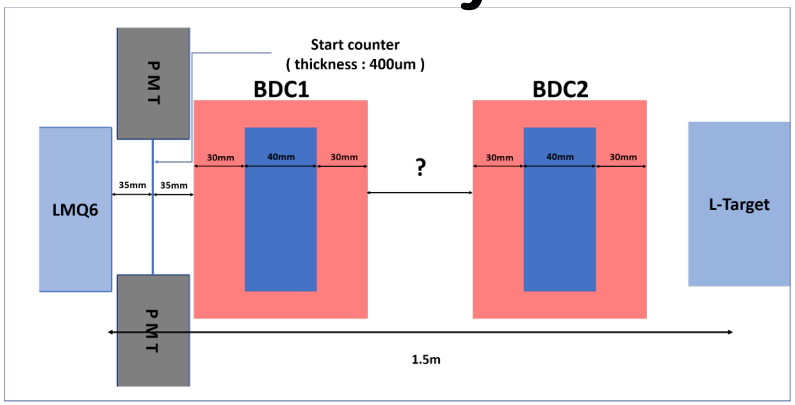


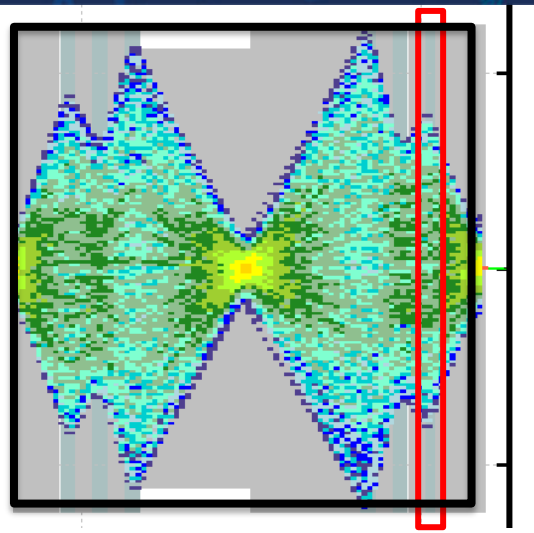


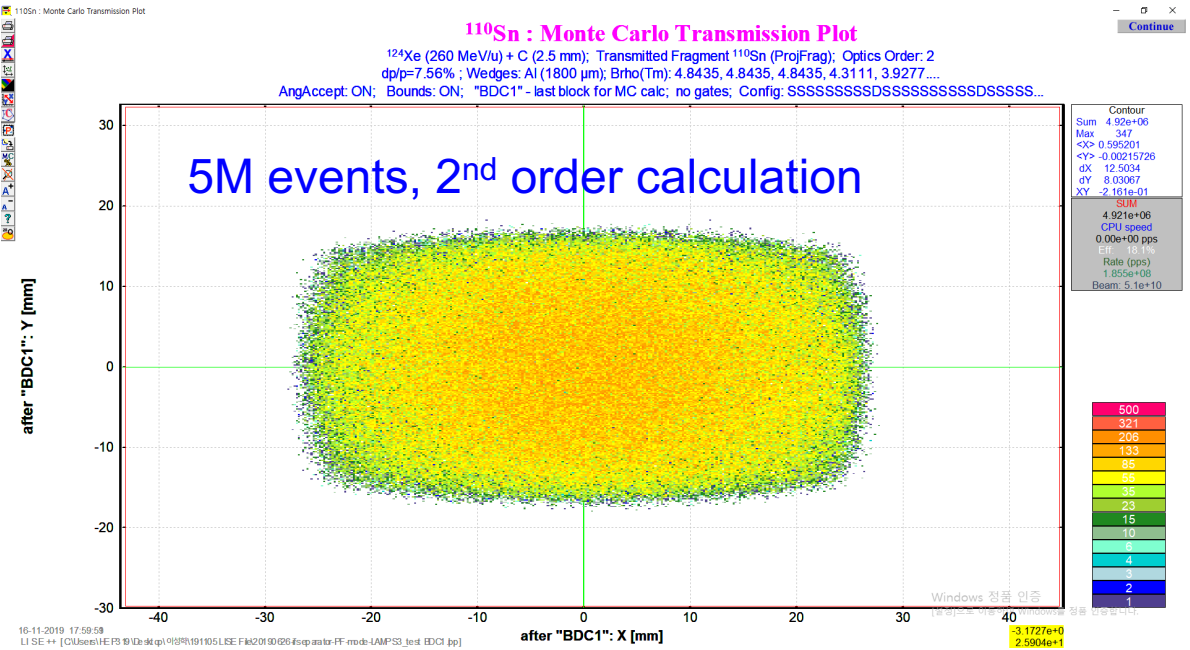
– MC results with 2nd order calculation

Reminder for active area determination

- **Beam study with Lise++**





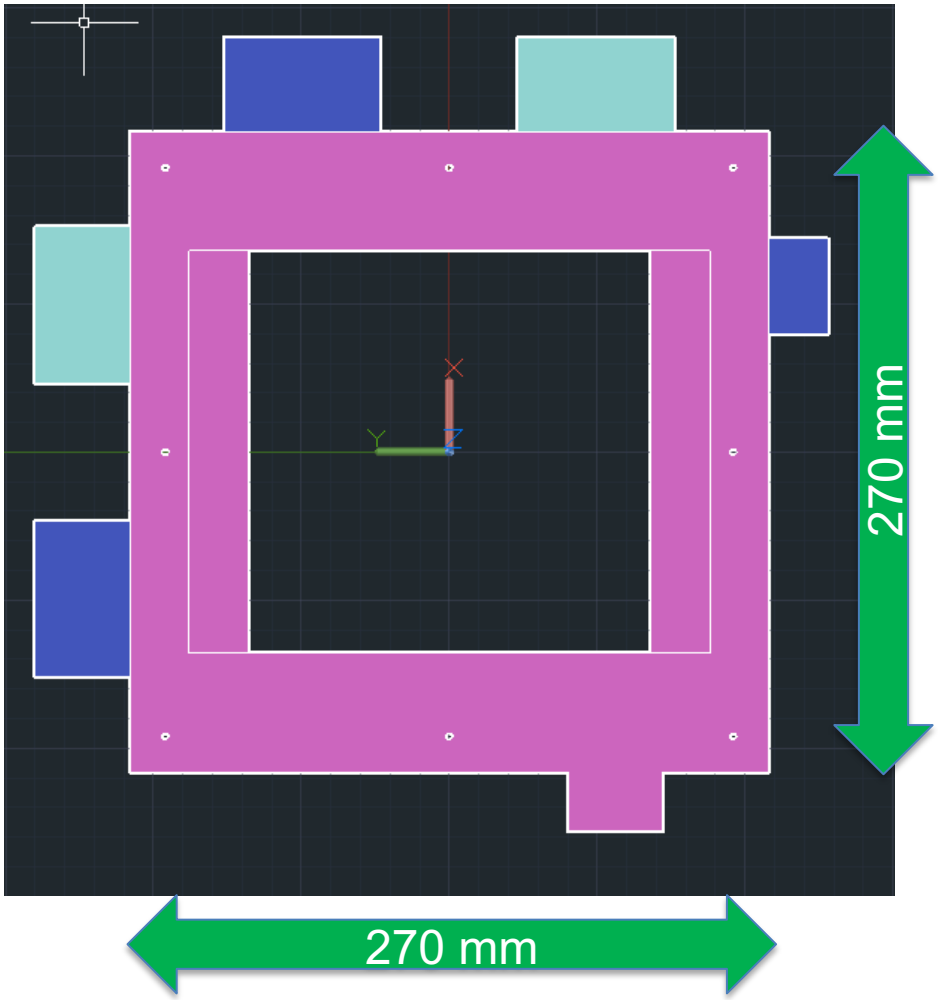


- Active area of BDC1 : 53 X 37 mm^2
- Conservatively consider to ~3-sigma :

(53*3) X (37*3) = 159 * 111 mm^2

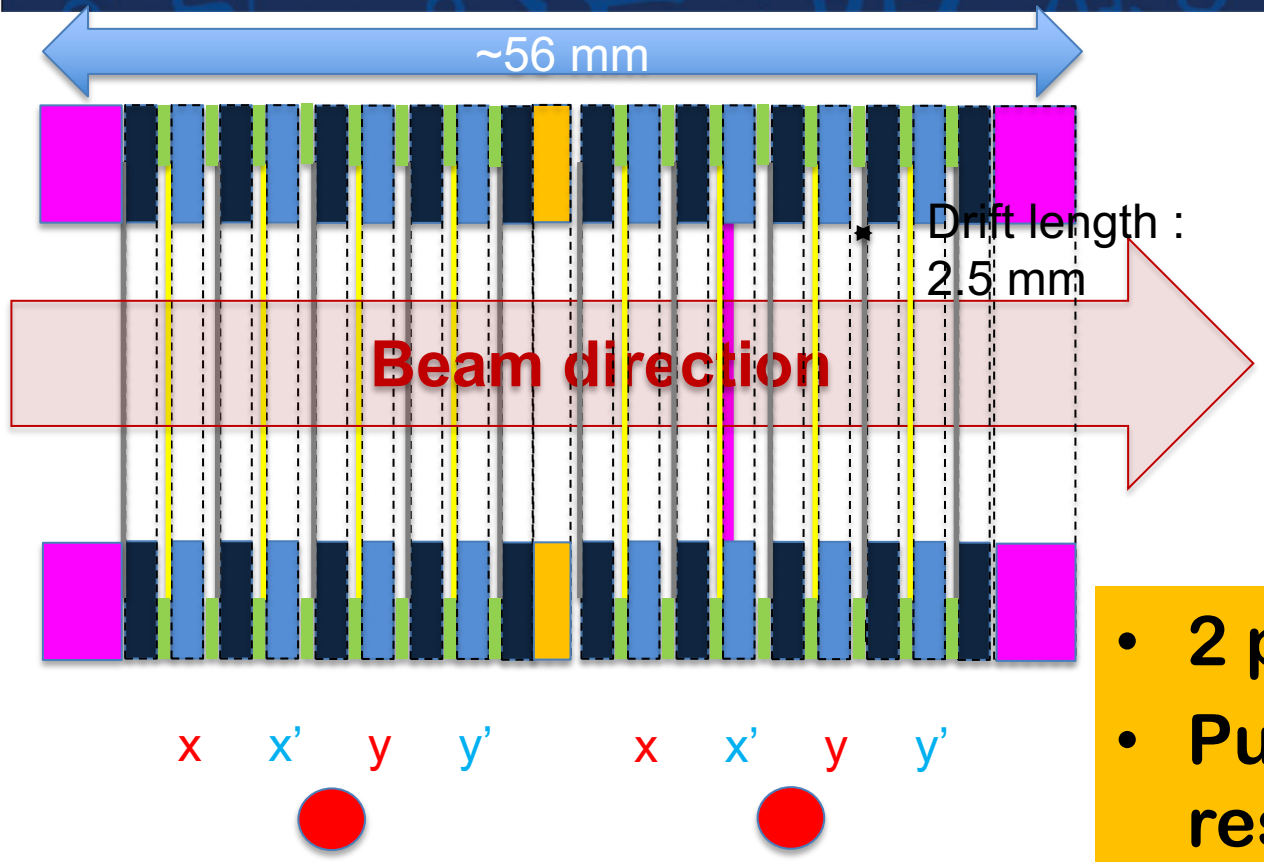
- Also, consider the technical limit and curvature by magnetic field
- Active area is decided to 160 * 160 mm^2

