

Active Target TPC 시작품 만들기

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2019년 4월 16일

ATTPC 만들기 첫 모임

AT TPC **시작품** 만들기

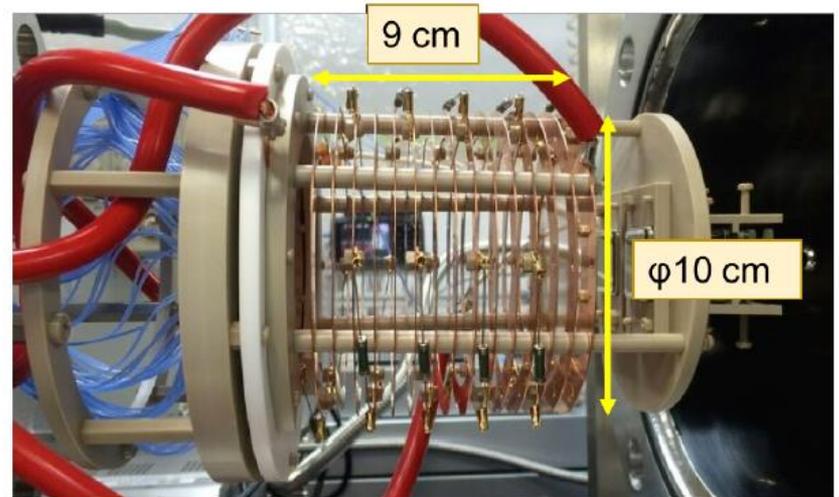
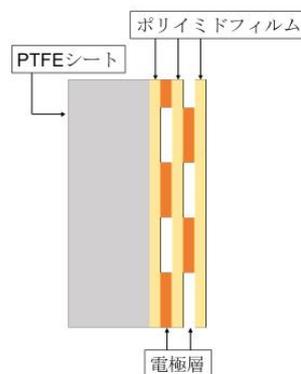
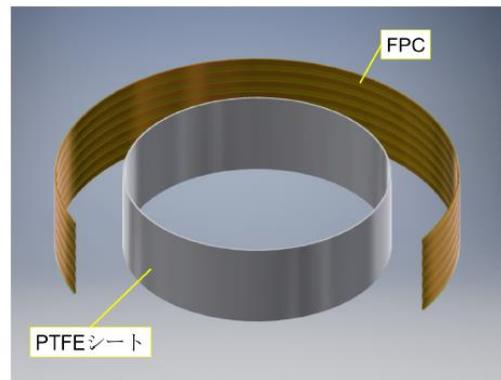
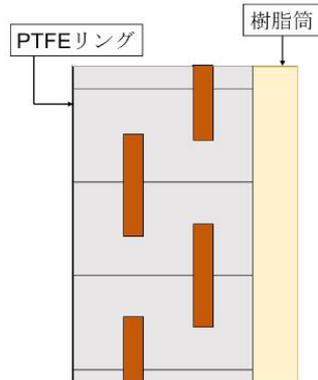
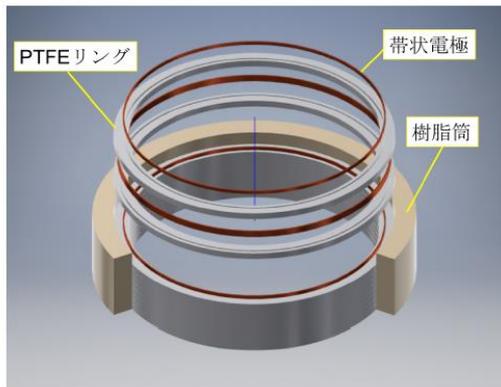
- 누가 만드나?
- 디자인 (간단한 계산) → 구매 → 시작품의 시작품 제작 → 테스트 → 반성/디자인수정 → 구매 → 시작품 제작 → 시작품 테스트
- 6개월에서 2년
- 가스 시스템
- HV 시스템 (Field Cage)
- Readout Chamber
- Readout Electronics (GET system)
- Geant4 시뮬레이션

