AT-TPC prototype

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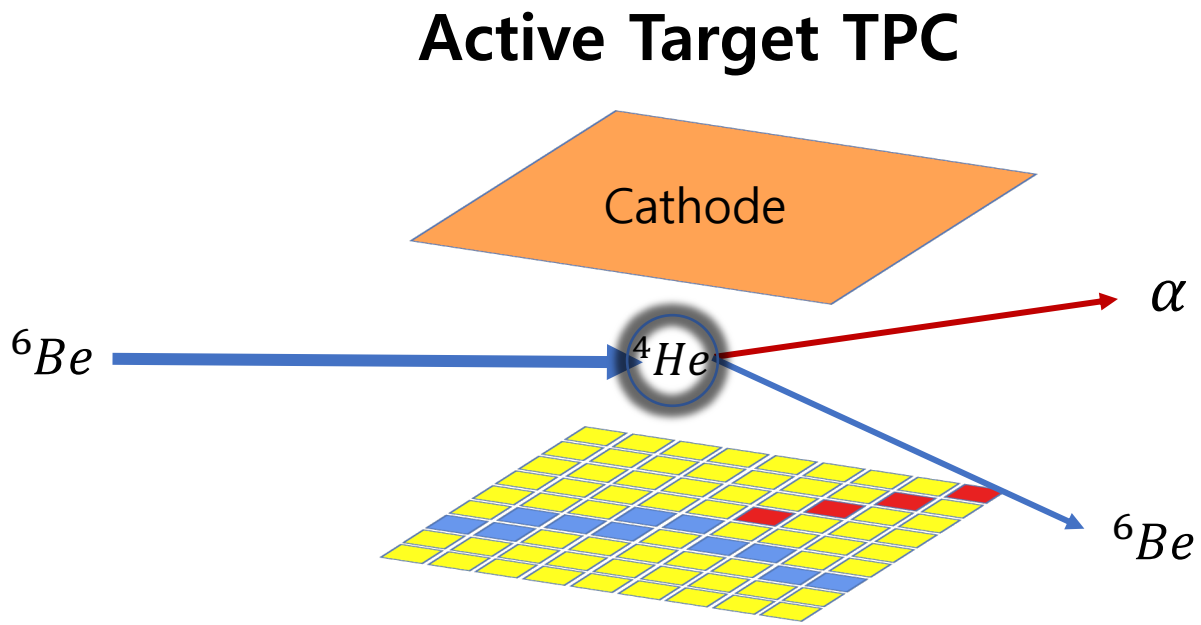
LAMPS WORKSHOP/2019.7.5

Introduction



- Low-Energy LAMPS 실험을 준비 중
- α, Proton, Oxygen 등이 scattering하는 것을 측정하려고 하는데,
  AT-TPC는 기존의 TPC와는 달리 drift gas가 바로 target이 됨
- 이를 위해서 AT-TPC (Active Target Time Projection Chamber)가 필요

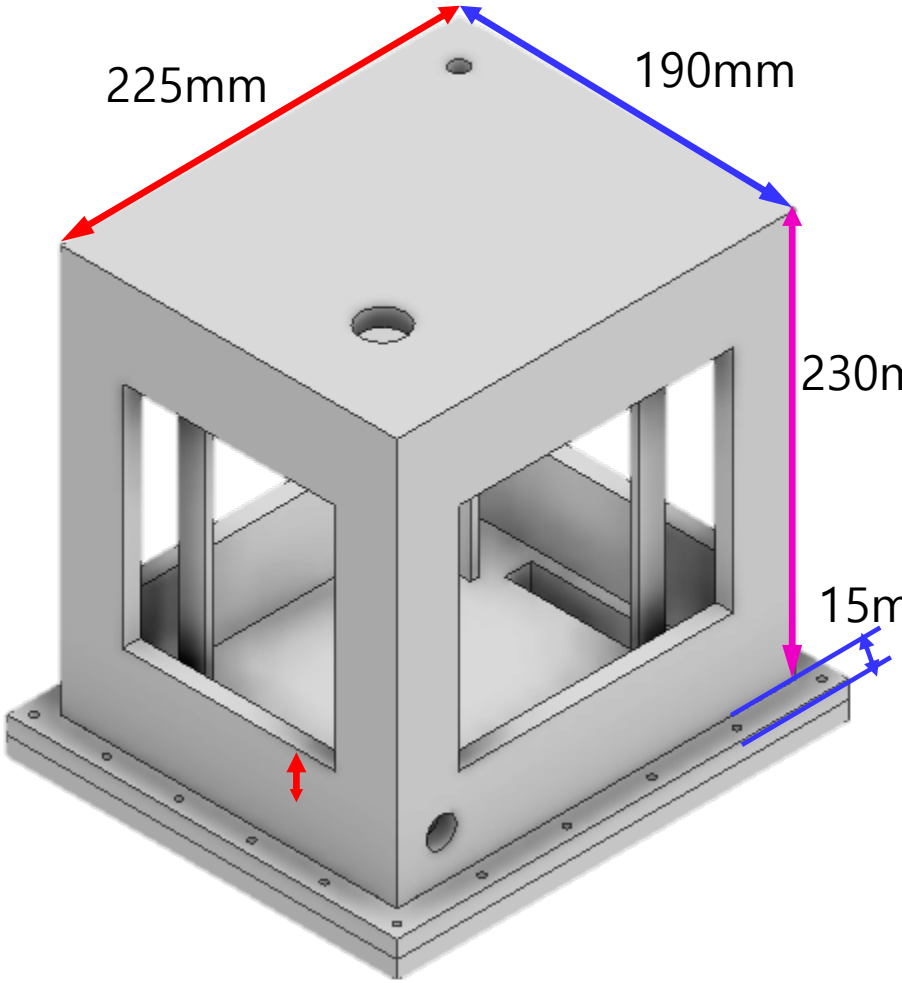
Introduction

현재 이 단계에 있음

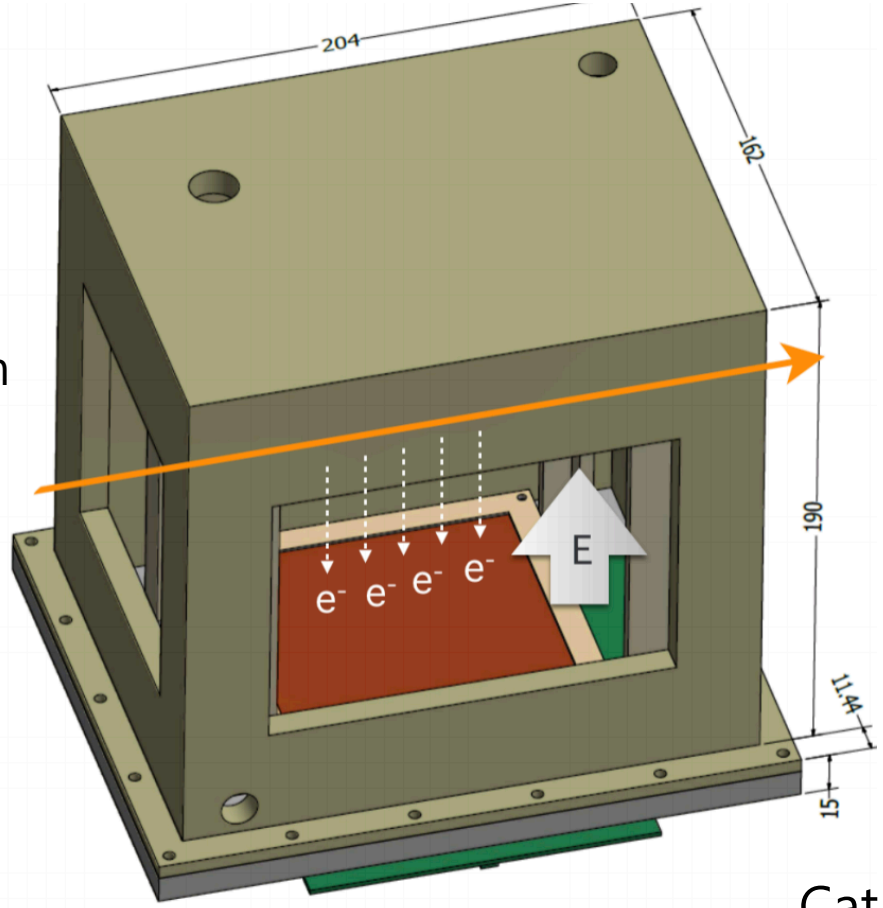
	19/04	19/05	19/06	19/07	19/08	담당
Field Cage	계획	디자인 E-Field	구매	시작품의 시작품 제작	테스트	?
Gas System	계획	디자인	구매 견적	제작	테스트	?
Readout Chamber	계획	디자인	구매 견적	제작	테스트	?
Geant4	계획	Event Gene	→	Geom	→	?
GET system	계획	테스트	→	→	→	?