프레임 내부 wired planes 사양 (1세트당)



- **2 mm** 두께의 **wired anode (x,x',y,y'),(x,x',y,y')** 총 **8**매
- **cathode plane** 총 **9**매 **(anode plane** 사이**)**
- 각 **anode** 와 **cathode** 사이에 **0.5 mm** 간격의 **spacer 15**매**, 2 mm** 간격의 **spacer 3**매
- **outer frame**에 **8**개의 나사로 고정

Structure of the chamber



Cathode plane
Signal plane
Mylar (for GND)
Wire
Spacer : 0.5 mm

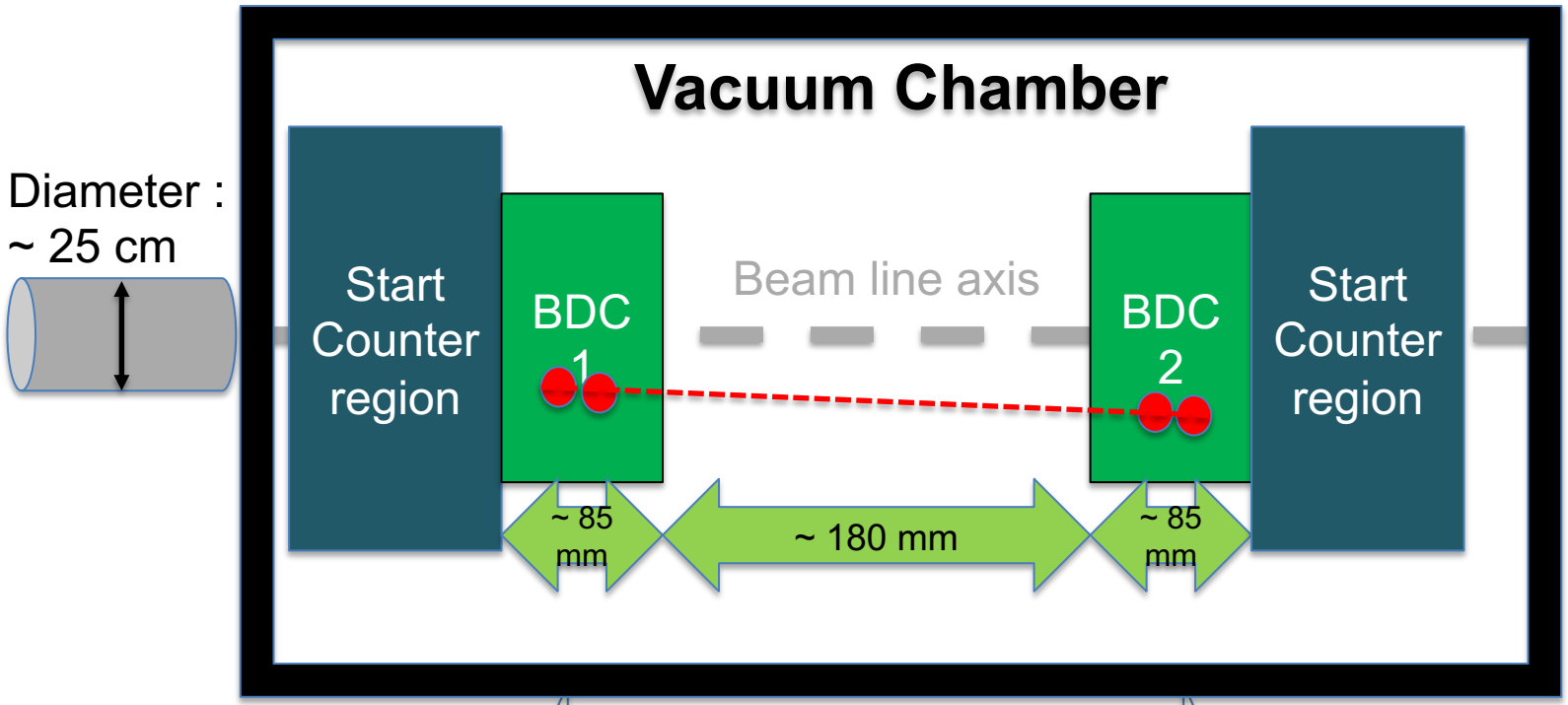
Middle
Spacer : 2 mm

Thick
Spacer : 5 mm

- **2 points in one set**
- **Purpose : position resolution of 100 μm (0.1 mm)**

xy plane is shifted from x'y' plane with 2.5 mm spacing

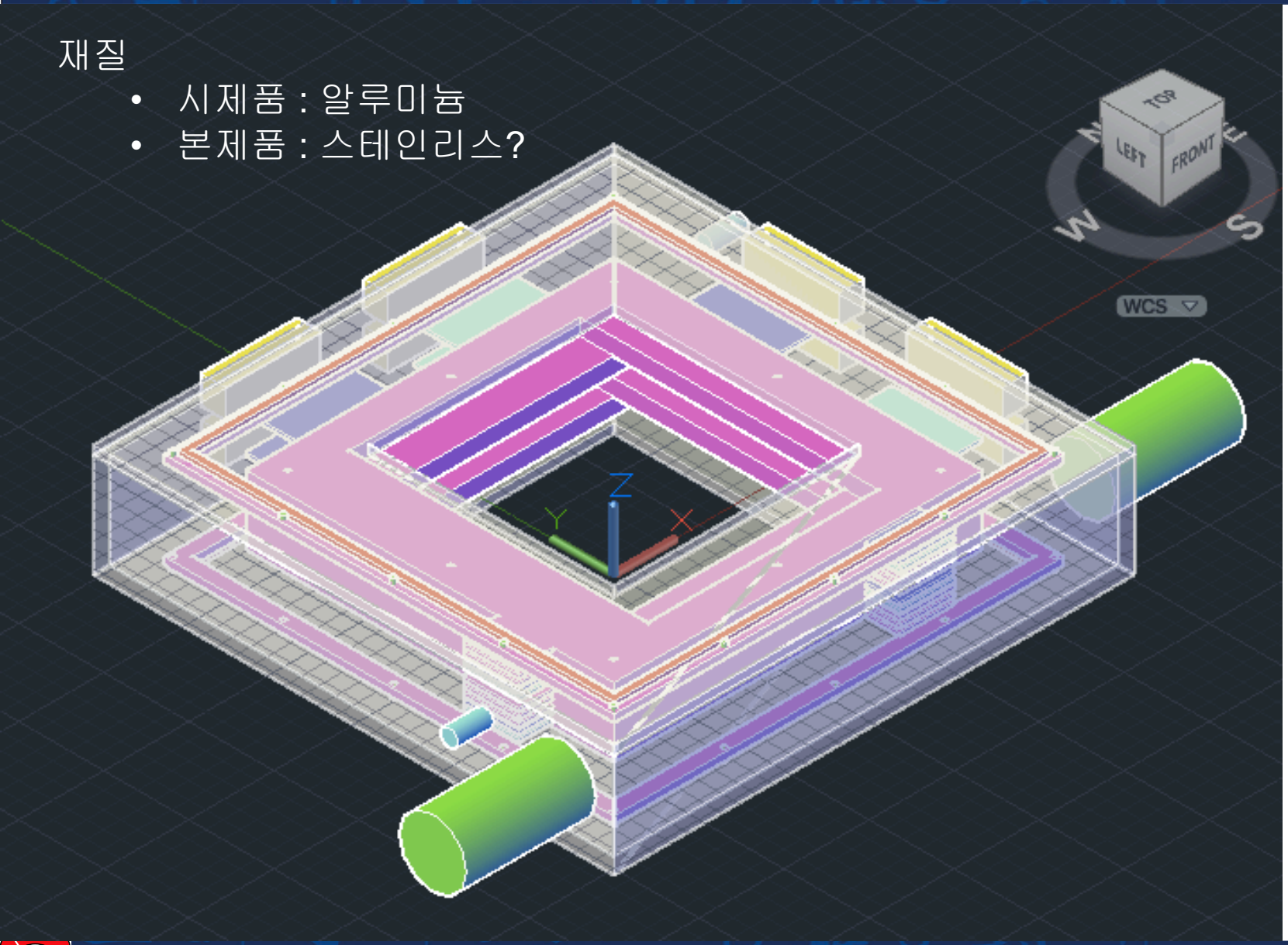
Position of BDC inside the vacuum chamber



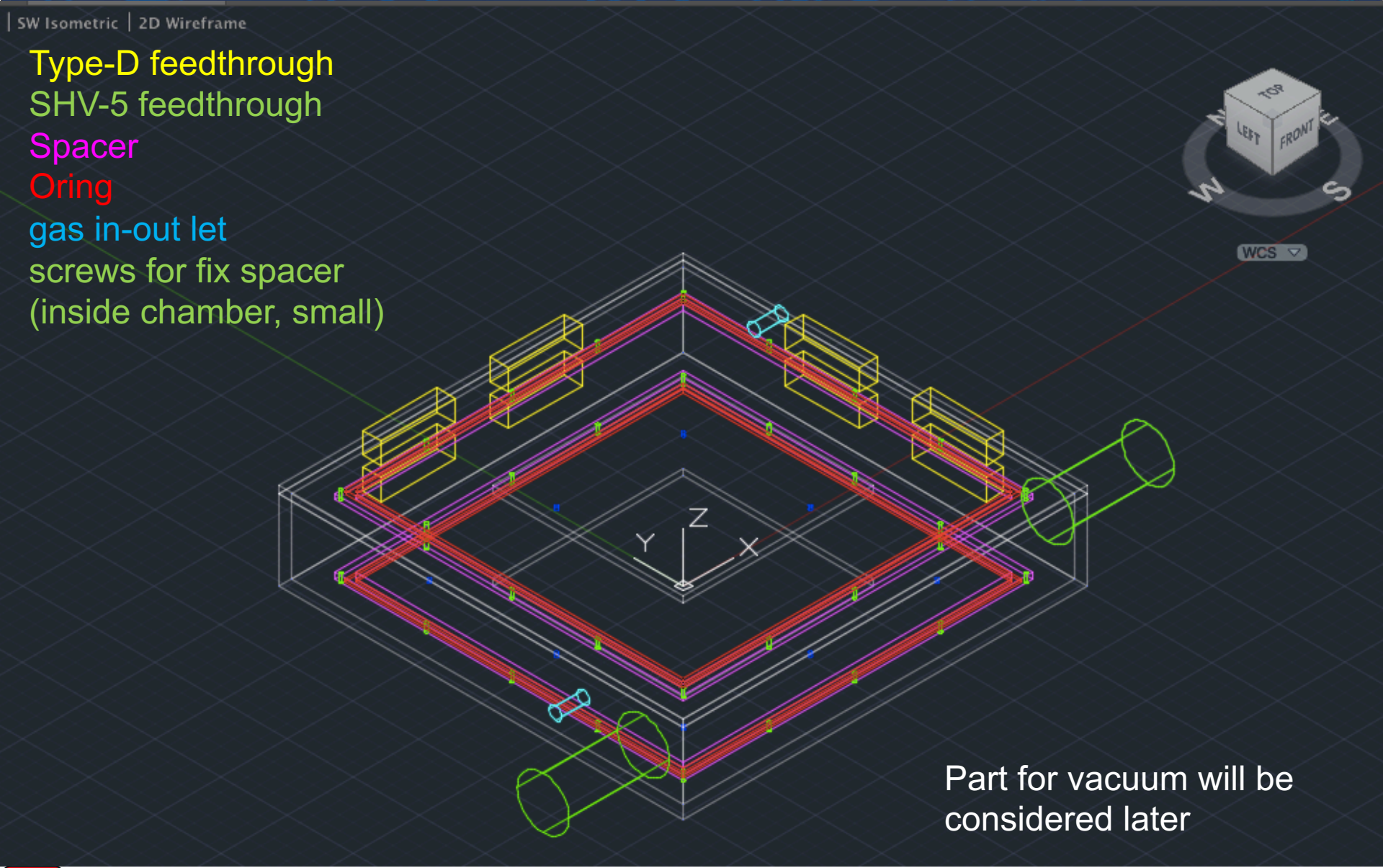
BDC design without chamber (preliminary)