Physics Program with AT-TPC

- He을 **Active Target**로 이용하니 α 가 관여하는 핵반응 연구가 가능. $\alpha(\text{Beam}, X)Y$ reaction. 2.5×10^{20} He atoms / cm² in 10 cm.
- $^{14}\text{O}(\alpha, p)^{17}\text{F}$ and $^{14}\text{O}(\alpha, 2p)^{16}\text{O}$ at typical novae outburst temperature or higher.
- Unbound proton-rich nuclei
- 2p Emission from four known ^{45}Fe , ^{48}Ni , ^{54}Zn and ^{67}Kr ground states (pp correlation).
- α clusters in unstable nuclei : ^{10}C and ^{10}Be

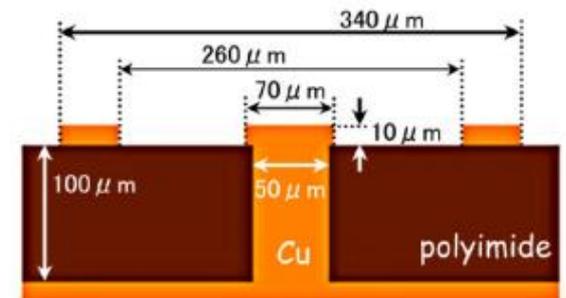
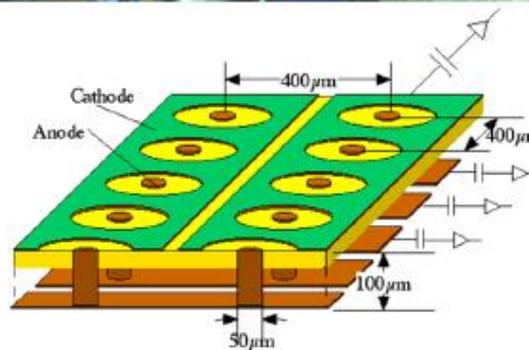
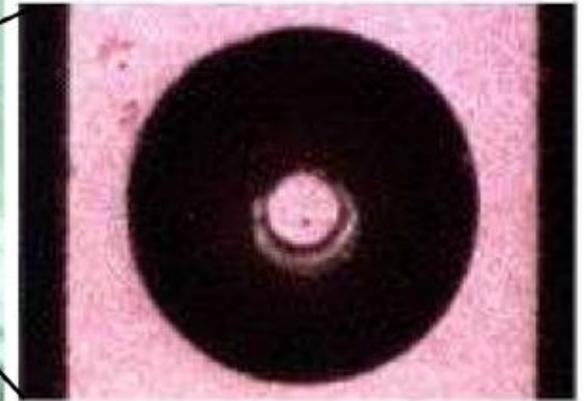
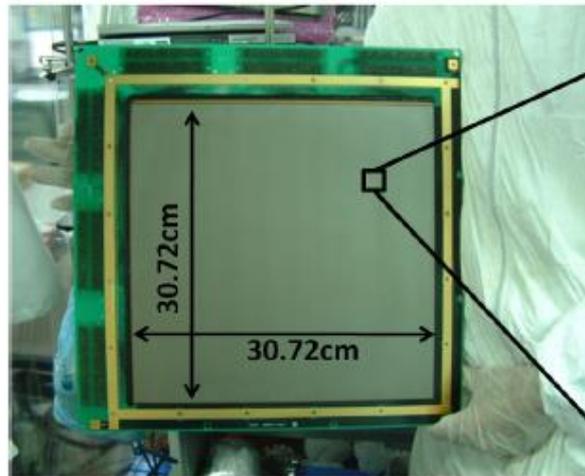
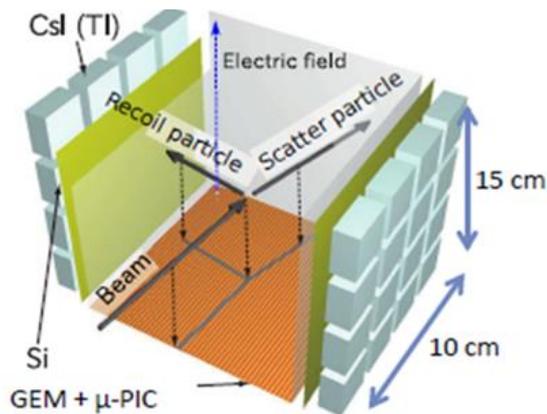
Field Cage

- Maxwell3D E-field Calculation : Flexible PCB? Cu ring? Cu wire? PTFE? G10?
- Resistor chain, Electric discharge in high E.