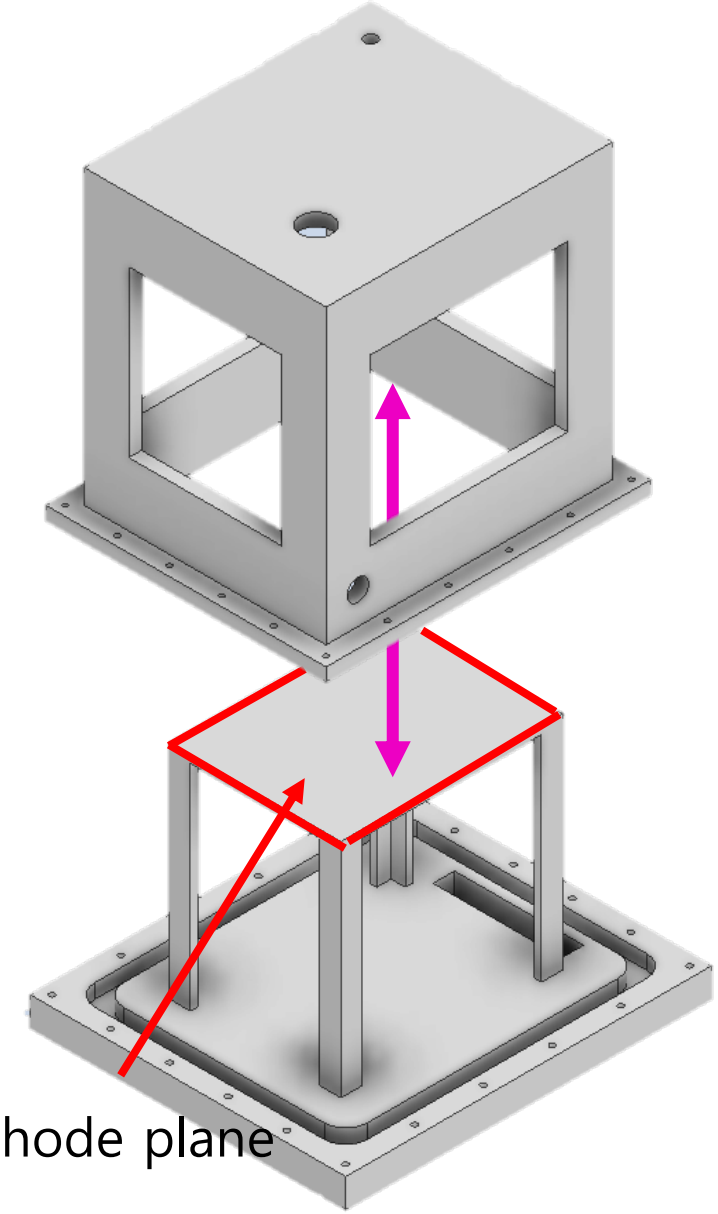
AT-TPC 설계/제작

Inventor 3D로 제작한 모형



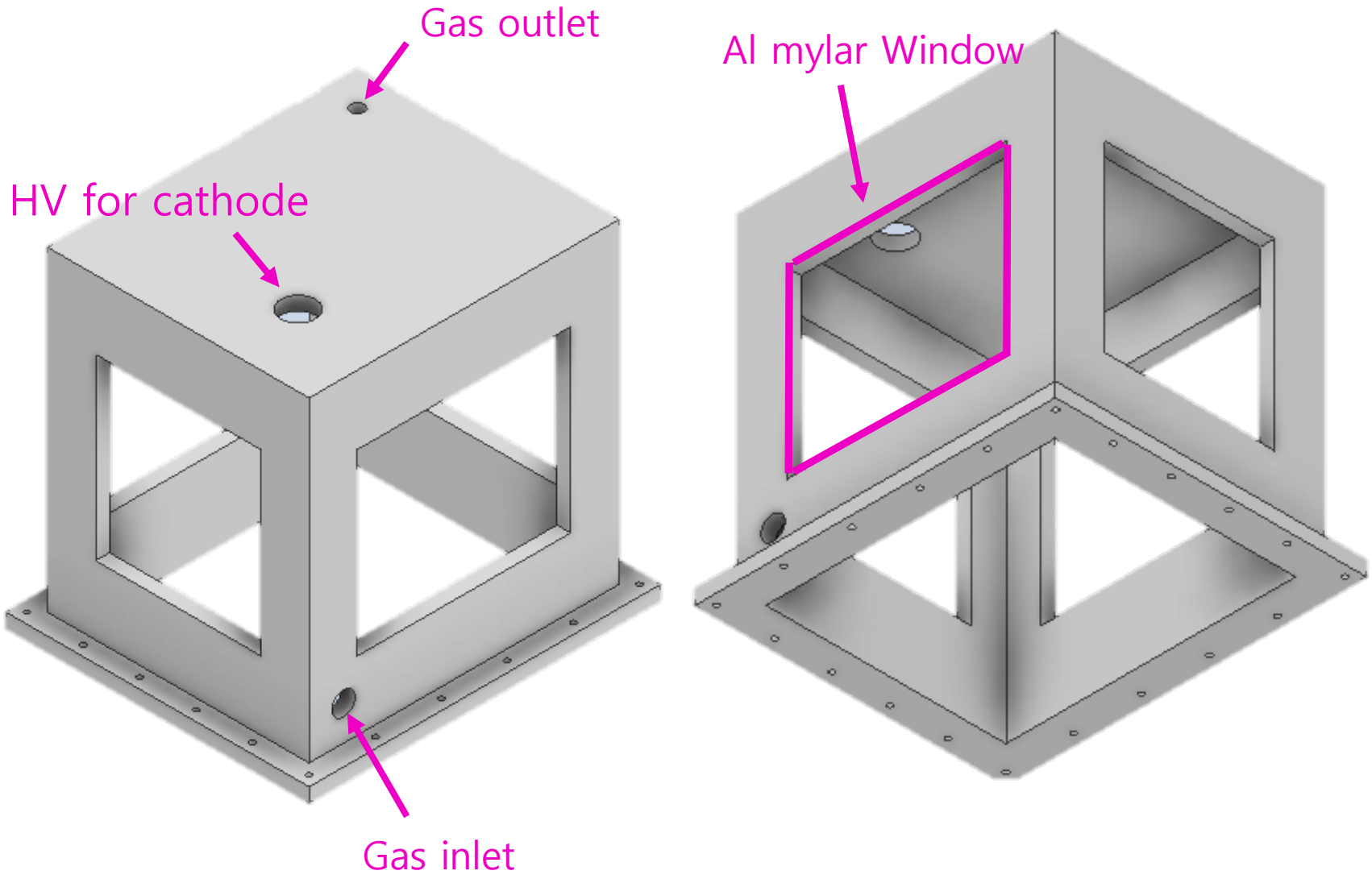
김신형님 KPS 슬라이드의 모형





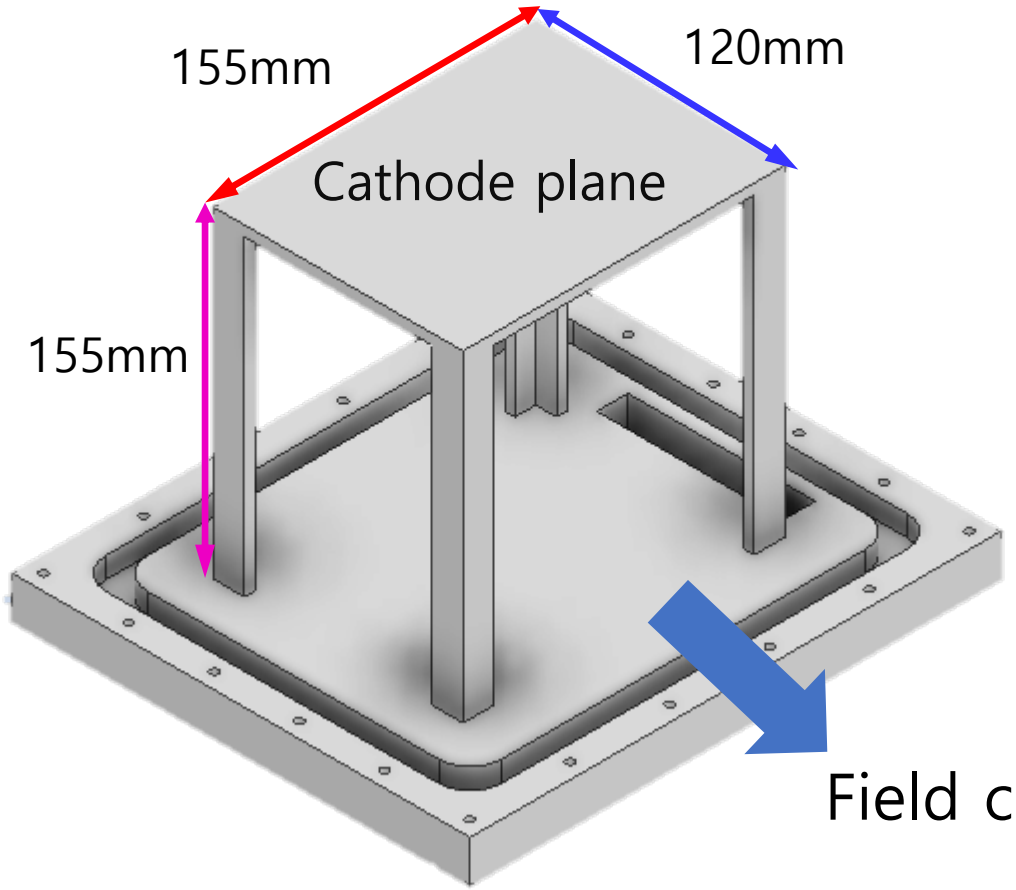
Cathode plane

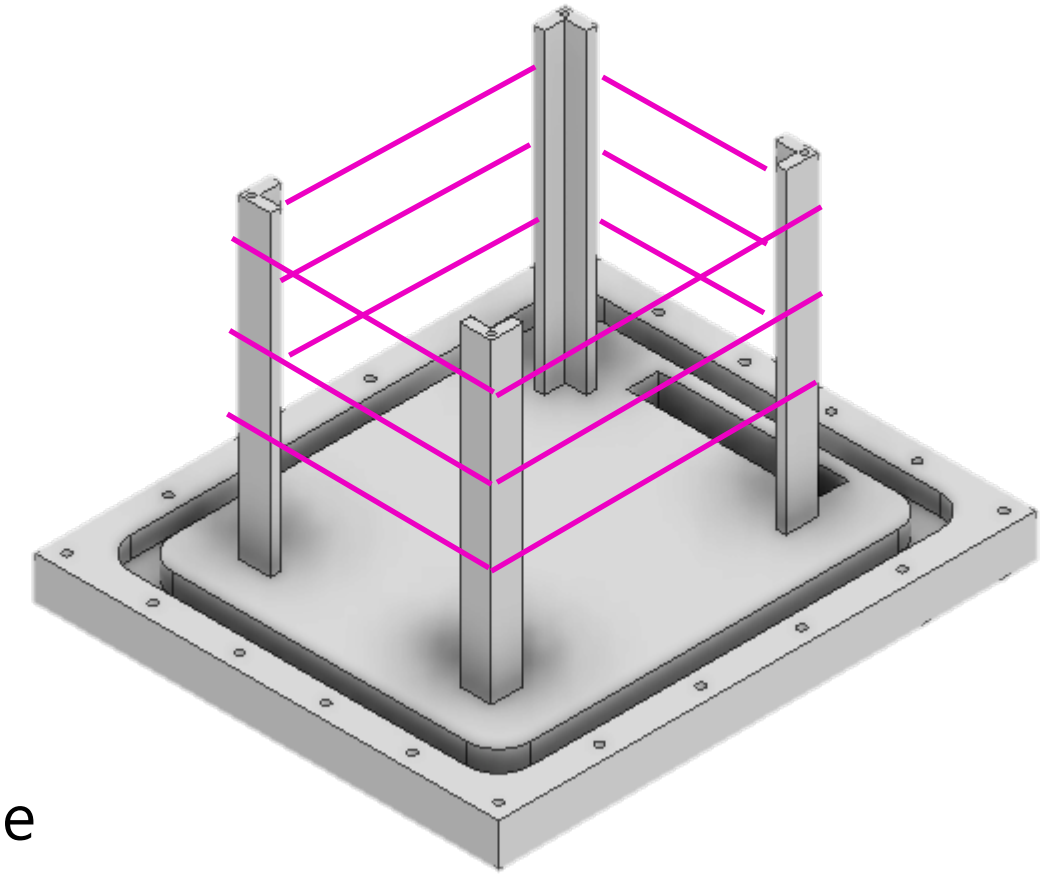
AT-TPC 설계/제작 – Gas Vessel



- Size 22.5x19x23 cm^3
- 알루미늄 프레임 + 알루미늄 마일라 윈도우
- 현재 '부일'에 견적을 받은 상태

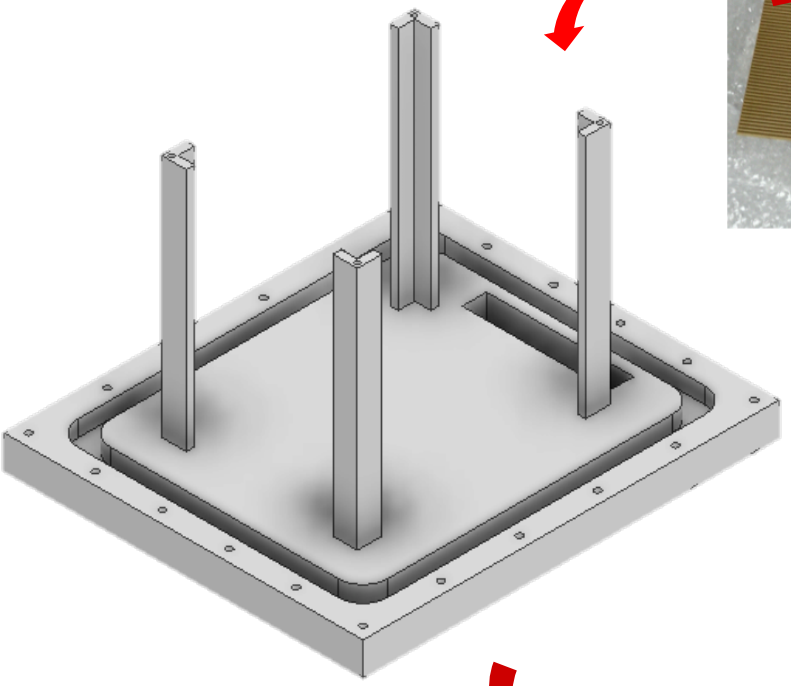
AT-TPC 설계/제작 – Field cage

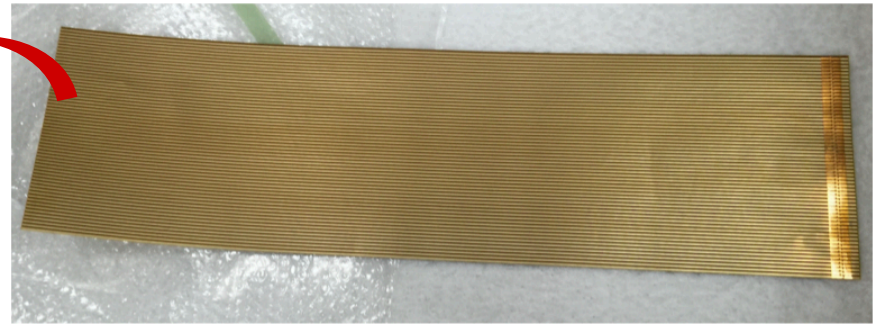


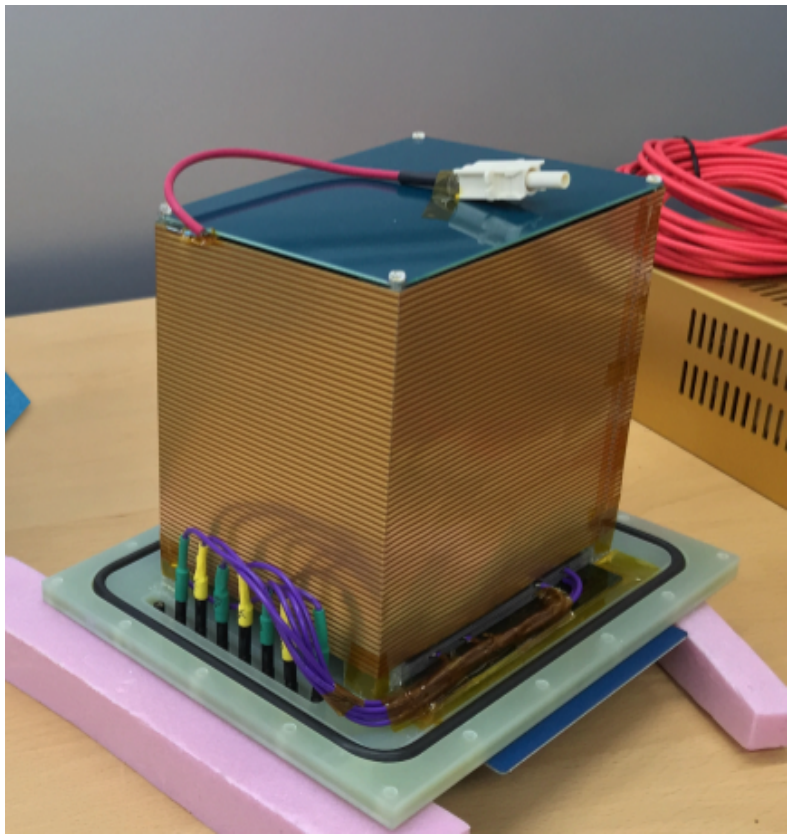