재질

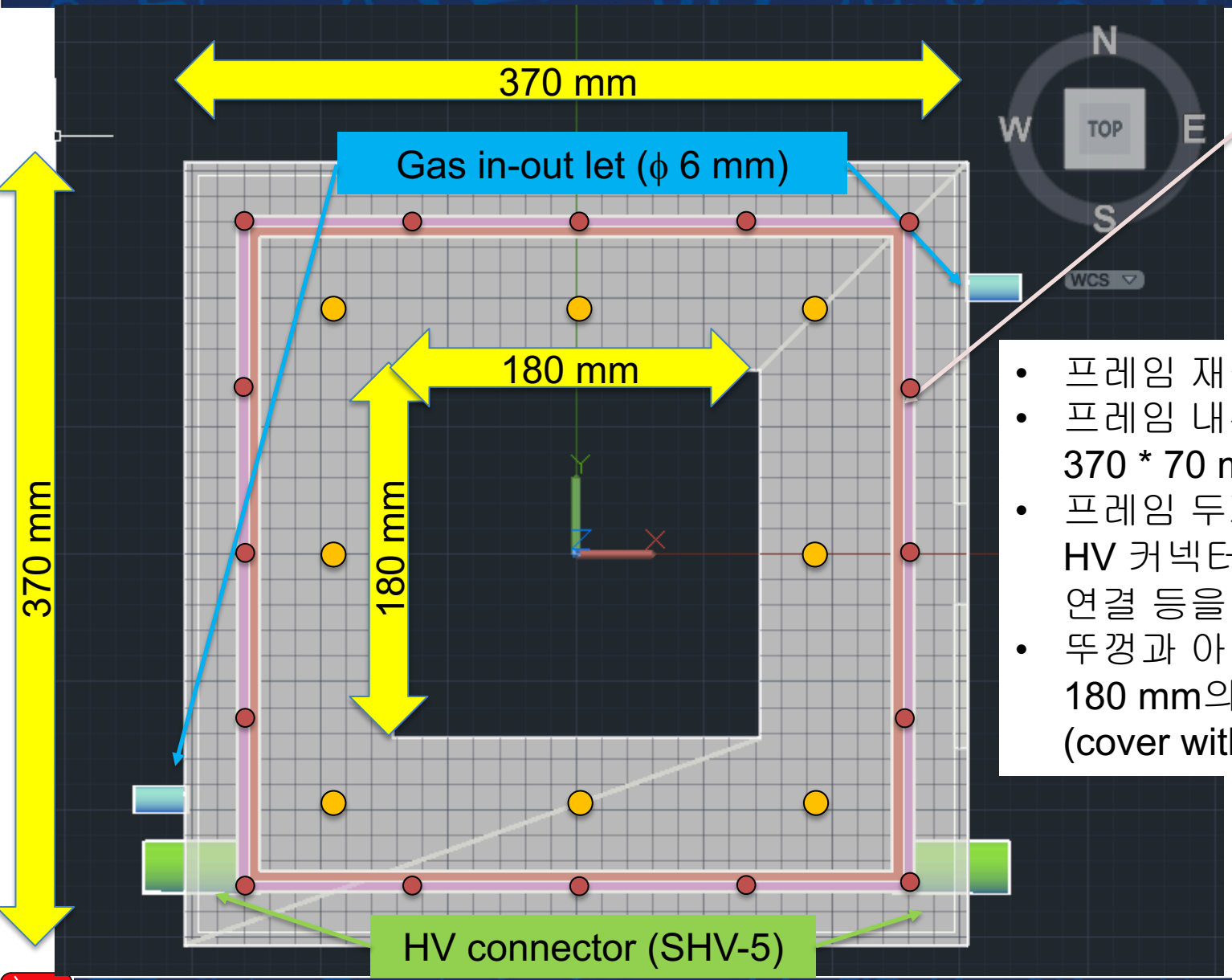
- 시제품 : 알루미늄
- 본제품 : 스테인리스?



Preliminary design of outer frame



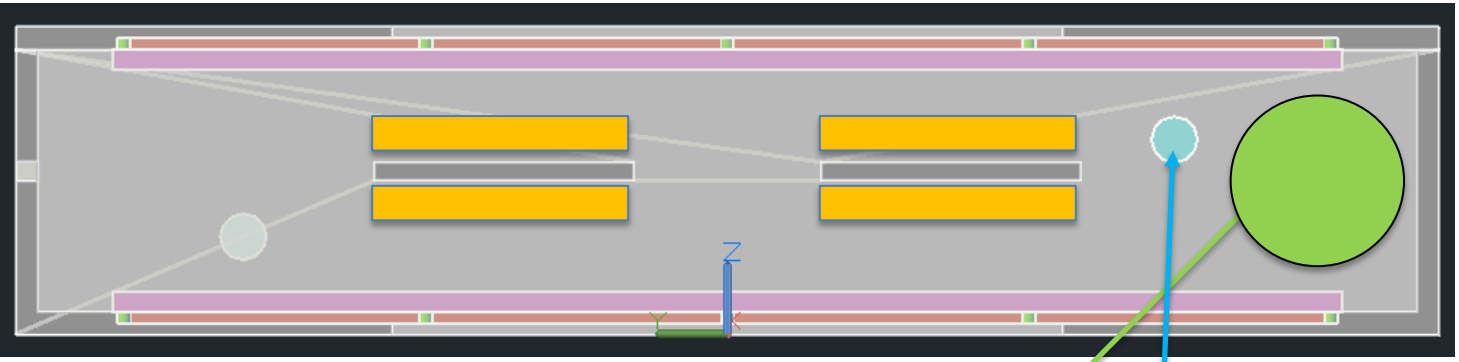
뚜껑 위에서 내려다 본 모양



오링과 5T 두께의 스페이서

- 프레임 재질 : 알루미늄
- 프레임 내부 규격 : 370 * 370 * 70 mm
- 프레임 두께 : 6 mm (단, HV 커넥터, 가스 커넥터 연결 등을 위해 조정 가능)
- 뚜껑과 아래 부분에 180 * 180 mm의 창을 내야 함 (cover with mylar film?)

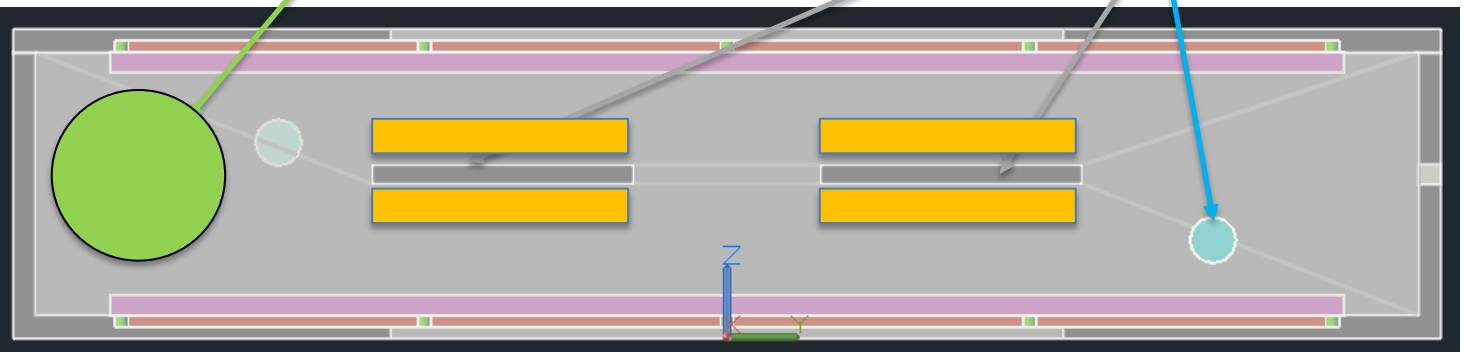
측면에서 바라 본 모양 (본제품)



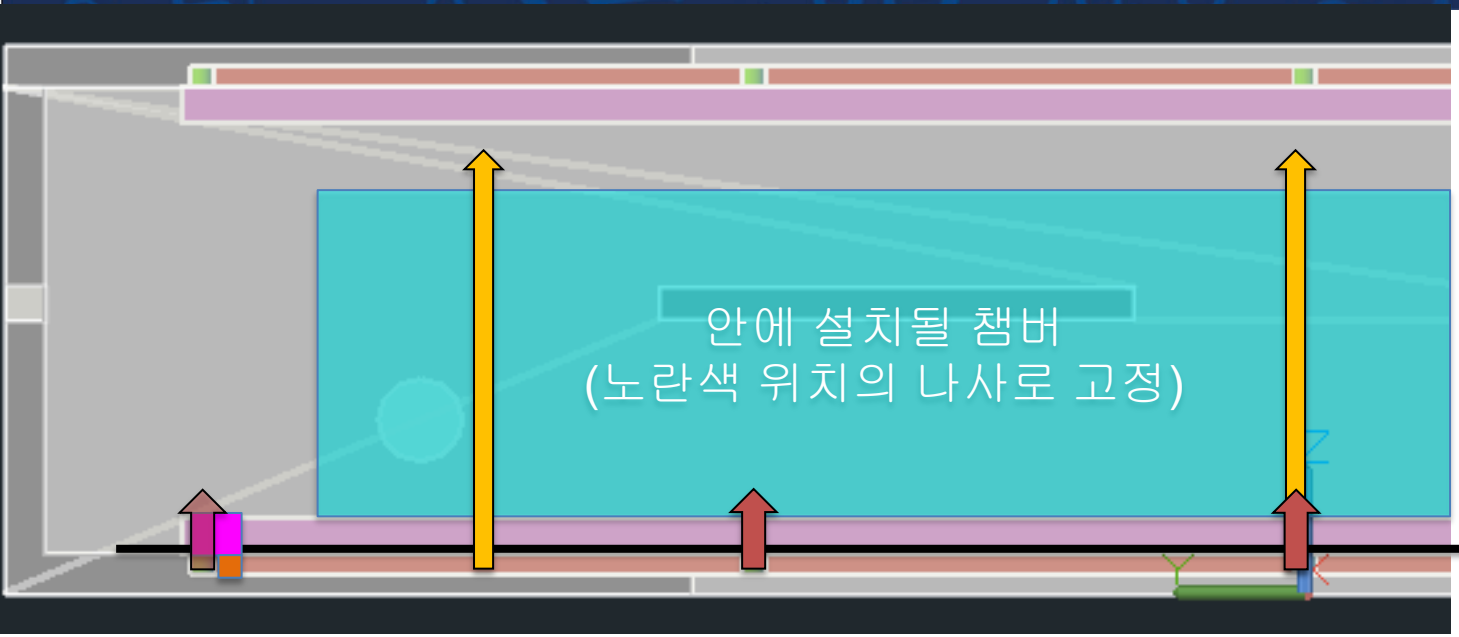
HV connector (SHV-5) feedthrough

Gas in-out let (ϕ 6 mm)