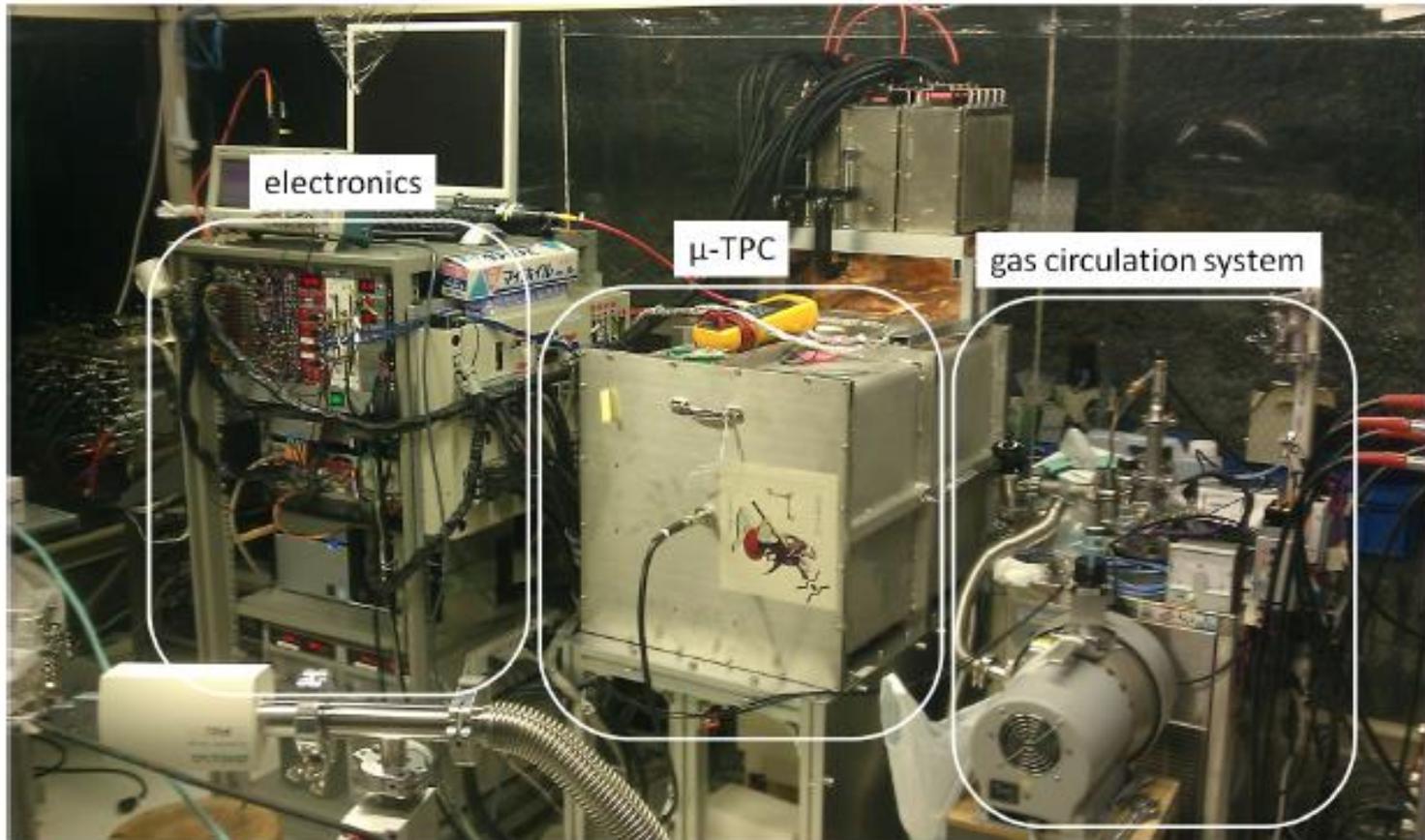
Readout Chamber

- Triple-GEM + anode pad : GEM 국내구입, PCB 인쇄