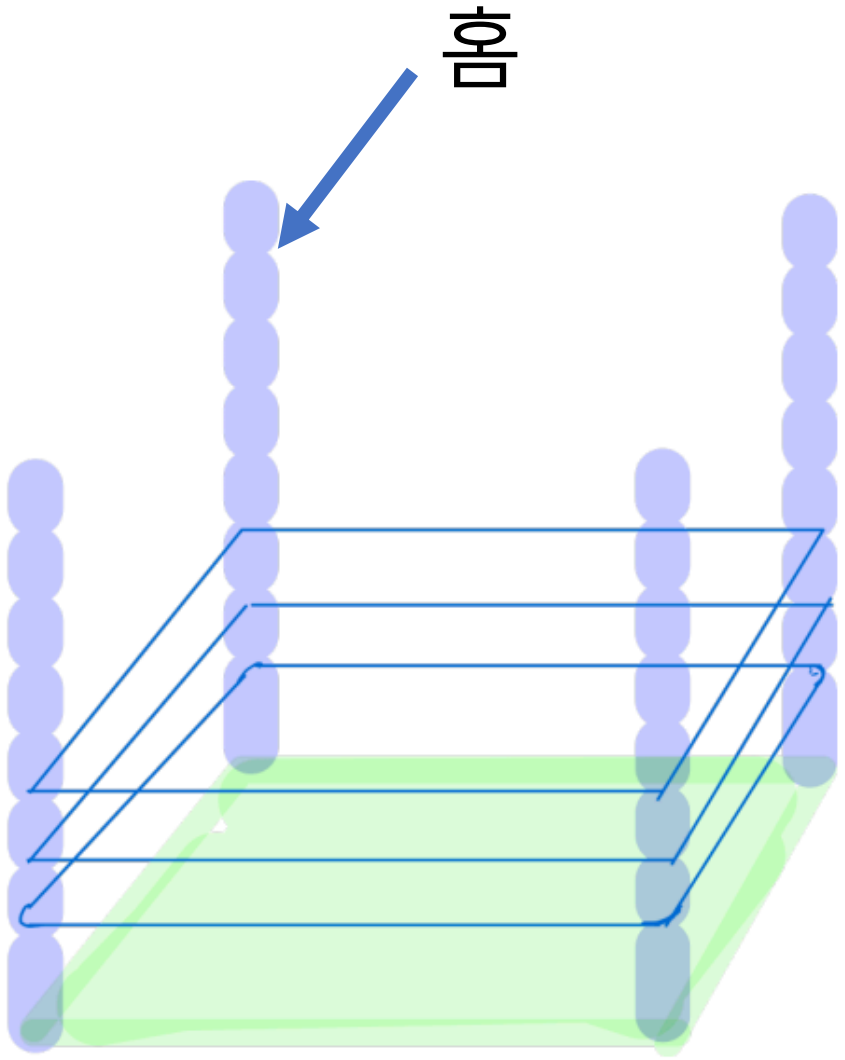
- G10 재질
- '일원 이엔피'에 견적 문의 진행 중
- 구리 선을 감을 계획이나 아직 기둥에 '홈'을 파지 않음

AT-TPC 설계/제작 – Field cage

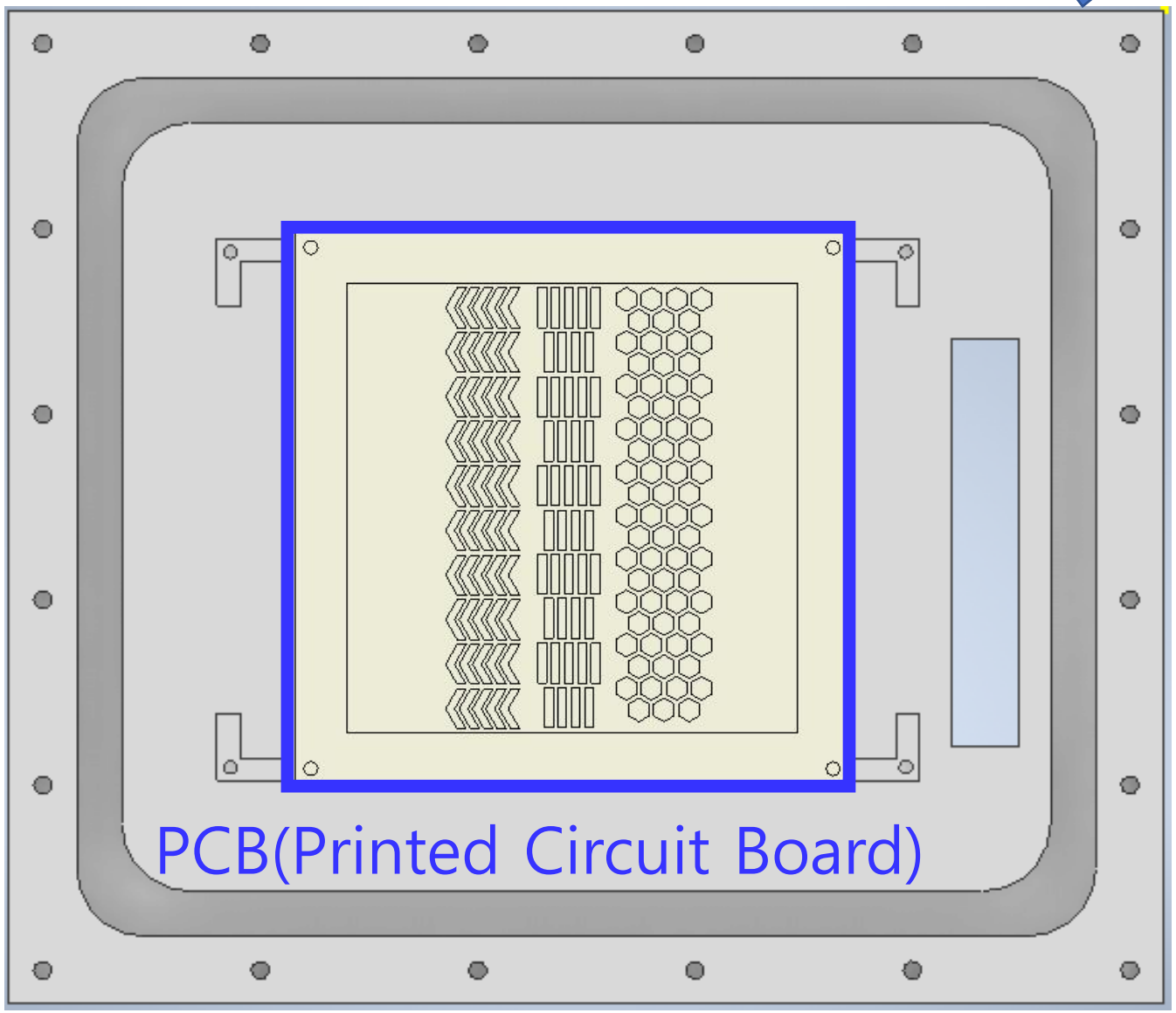


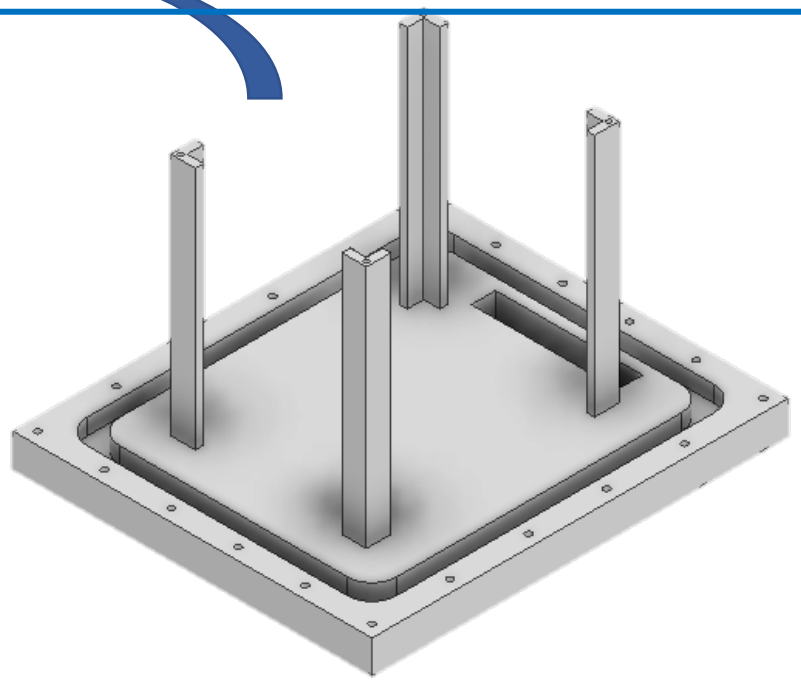






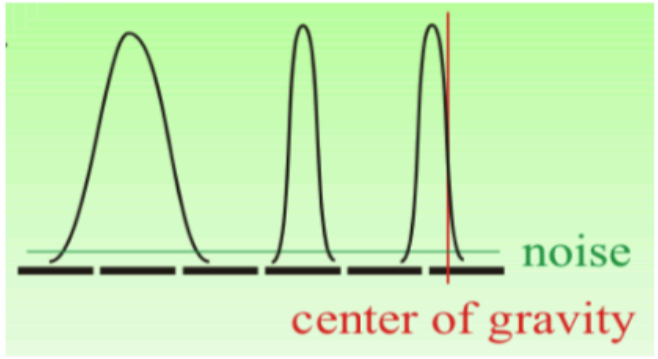
AT-TPC 설계/제작 - PCB

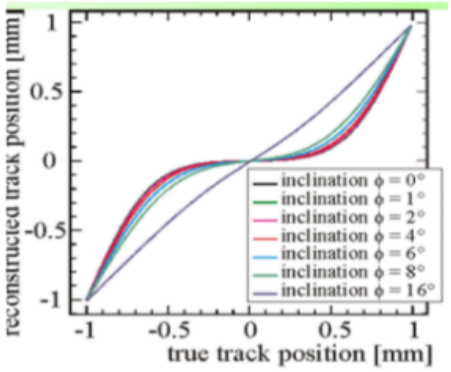


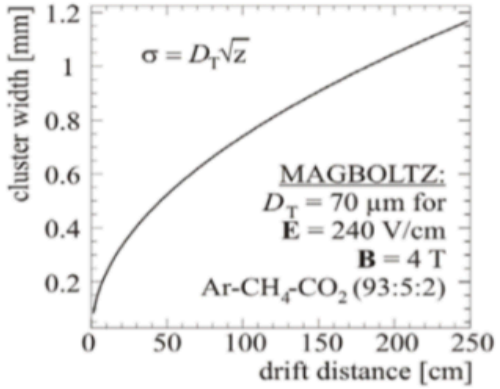


Pad shape study

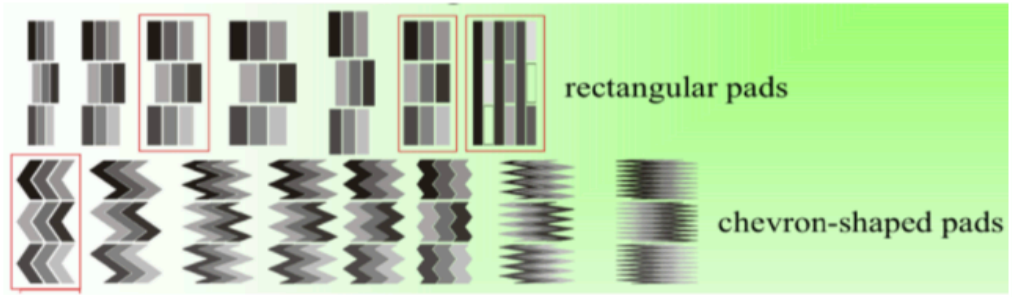
- Nice slides (but old) about pad shape study: link