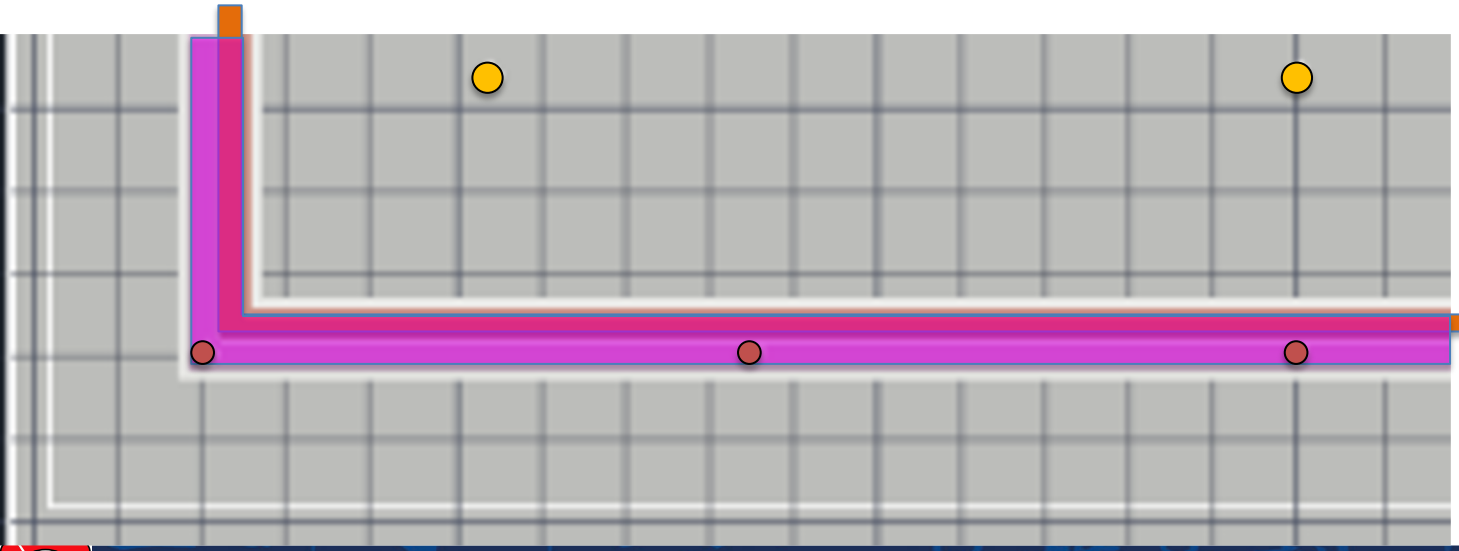
프레임 측면에 IDC cable connection을 위한 feedthrough 설치 (4*2=8 / set)



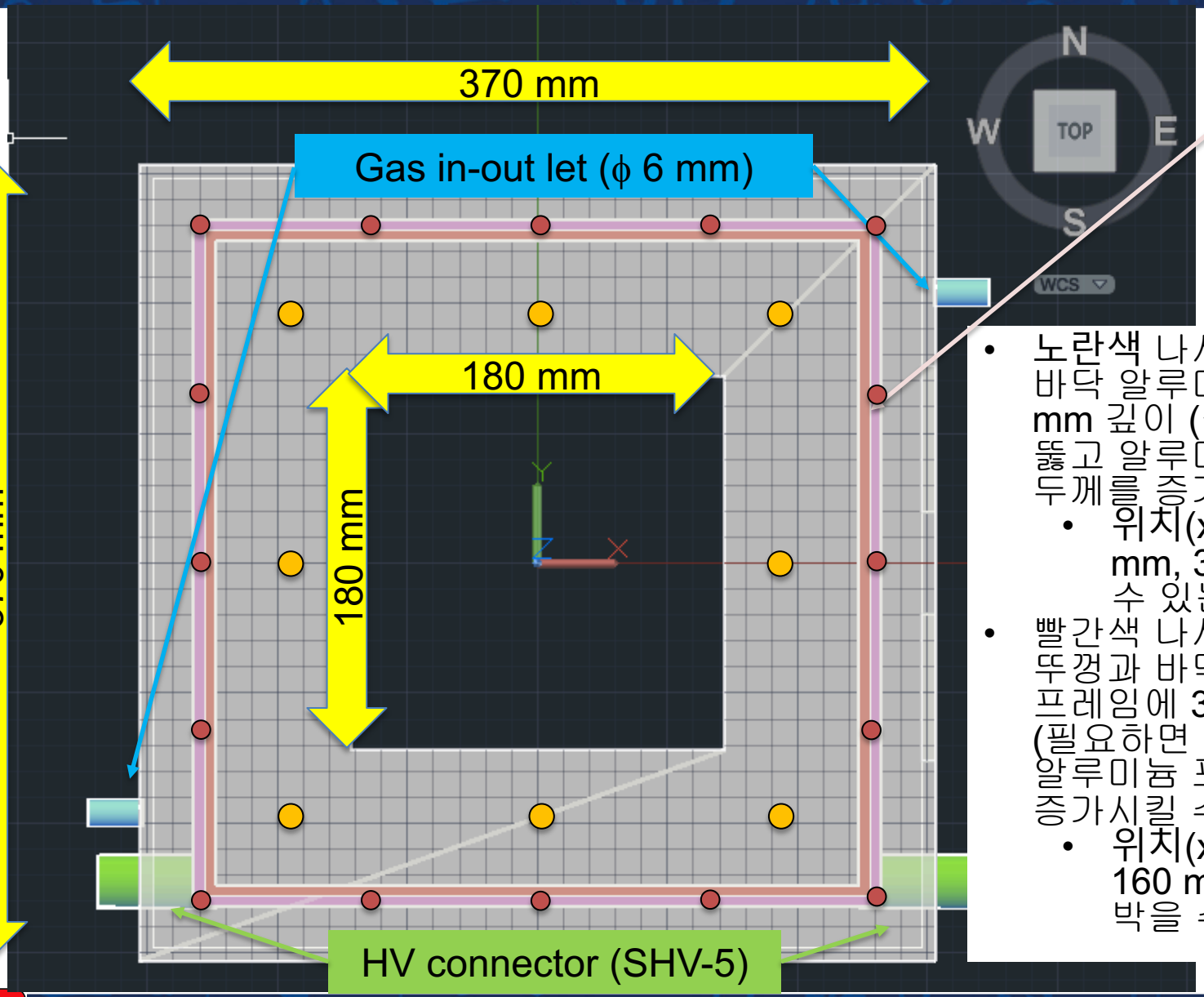
측면에서 바라 본 모양 (프레임에 낼 탭 구멍)



- **빨간색** 나사 부분 – 뚜껑, 바닥 모두 프레임에 3 mm 깊이로 뚫기 (깊이 조정 가능)
- 구멍 위에 5 T 두께, 사각틀 모양의 아크릴(또는 비절연성 재질) spacer 를 대고 위에서 나사로 고정 예정



뚜껑 위에서 내려다 본 모양 (나사 구멍 위치)

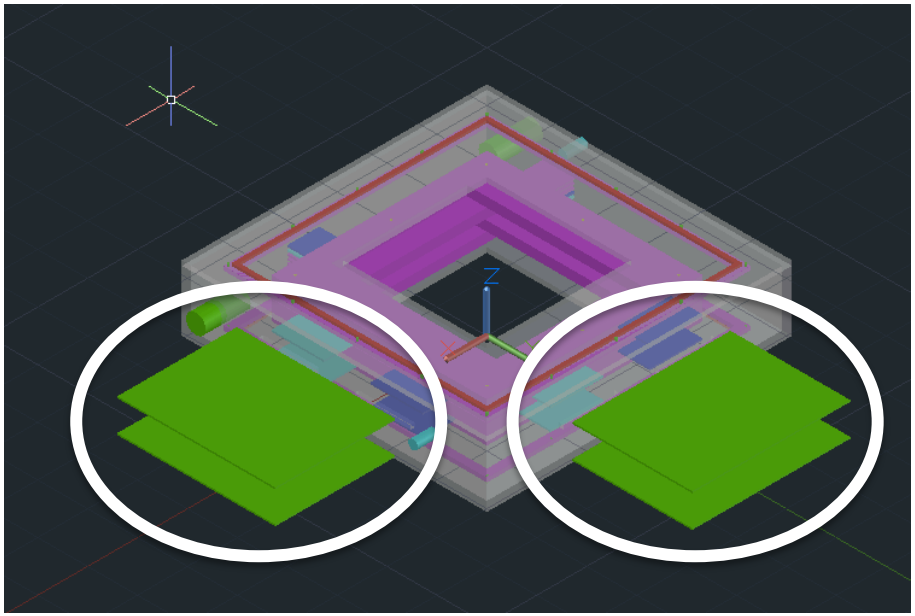


오링과 5T 두께의 스페이서

- 노란색 나사를 박을 구멍 – 바닥 알루미늄 프레임에 3 mm 깊이 (필요하면 더 깊이 뚫고 알루미늄 프레임 두께를 증가시킬 수도 있음)
  - 위치(x, y 축 기준 120 mm, 3T짜리 나사 박을 수 있는 구멍)
- 빨간색 나사를 박을 구멍 – 뚜껑과 바닥 알루미늄 프레임에 3 mm 깊이 (필요하면 더 깊이 뚫고 알루미늄 프레임 두께를 증가시킬 수도 있음)
  - 위치(x, y 축 기준 80, 160 mm, 3T짜리 나사 박을 수 있는 구멍)