- u-PIC : R&D 필요, 다층박막인쇄

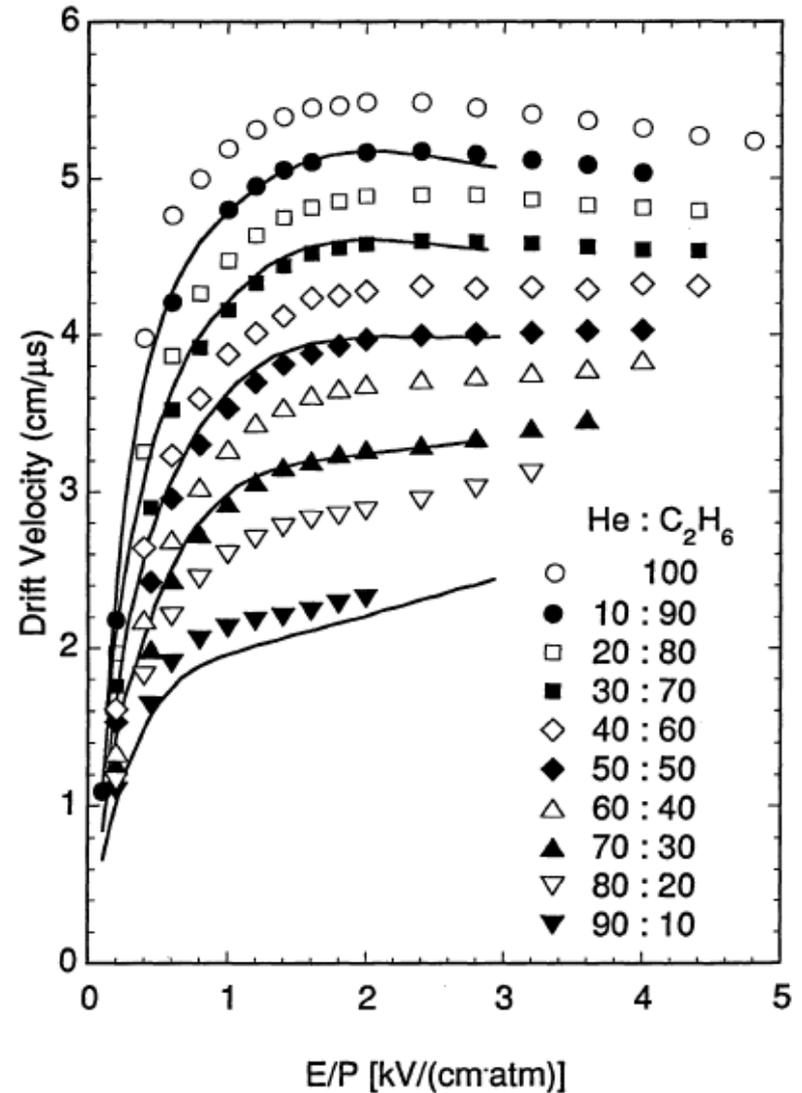
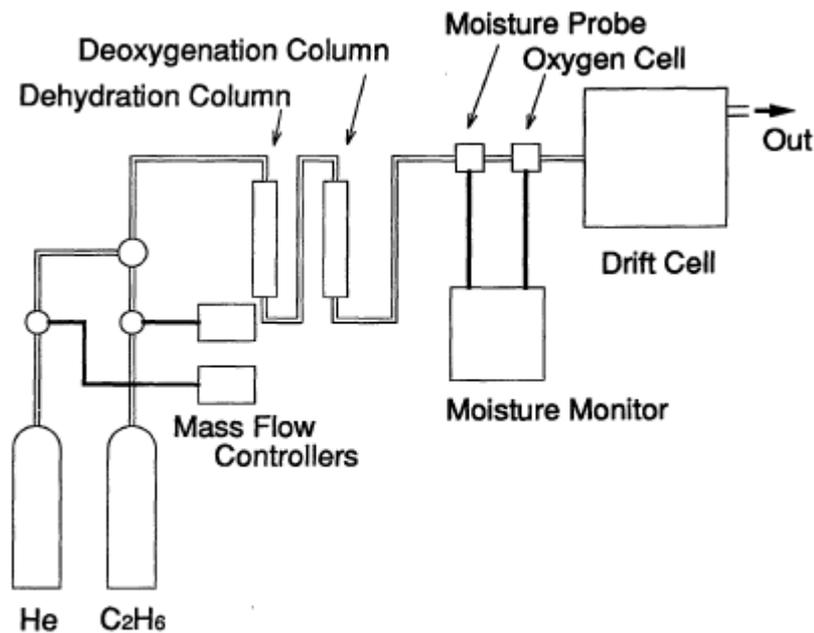