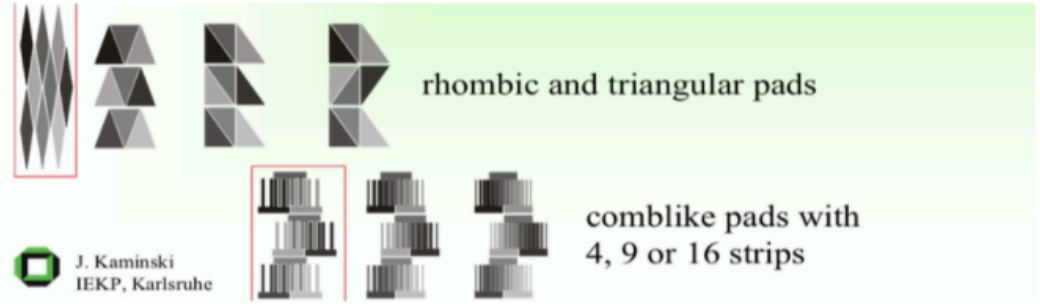






- Tested several shapes

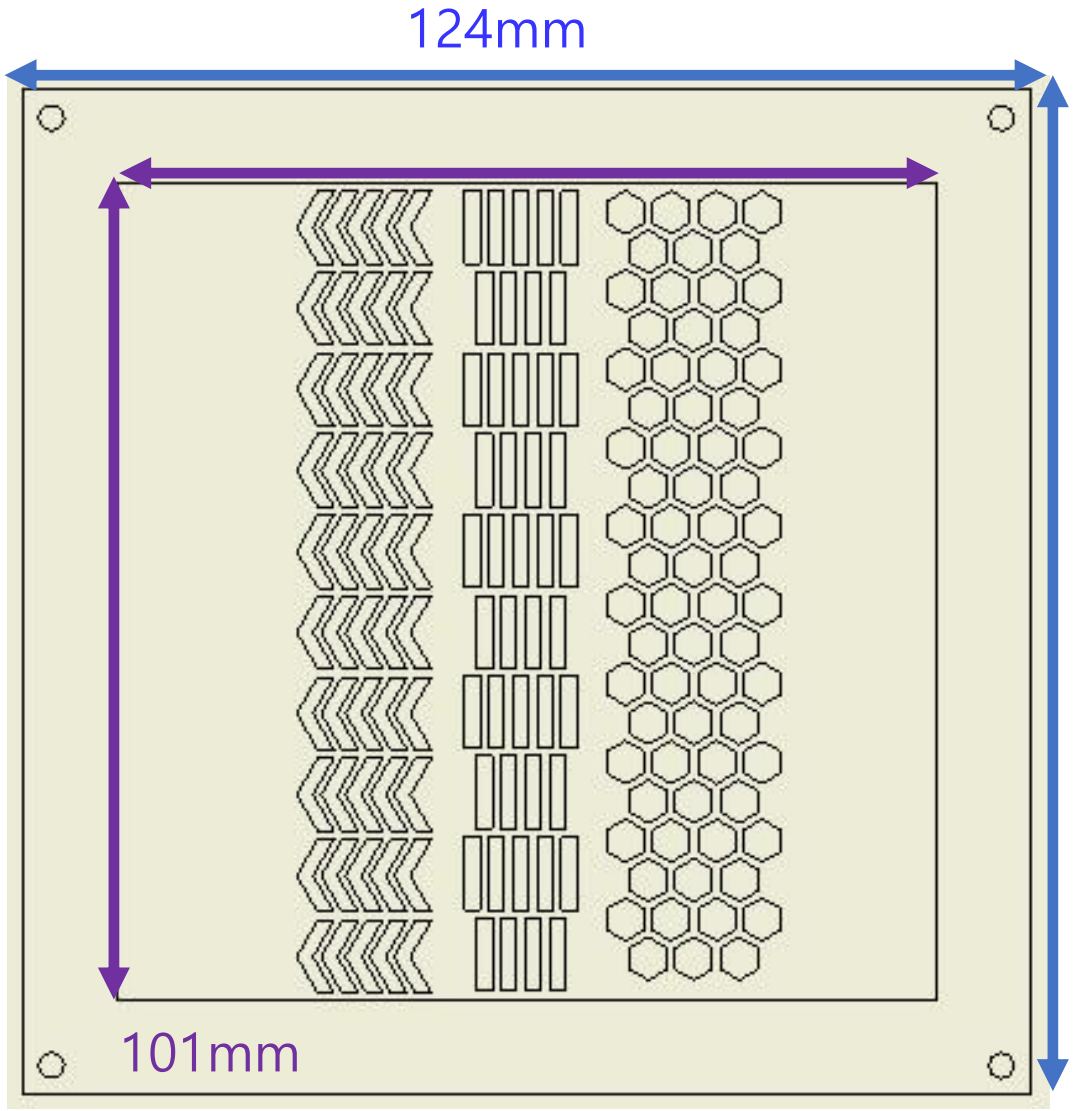


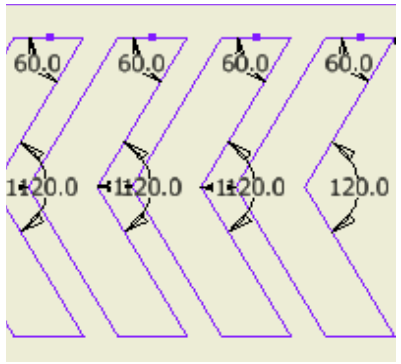


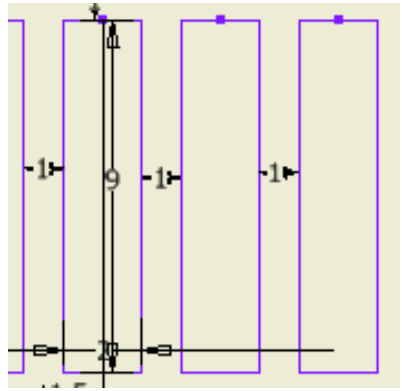
- Staggered rectangular pads give the best resolution, if the center of gravity algorithm is used for reconstructing clusters.

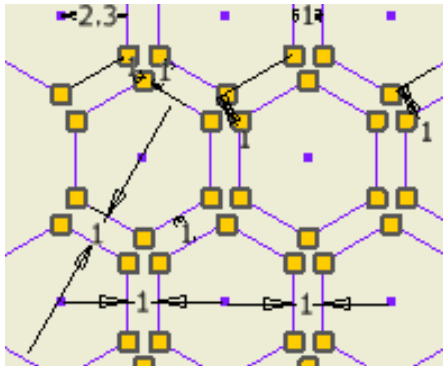
- Caveat: drift speed and dispersion is different from out experiment

AT-TPC 설계/제작 - PCB









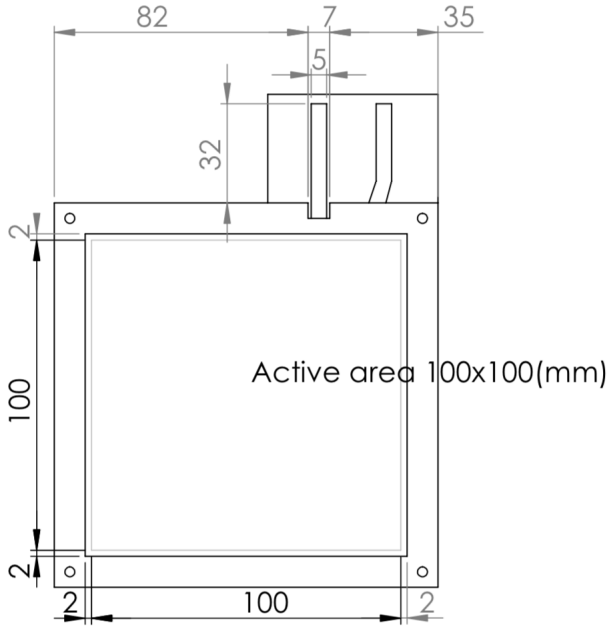
면적 : 18 mm^2
갯수 : 45개

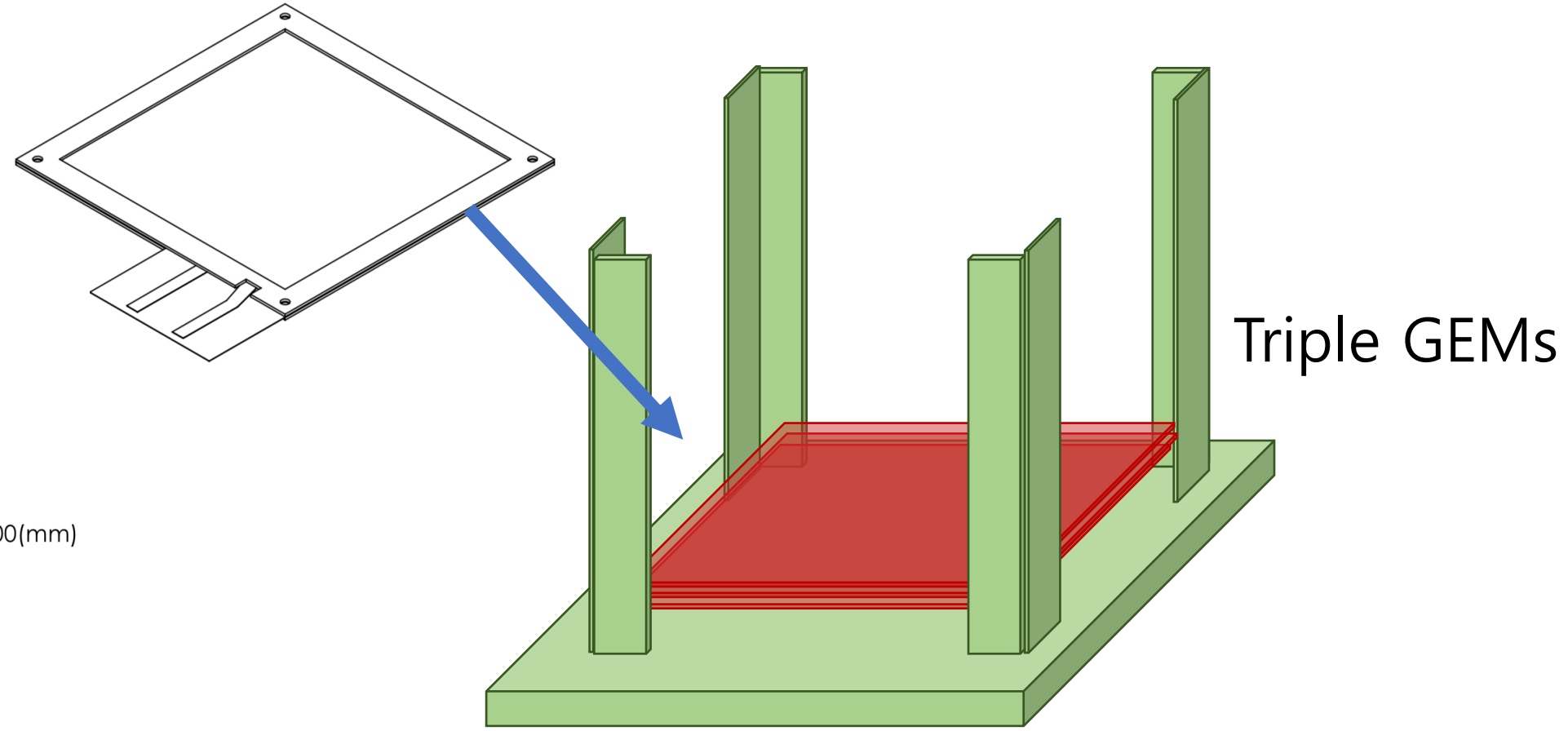
면적 : 18 mm^2
갯수 : 50개

면적 : 18.354 mm^2
갯수 : 70개

- 총 165개의 channels
- '이룸테크'에 견적 문의 진행 중
- Test를 통해 3개 중에 response와 position resolution이 가장 좋은 모양을 선택할 예정