기판 지지대

- 2개 측면에 2개 보드를 메인 프레임에 지지대를 이용하여 고정
- 구조는 연결할 각종 커넥터와 구멍을 막지 않으면 어떤 것이든 가능함



시제품용 기판 지지 방식

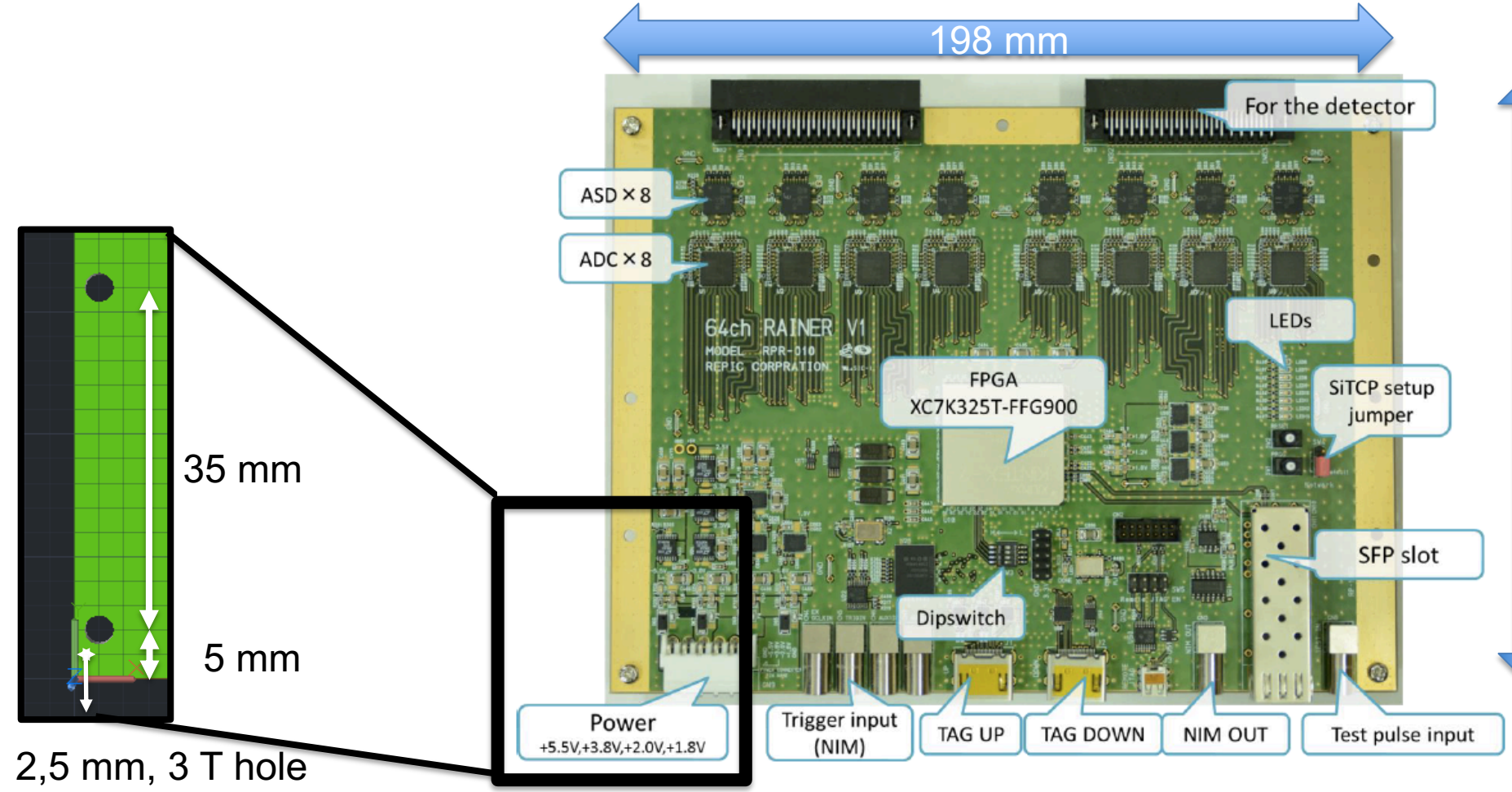
- cosmic muon test까지 가능하도록 프레임에 세워서 지지하는 방식으로

본제품용 기판 지지 방식

- If 기판이 0.2-0.3 T의 magnetic field와 진공 환경에서 동작이 가능하다면 (Anyone have answer?)
  - Y : vacuum chamber 안에 위치(보드와 검출기의 거리는 가까워야 함), 보드는 눕히는 방식으로 공간 최소화
  - N : ASD 보드는 vacuum chamber 외곽에 위치해야 함

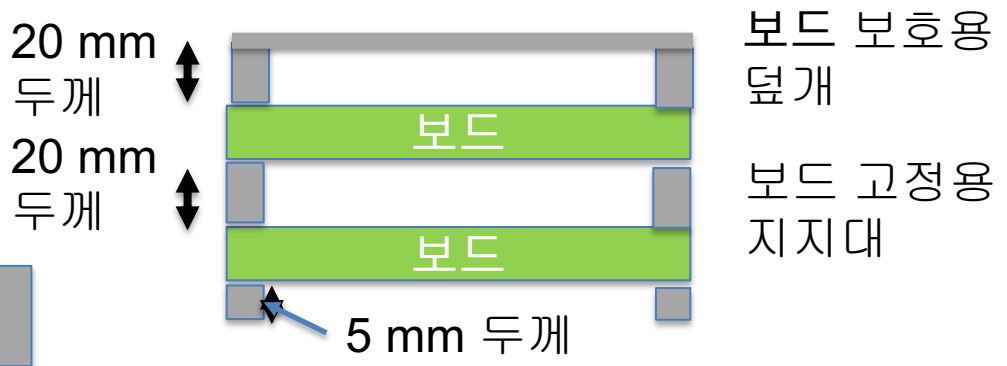
고정 시킬 기판의 정보

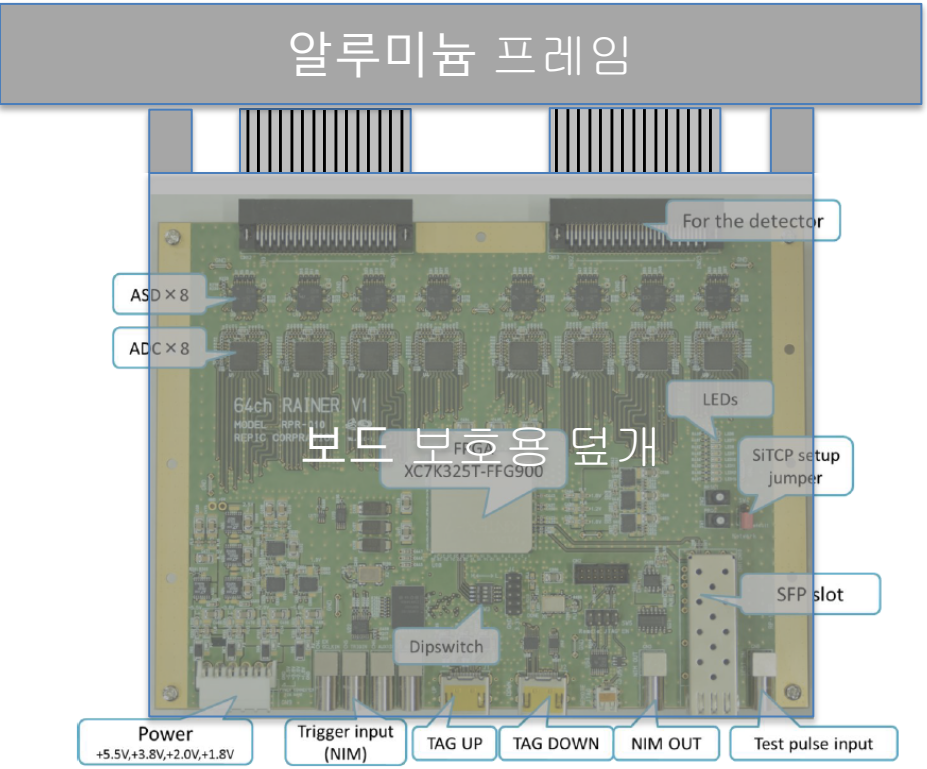
- 두 측면에 이런 기판을 **2**층으로 고정해야 하고,
- 기판 사이 **20 mm** 이상의 차이는 둬야 함

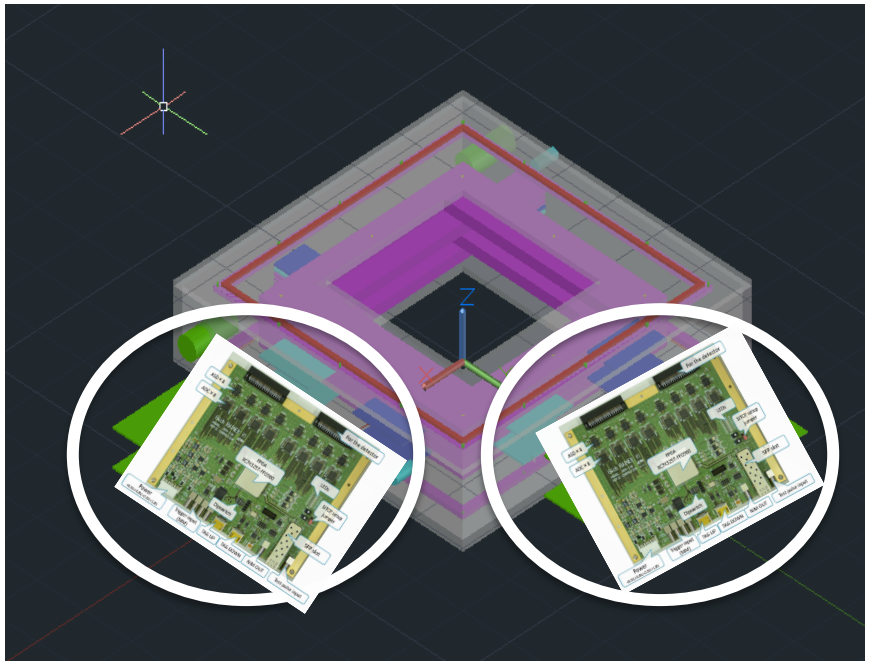


기판 지지대

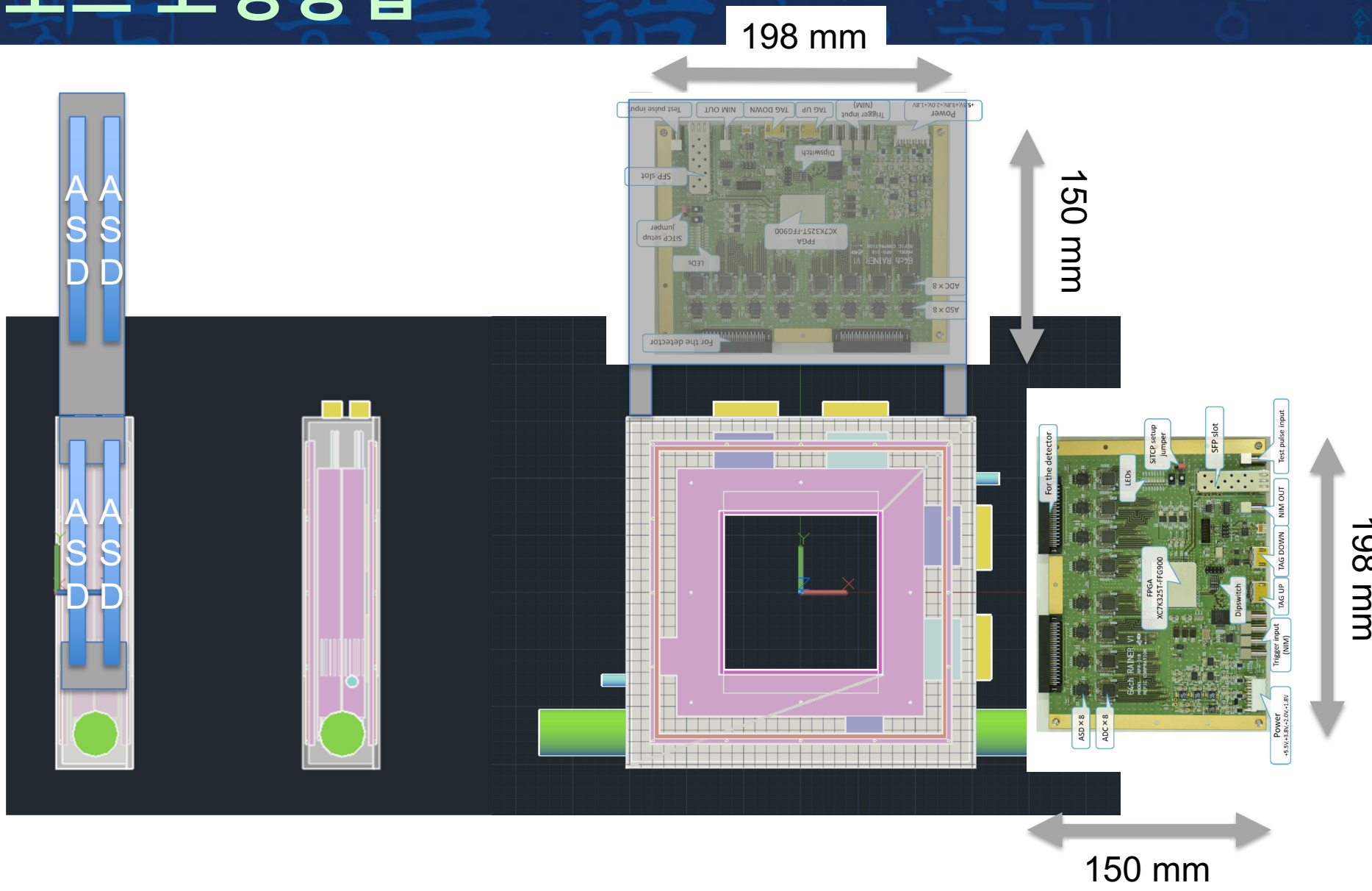
- 보드의 **IDC** 커넥터가 프레임에 가까운 쪽으로 향해 있어야 함