Gas System

- He + CO₂ (i-C₄H₁₀) gas mixture : Gas mixer, Circulation, Monitoring system, Vacuum pump and gauge.



Drift velocity in He Gas Mixture

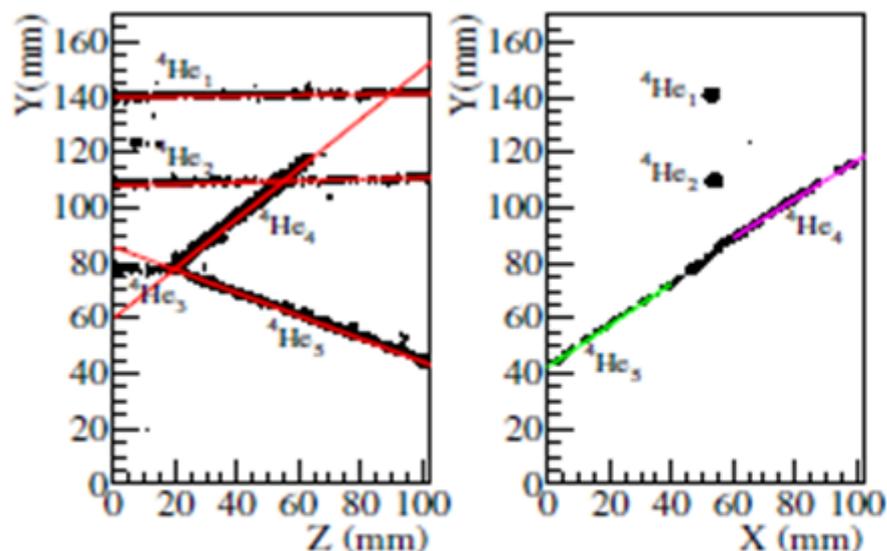


Active Target TPC @ RCNP

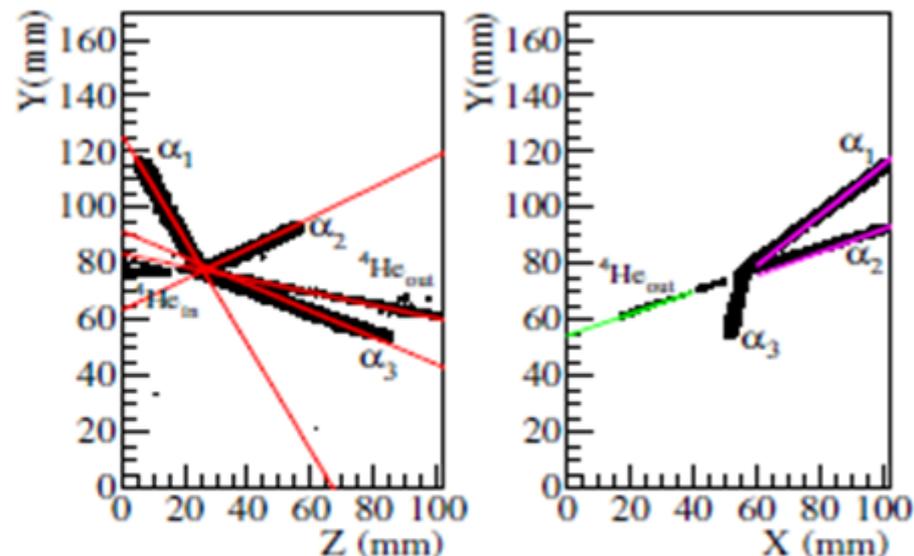
- Osaka U Group
(Kawabata 그룹)
- μ PIC TPC + Silicon +
CsI (MAIKo)
- μ PIC 개발 + Kyoto 우주
선 그룹 개발 Board →
(α, α') 반응 연구