AT-TPC 설계/제작 - GEM



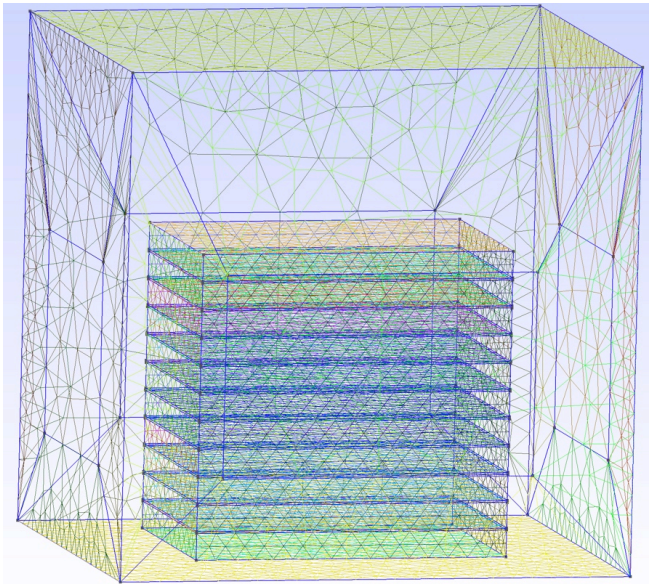


- 전달받은 Frame이 있는 GEM샘플을 토대로 다른 부품들의 사이즈를 결정하였음
- 현재 생산라인이 중단되어 8월 말에 실험에 사용될 GEM을 받을 수 있을 것이라 예상

Field simulation

Garfield++
(a toolkit for the detailed simulation of particle detectors)

WITH



Gmsh
(a finite-element mesh generator)

+

Elmer

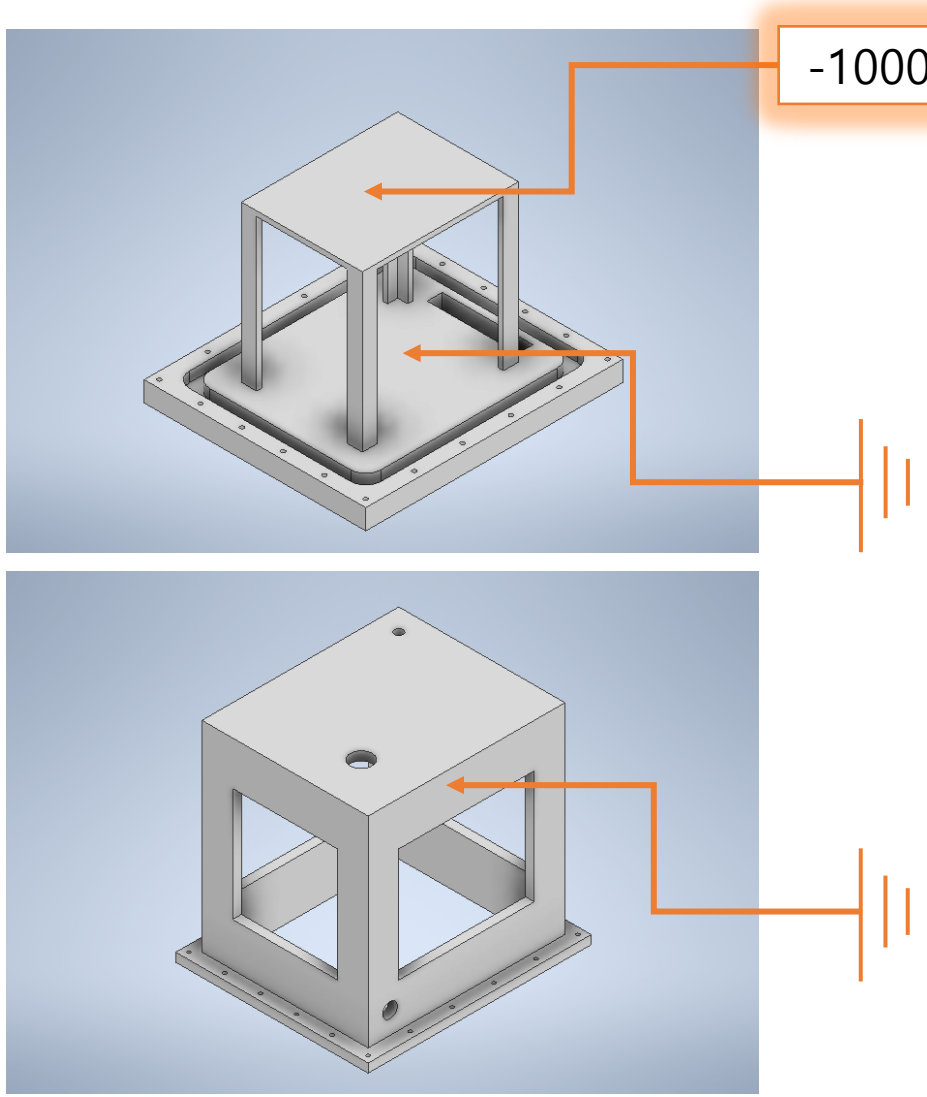
ElmerGrid
(a mesh conversion tool)
ElmerSolver
(The numerial solver)

Field simulation

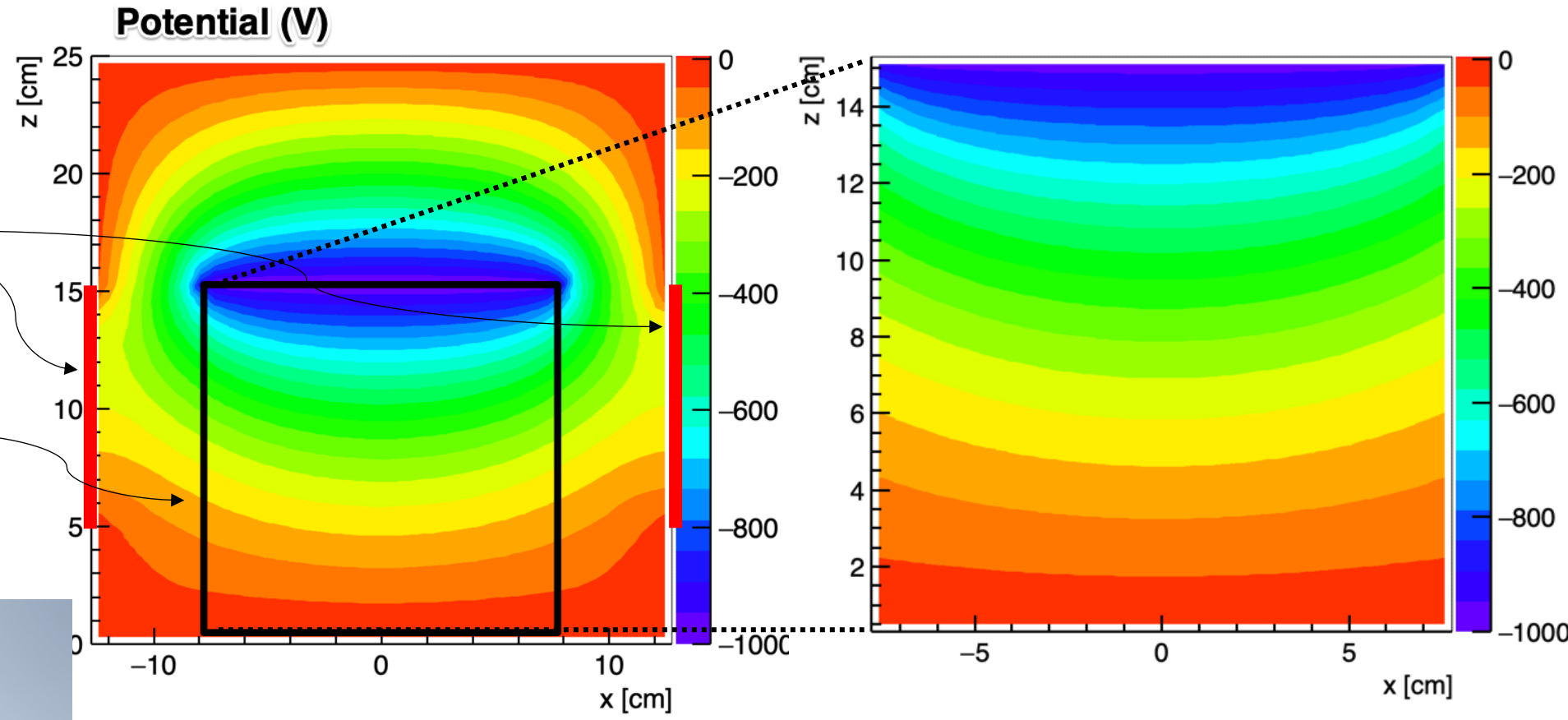
Medium Gas

- P10 (Ar 90% / CH4 10%)
- 298.15 K (25 ℃)
- 760 Torr (1 기압)
- Dielectric constant $\frac{\epsilon}{\epsilon_0} = 1$