보드 고정방법


198 mm
150 mm
ASD
ASD
ASD
ASD
For the detector
LEDs
SiTCP setup jumper
SFP slot
Test pulse input
NIM OUT
TAG DOWN
TAG UP
Trigger input (NIM)
Dipswitch
FPGA XC7K325T-FFG900
ASD × 8
ADC × 8
Power
198 mm
150 mm

예상 견적 내용

총 1억 5000 만원 예상

BDC 본제품 제작을 위한 견적서

No.1	품 명 및 규 격	단위	수량	단 가	금 액	비고(발주처정보)
1	outer frame (내부 wired chamber 제외)	식	2	20,000,000	40,000,000	영하이테크 (백병창 : 042-635-2845)
	-.400mm*400mm*100H (15T)					
	-.Chamber Wall electro polishing					
	-.설계및 제작					
	-.Vacuum Test					
	Flange					
	-.SHV CF1.33", DC5KV10A	ea	4			
	-.SUB-D ,37pin	ea	16			
	-.outside Plug & inside Plug	조	2			
	Chamber 제작을 위한 각종 잡자재 및 인건비					
2	ASD boards	개	7	10,000,000	70,000,000	Hayashi-Repic Co., LTD.
	- 총 4개 소요, 3개 추가 주문(여분 1개)					https://www.h-repic.co.jp
3	chamber 거치대	식	2	2,500,000	5,000,000	영하이테크 (백병창 : 042-635-2845)
4	와이어(길이 270 m), 운송비 포함		1	2,500,000	2,500,000	California Fine Wire company
	- Signal : Au coated Tungsten (20 micron)					https://calfinewire.com/request-quote/
	- Potential : Au coated Aluminium (80 micron)					
5	anode, cathode planes, spacers			2,000,000	2,000,000	이룸테크 (임도진 : 02-3281-2484)
	- anode : xy, x'y' 각 8매 이상					
	- cathode : 18매 이상					
	-spacer : 0.5 mm 간격 35매 이상					
6	Metalized mylar				1,600,000	G-Tech Corp. (Japan)
						goto@ggg-tech.co.jp
7	HV module (CAEN N 1471 HET)		1		8,000,000	오토텍
						http://atkinc.com/Introduction
8	LV modules	개	2	700,000	1,400,000	엘레파츠
						https://www.eleparts.co.kr/main/index
9	유량자동조절시스템	식	1	15,000,000	15,000,000	영하이테크 (백병창 : 042-635-2845)
10	각종 소형 부품 등 잡비용				4,500,000	
	- 기판 고정용 부품들					
	- Electronics까지 연결할 케이블					
	- 데이터 처리를 위한 DAQ 장비 등					
	소 계				150,000,000	VAT포함

Need 5 more

Hopeful plan for next

- Aug. 3rd : Order the outer frame, DAQ code check
- Aug. 4th : Assemble the inside chamber with 4 anode layers (KRISS)
- Sep. 1st : Assemble outside frame
- Sep. 2nd : Test with cosmic muons, try to wiring 4 anode planes
- Sep. 3rd : Try to wiring 4 anode planes
- Sep. 4th : Try to wiring 4 anode planes
- Oct. 1st : Assemble the second set + test

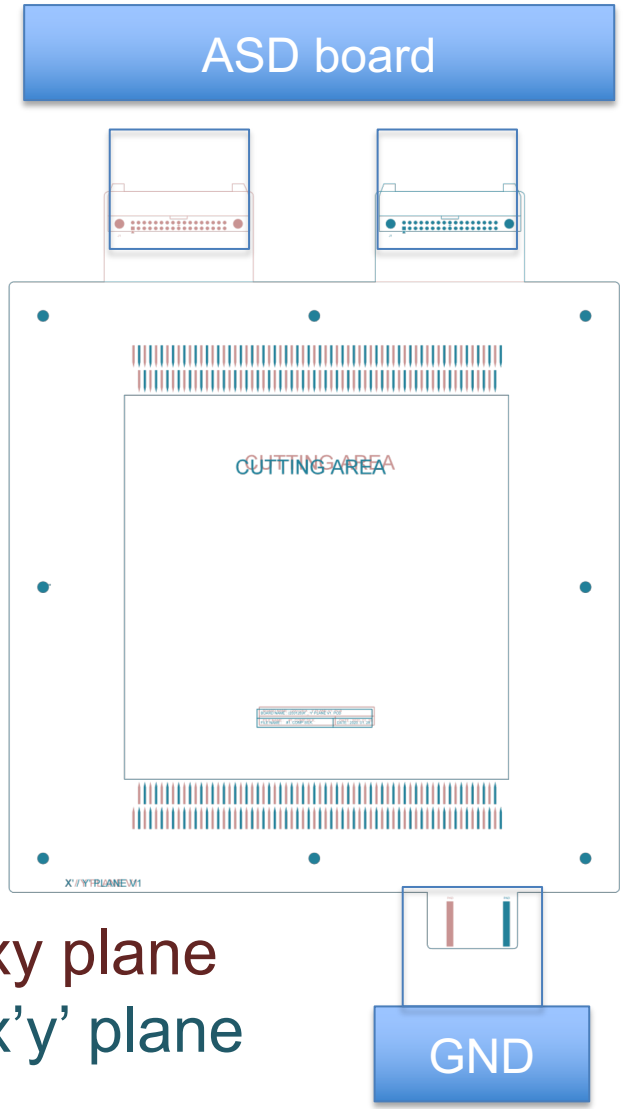
- Will continue, if we could

BDC crews are doing the best for the detector with good performance! Stay tuned!