${}^4\text{He} + {}^4\text{He}$ elastic



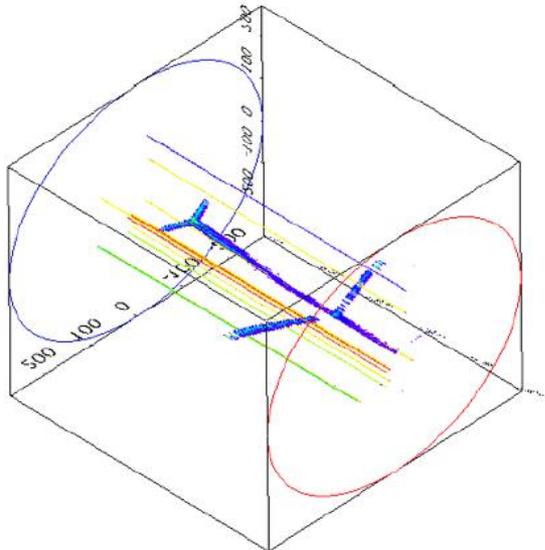
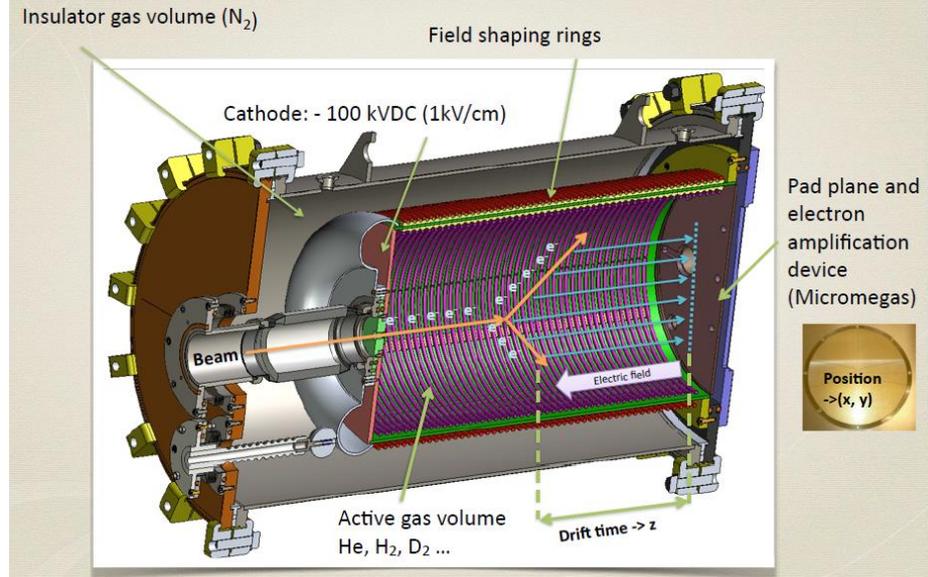
3α decay from ${}^{12}\text{C}^*$



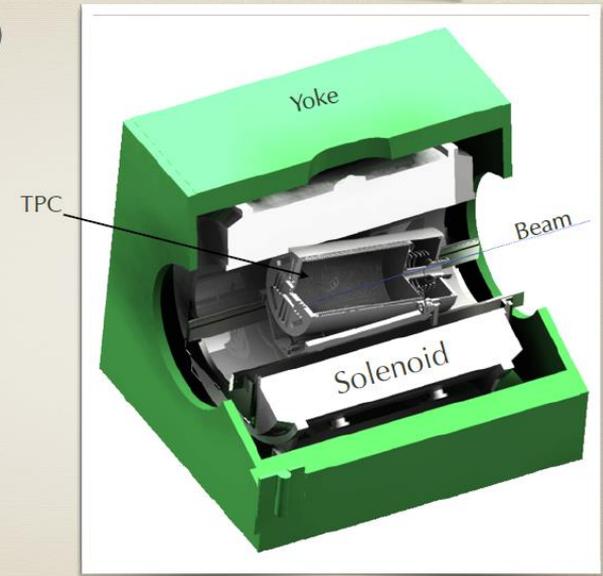
- ✓ beam: ${}^4\text{He}$ @50 MeV
- ✓ gas: He(93%) + iC_4H_{10} (7%) @430 hPa