Boundary Conditions

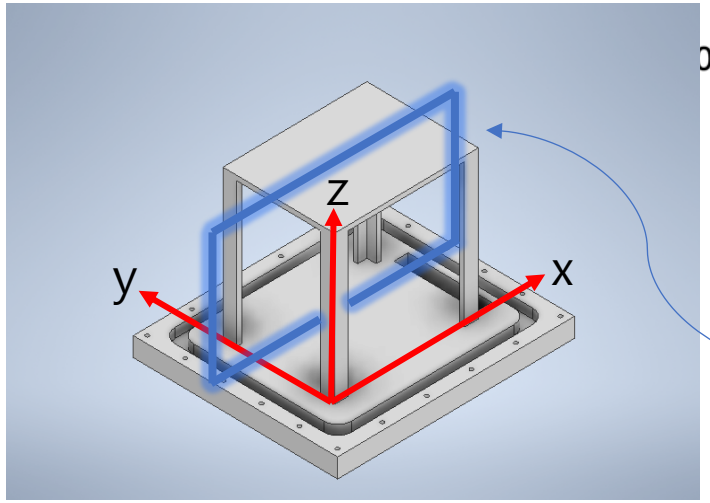


Field simulation *without Voltage divider*



Al mylar window

Field Cage

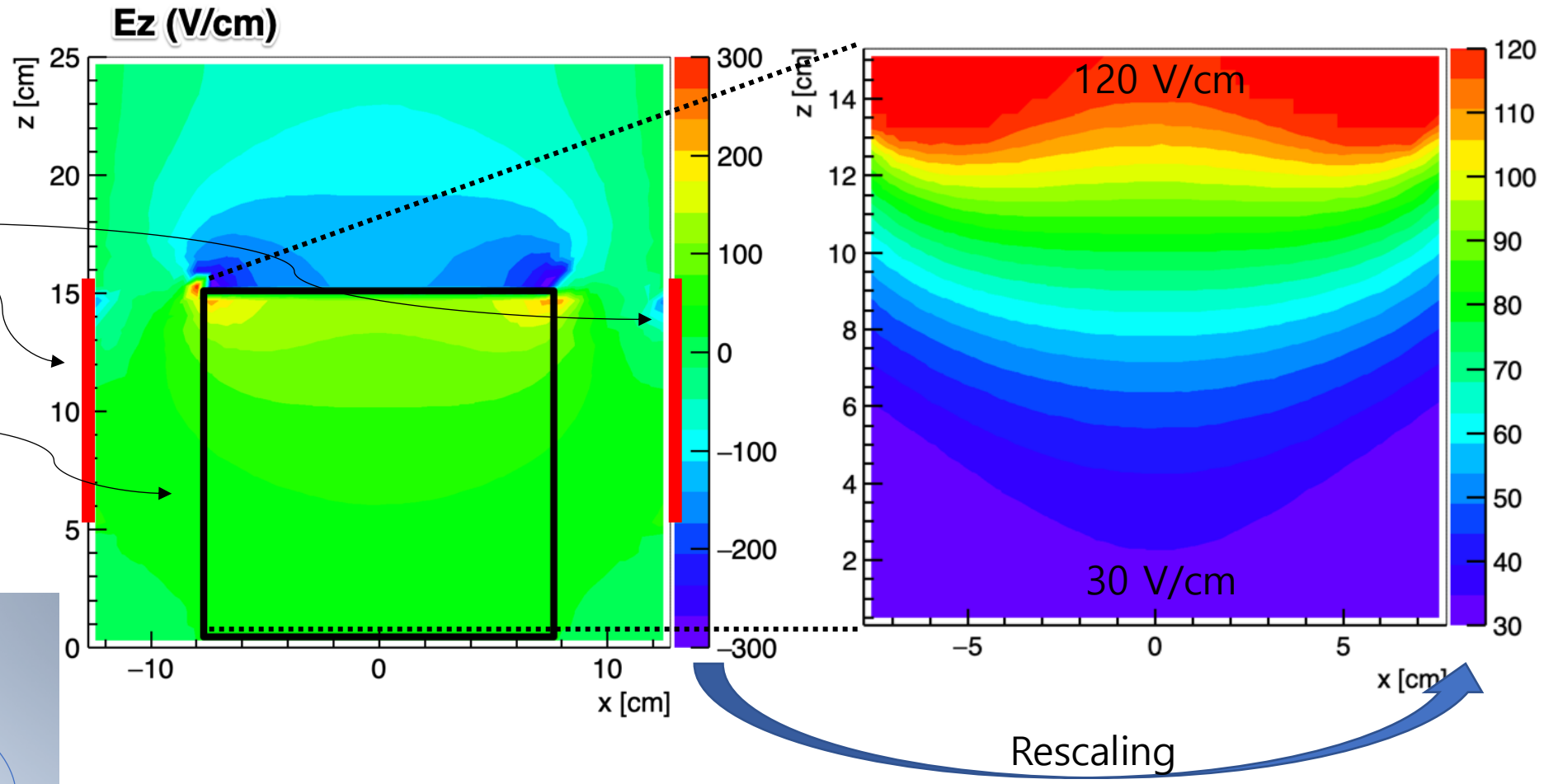


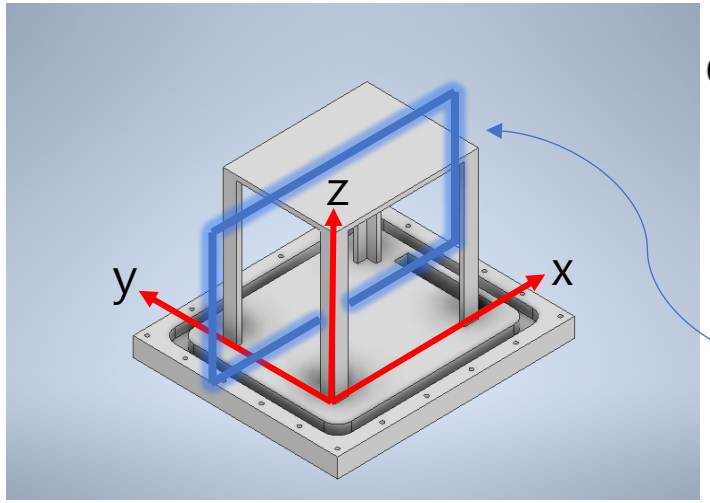
y is fixed at 0 (center)

Field simulation *without Voltage divider*

Al mylar window

Field Cage





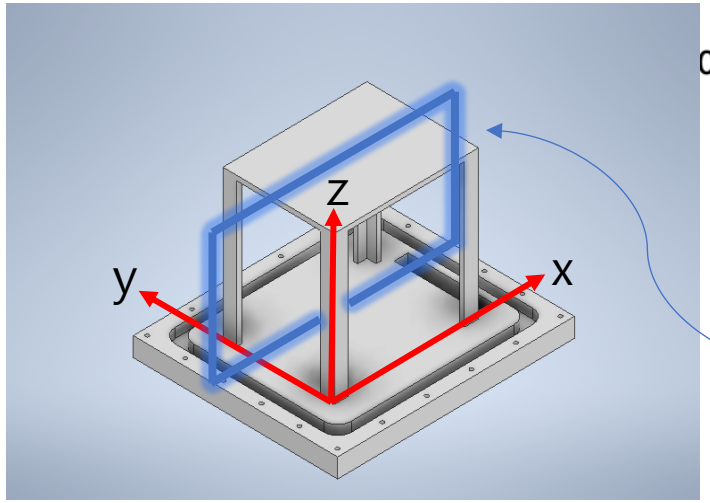
y is fixed at 0 (center)

$E_z \approx 30 \sim 120\ V/cm$ inside Field Cage

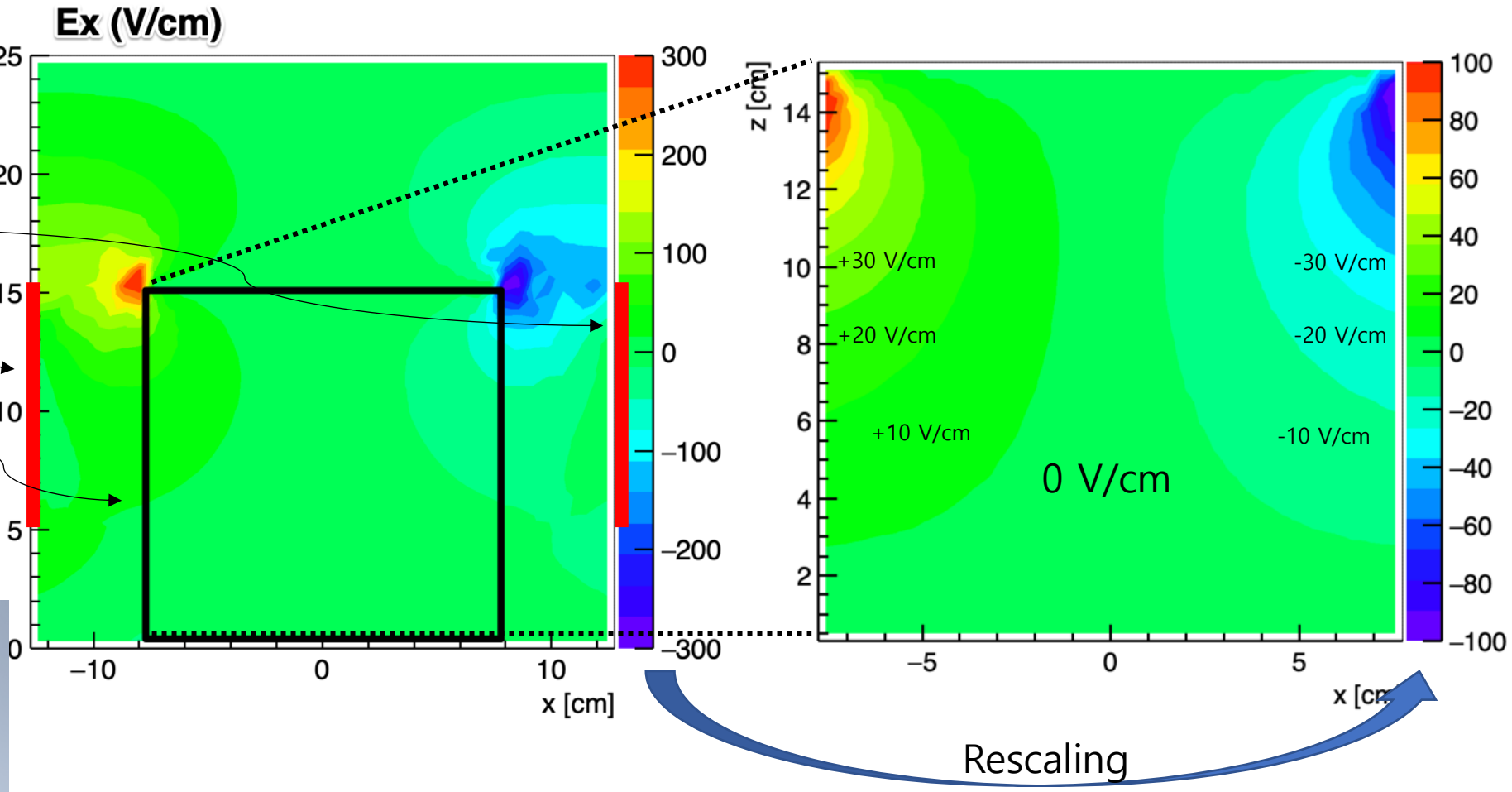
Field simulation *without Voltage divider*

Al mylar window

Field Cage



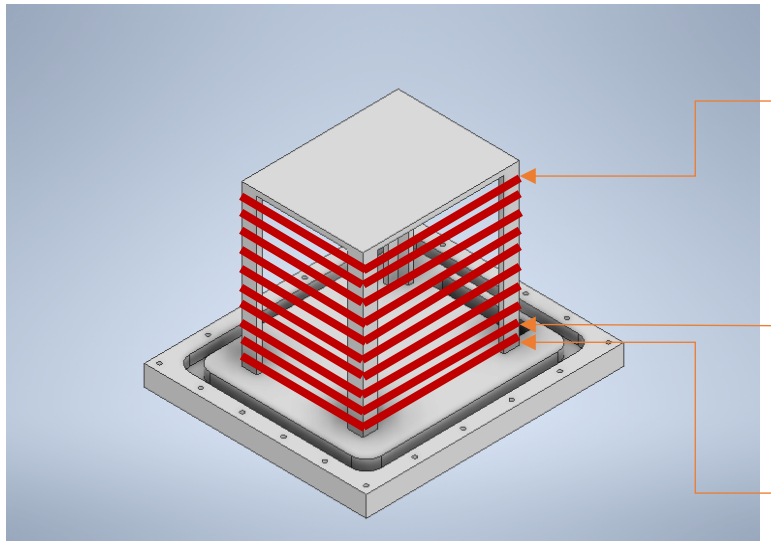
y is fixed at 0 (center)



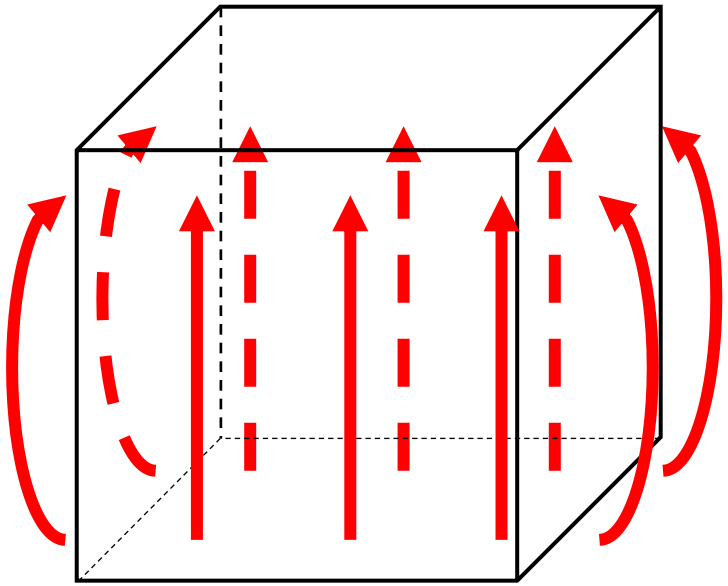
$E_x \approx -30 \sim 30\ V/cm$ iside Field Cage

Field simulation *with Voltage divider*

+Boundary Conditions

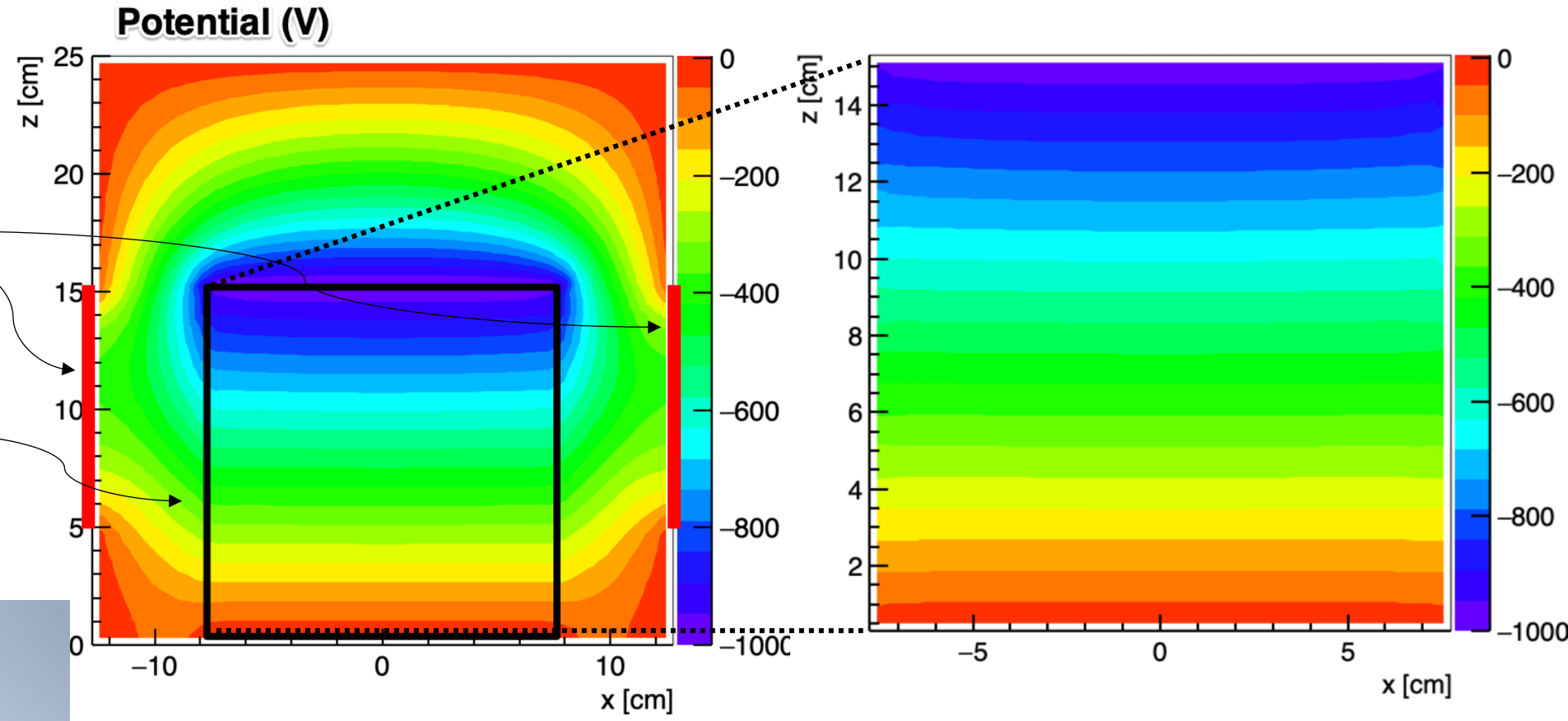


Voltage divider
(10 Copper wires)