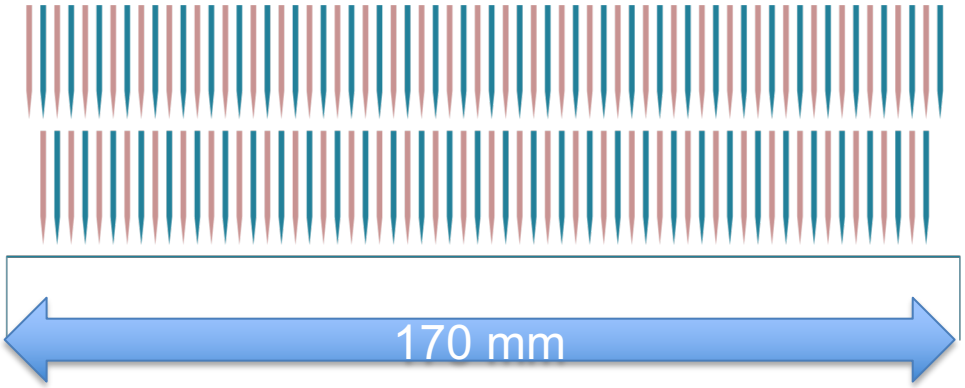
Animation, Montana Jones

Supplement matrials

Design of anode planes



Drift length : 2.5 mm

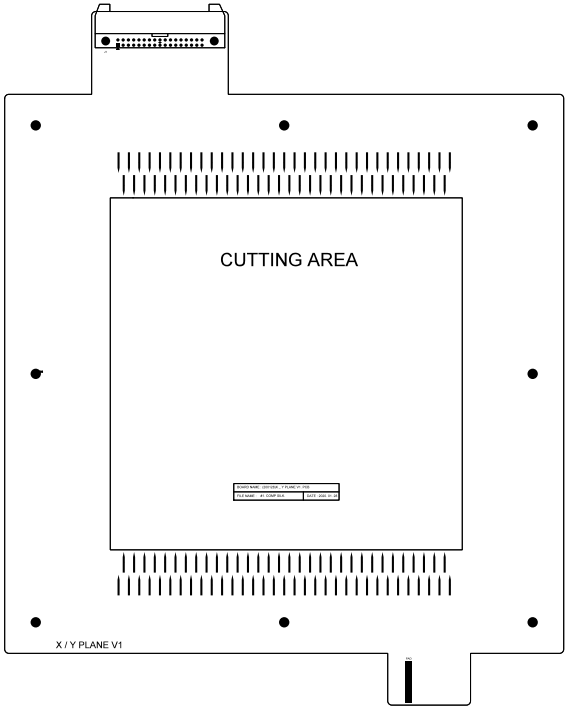


xy plane is shifted from x'y' plane
with 2.5 mm spacing

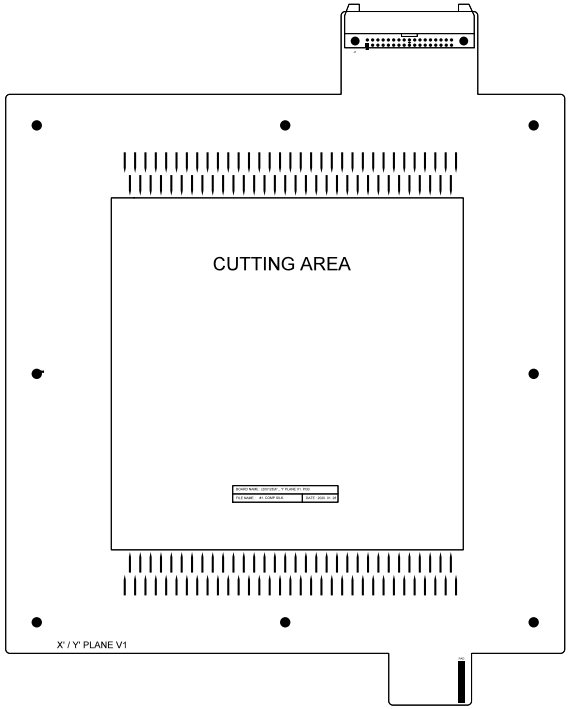
Designed by Sanghoon Hwang

Design of prototype BDC

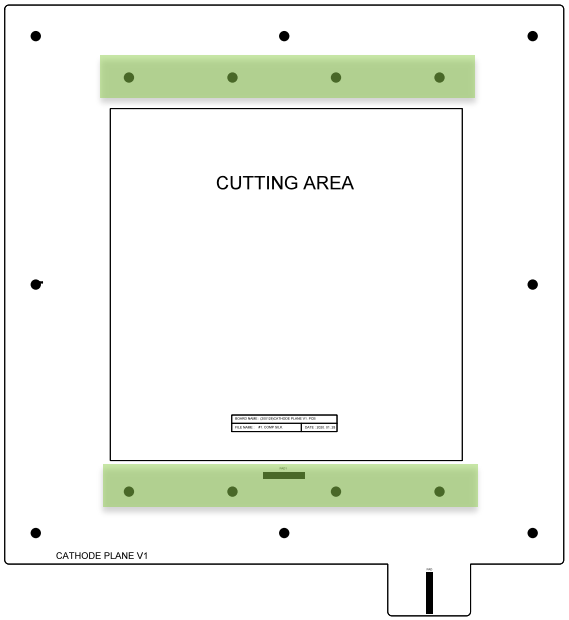
xy plane



x'y' plane



cathode plane



Holes for gas circulation

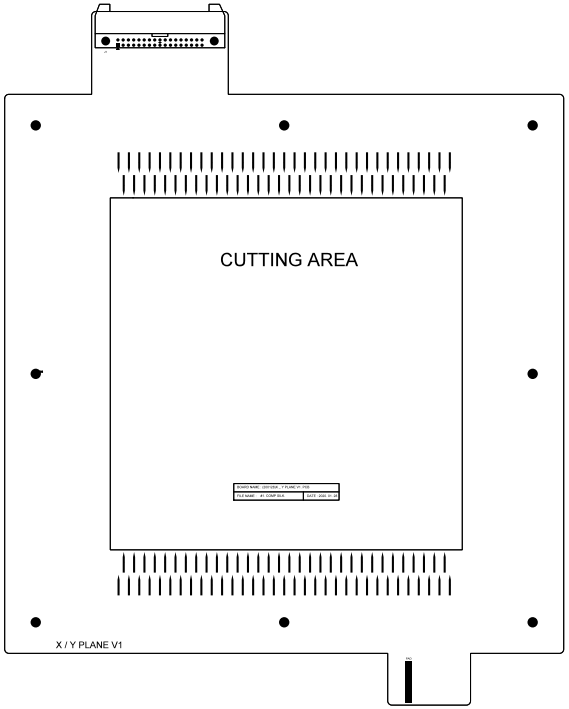
Designed by Sanghoon Hwang

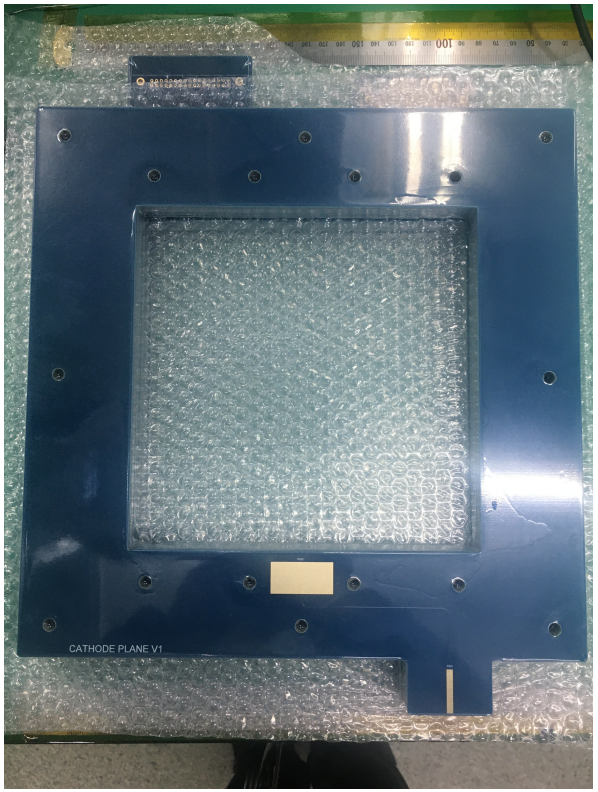
Gas가 순환하는데 이 구멍이면 충분한가?

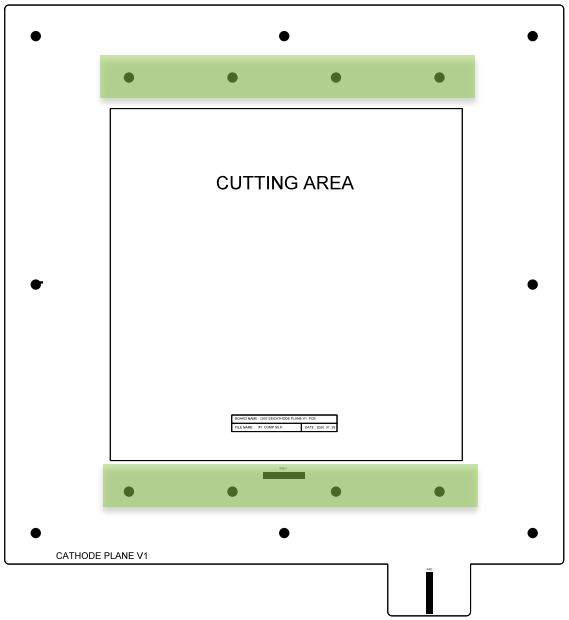
Design of planes

R : 1.5 mm

cathode plane







Holes for gas circulation

Designed by Sanghoon Hwang

Q) Gas가 순환하는데 이 구멍이면 충분한가?

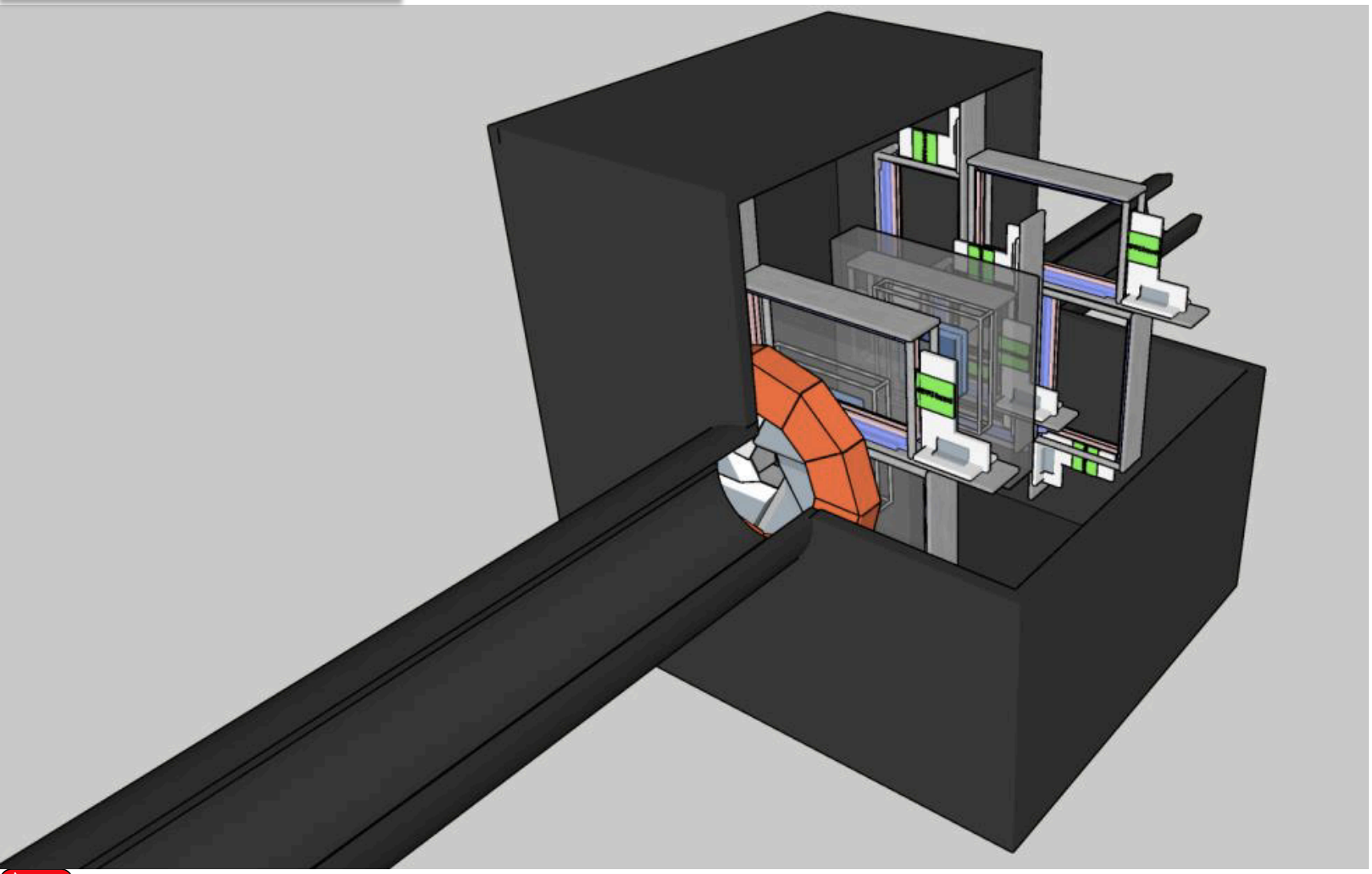
Applied gas to chamber

- **P-10 mixed gas**
- **Pressure : 100 torr (same as the pressure inside the vacuum chamber)**
- **Needed volume**
  - Volume inside BDC : 37*37*7 cm^3 = 9.583 L
  - Structure's volume (planes) = 2.288 L
  - Estimated gas volume : 7.3 L / set
  - Circulation rate : ~ 200 mL / minutes (~ 300 mL / min in initialization step)
    - ~ 35 minutes / 1 circulation

New version of LAMPS design (이형준)

Vacuum chamber

Cylindrical shape -> rectangular shape

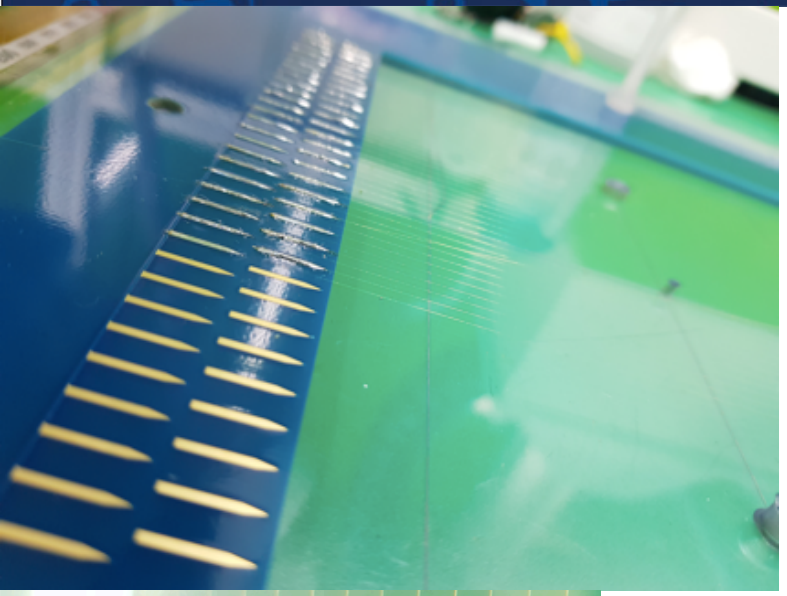


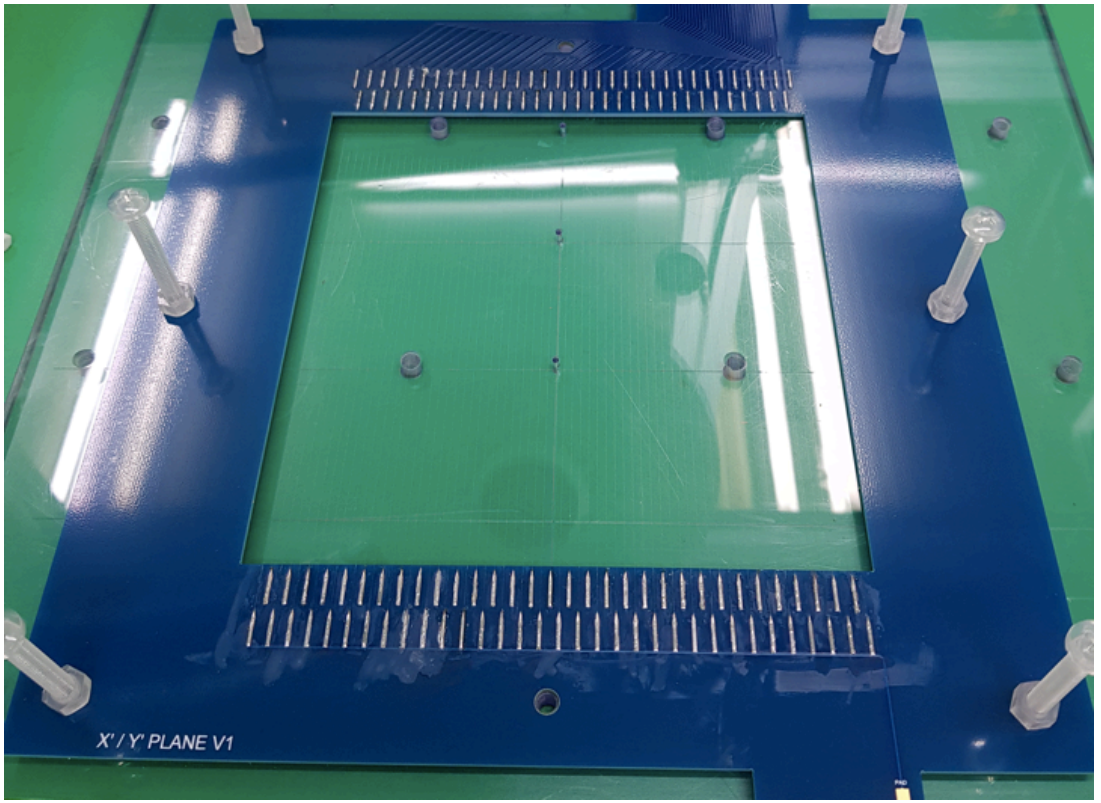
Setup for wiring in clean room, KRISS

- Jaein (undergraduate student) worked at KRISS in Feb. 10-14

Wire thickness : 16 μm
Gold coated tungsten wires
for signal and potential wires

Plane after wiring





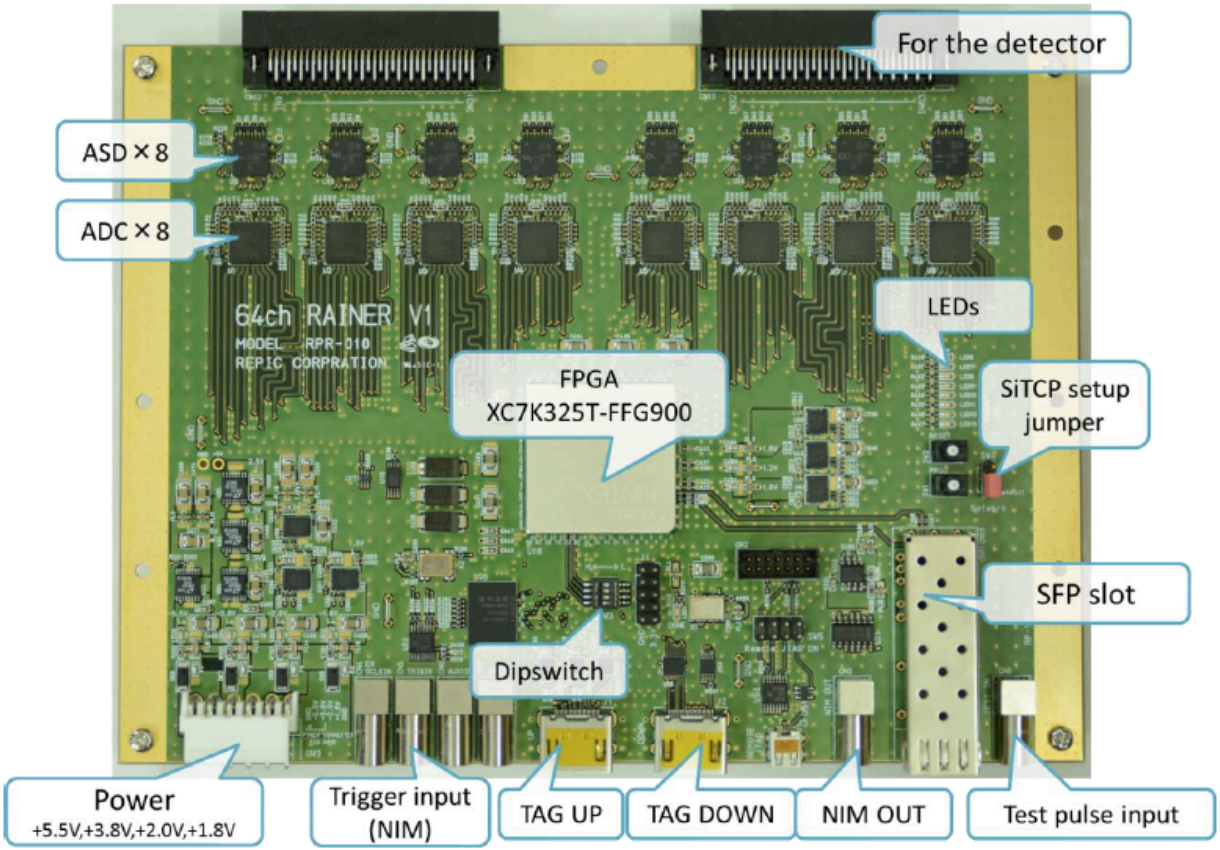
Wiring is done in 1 xy plane and 1 x'y' plane

Next step for prototype BDC

- **Cleaning and assembly chamber**
  - Clean wired planes in the machine
  - On the cathode plane, attach the metalized mylar
  - To keep 2.5 mm spacing between mylar and wires, attach the spacer (0.5 mm thickness)
  - And assembly chamber for the test
    - Cathode-xy plane-Cathode-x'y' plane-Cathode

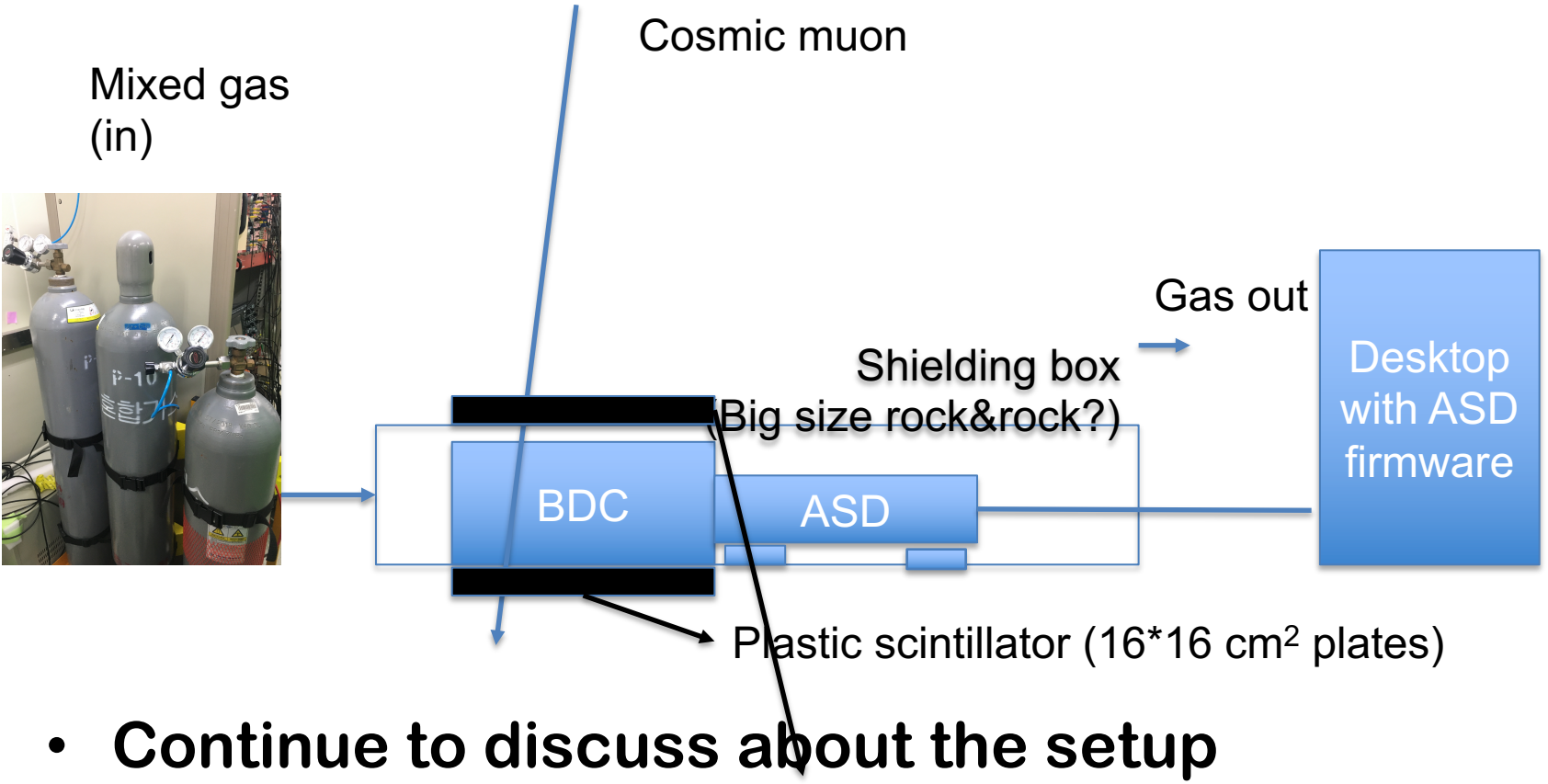
- **Hope to continue in next week..**

Preparation of ASD board test



- Power input connector : S6P-VH
- 6 wires should be connected (GND, +5.5V, +3.8V, +2.0V, +1.8V, GND), Maximum current : 5A
- 2 * 2 channel power supply are needed
  - 1 from KRISS, 1 will be ordered

(Preliminary) setup of the prototype BDC test



- **Continue to discuss about the setup**