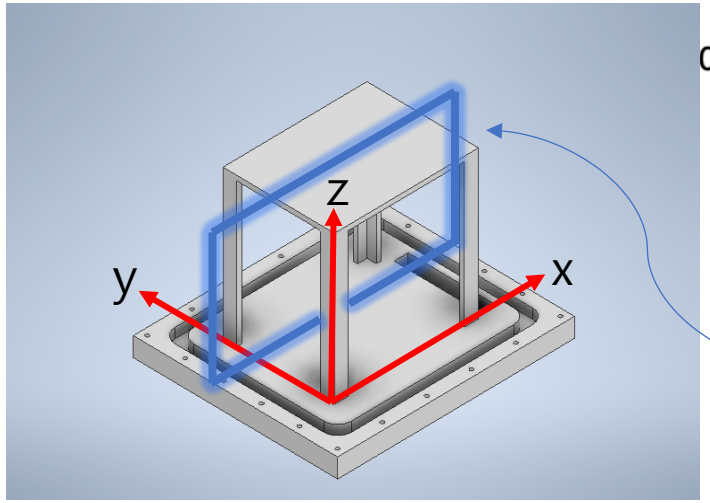
Electric Field inside Field Cage

Field simulation *with Voltage divider*



Al mylar window

Field Cage

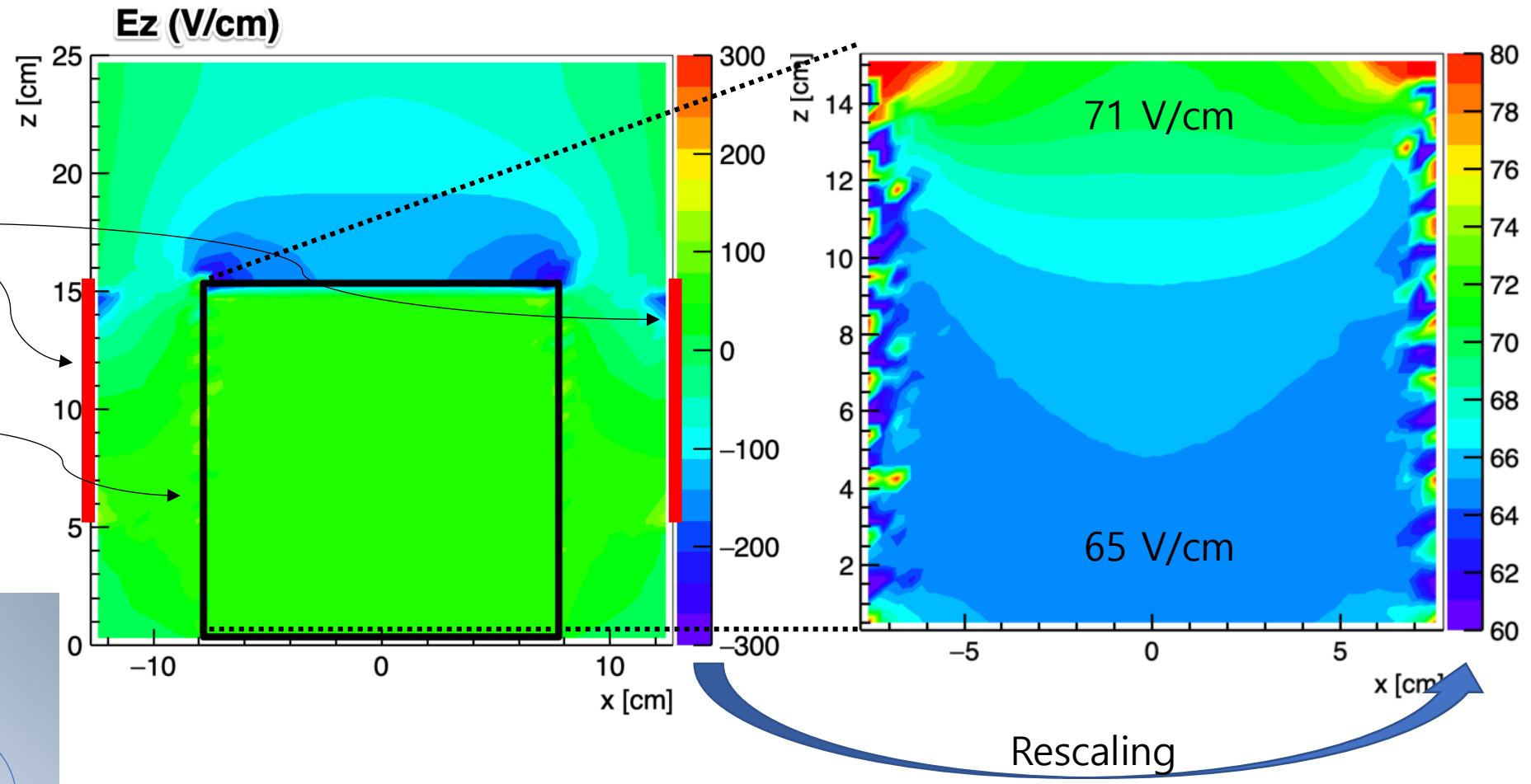


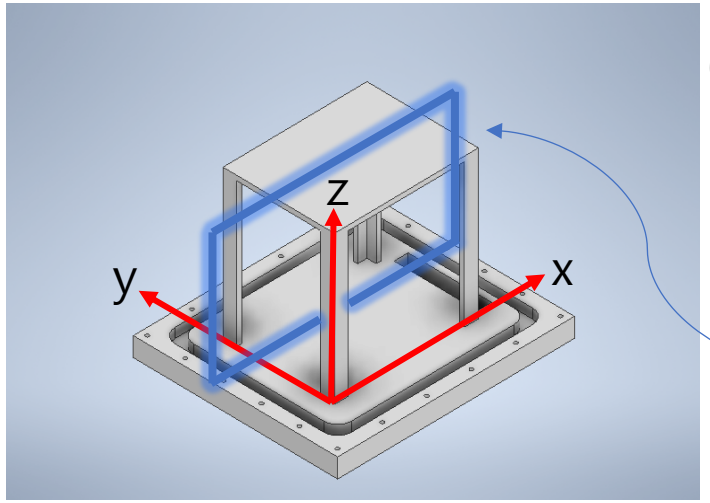
y is fixed at 0 (center)

Field simulation *with Voltage divider*

Al mylar window

Field Cage





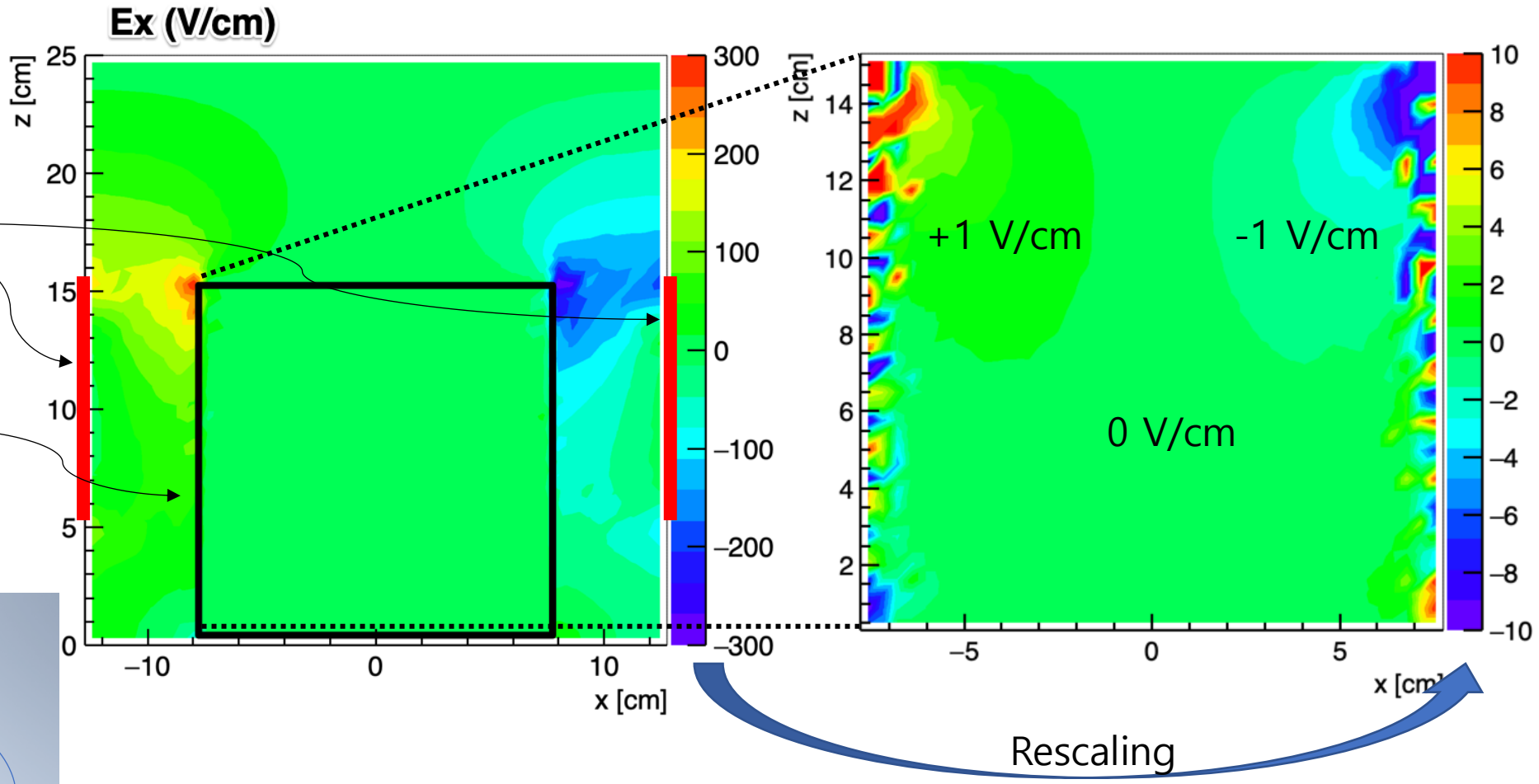
y is fixed at 0 (center)

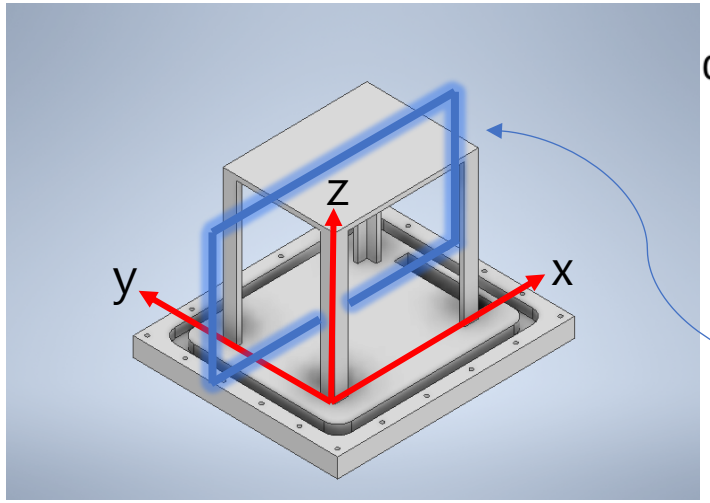
$E_z \approx 65 \sim 71\ V/cm$ inside Field Cage

Field simulation *with Voltage divider*

Al mylar window

Field Cage

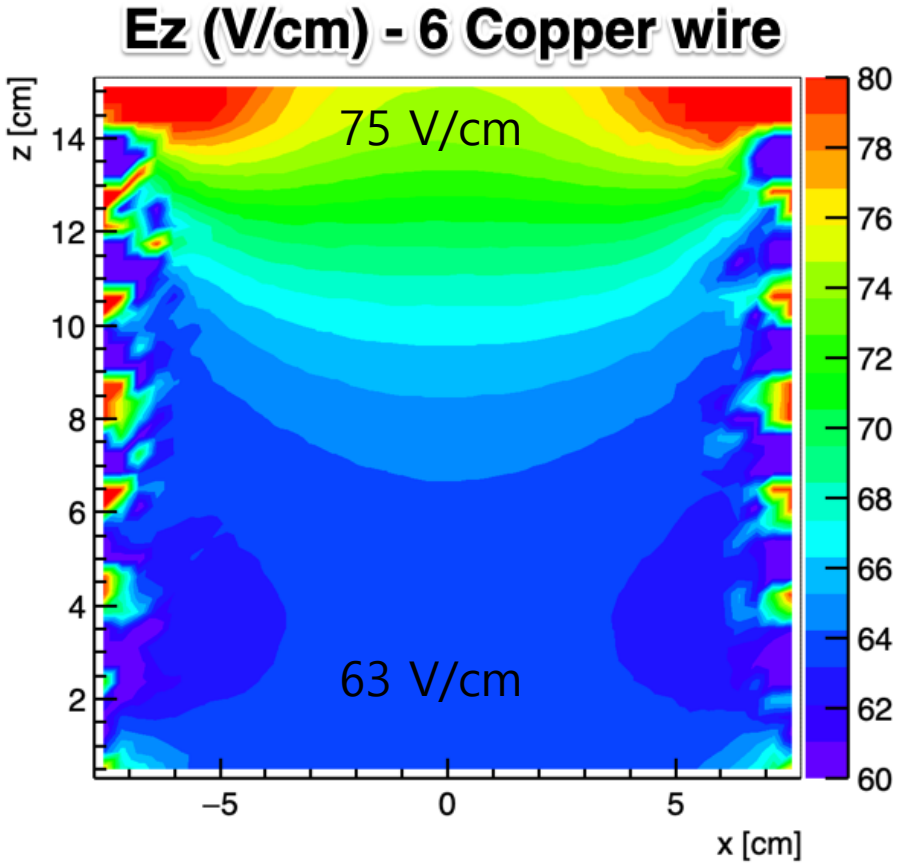


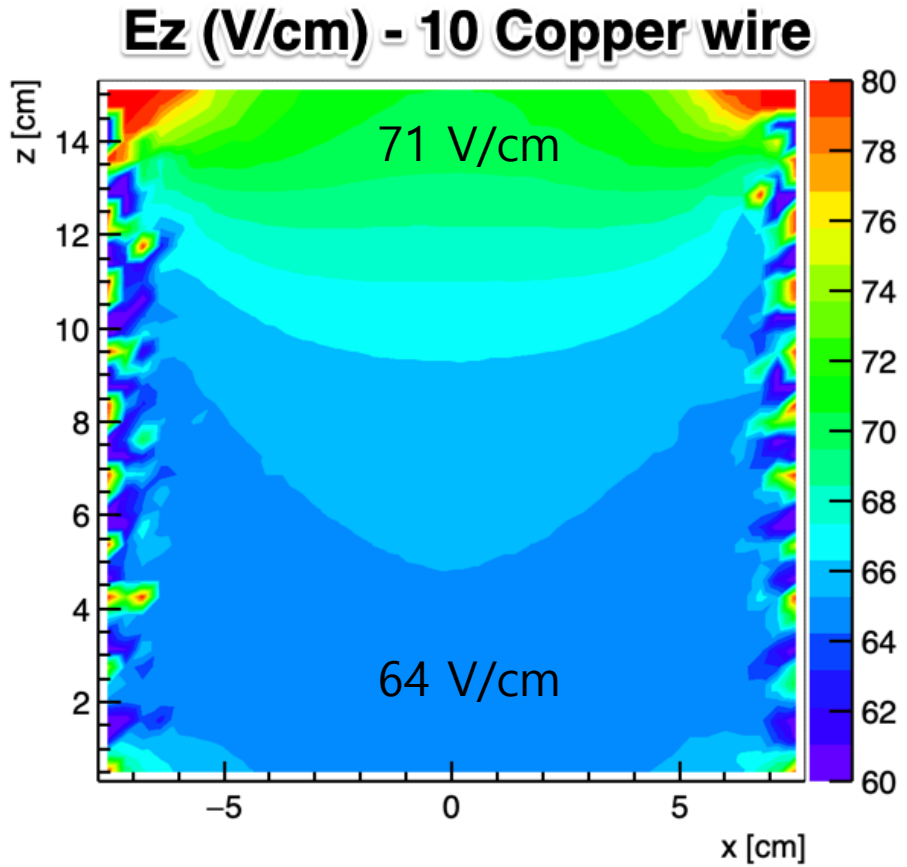


y is fixed at 0 (center)

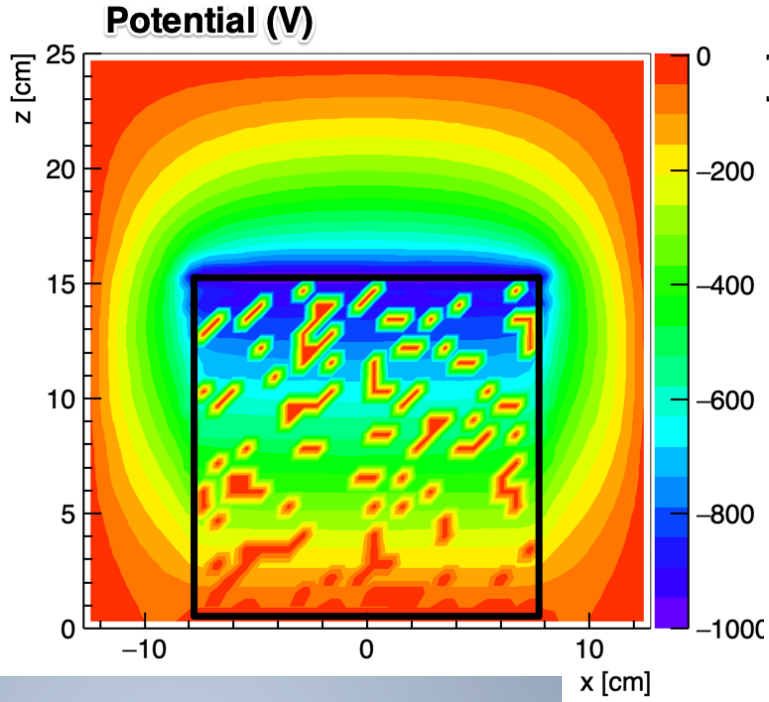
$E_x \approx -1 \sim 1\ V/cm$ inside Field Cage

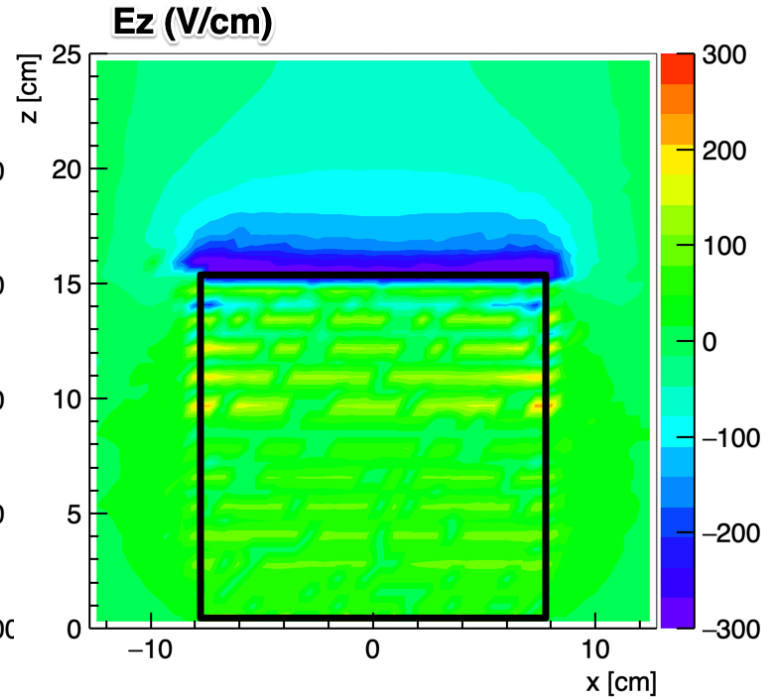
Field simulation *with Voltage divider*

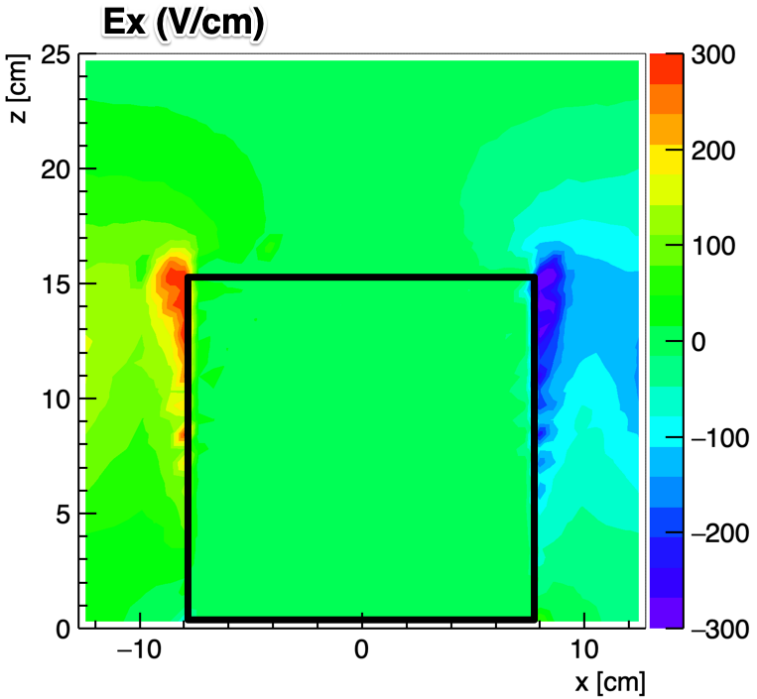


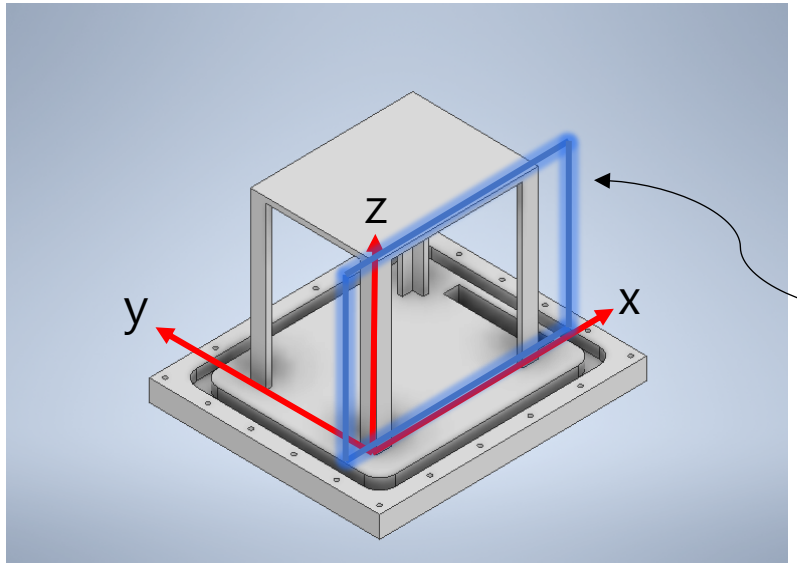


Field simulation *with Voltage divider*









y is fixed at -7.75cm (Field Cage surface)

결론

- 모든 부품의 주문이 진행되는 중이며, 제작이 완료되는 대로 시작할 예정
- 후에 Strontum source 로 beam test를 할 예정이고, 이 또한 GARFIELD로 simulation 할 계획
- 목표 : 8월 안에 조립을 완성하고 GEM을 받아 test 실험을 시작
- → 다가오는 10월 KPS에서 결과보고