Prototype TPC at NSCL

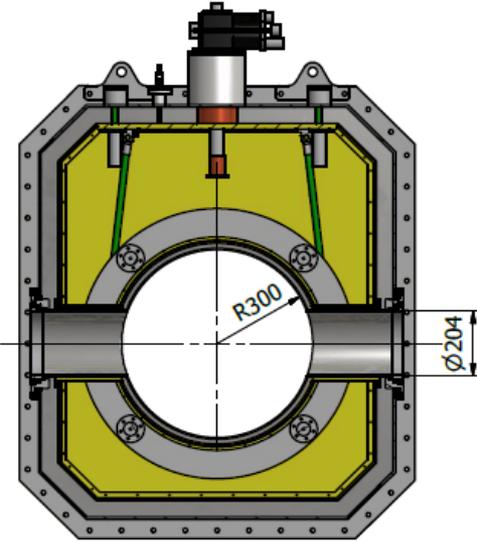
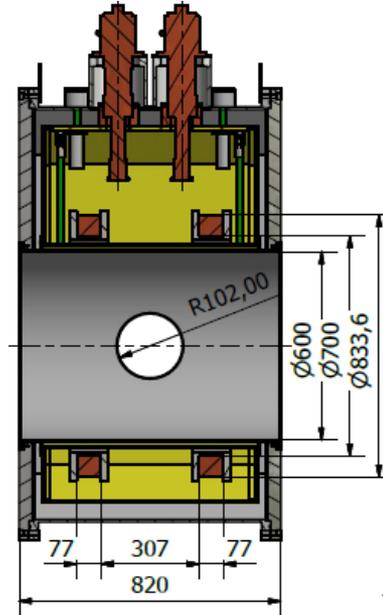
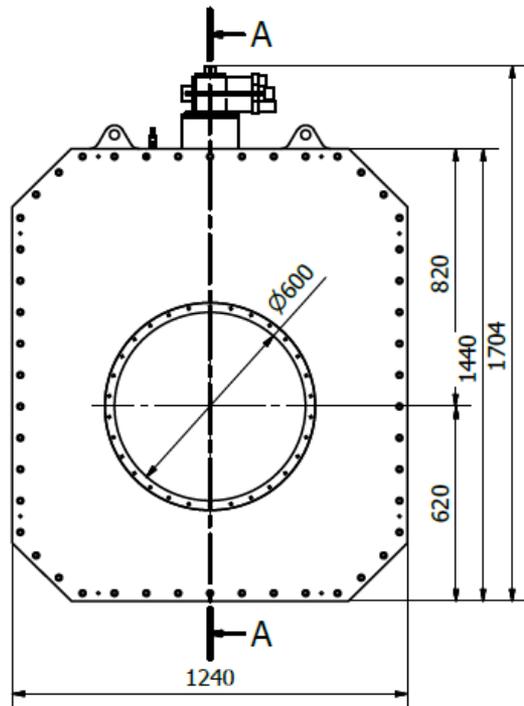
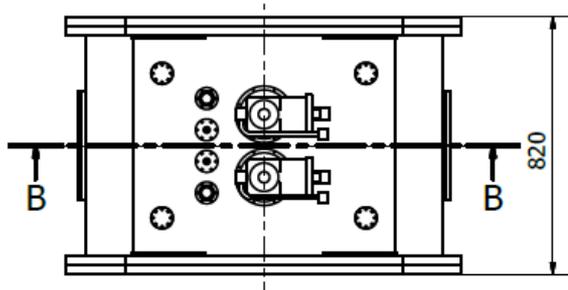
- He/CO₂ gas under high E (1kV/cm)
- 1 m long (100 kV)
- HV insulation problem against discharge.
- 13k readout pads



- ▶ Straight and tilted (7°) configurations
- ▶ Tilt relative to beam axis to increase accuracy for small angles
- ▶ Placed inside 2 Tesla solenoid (increase range and measure Brho)
- ▶ 250 liters (1 m by 55 cm) active volume

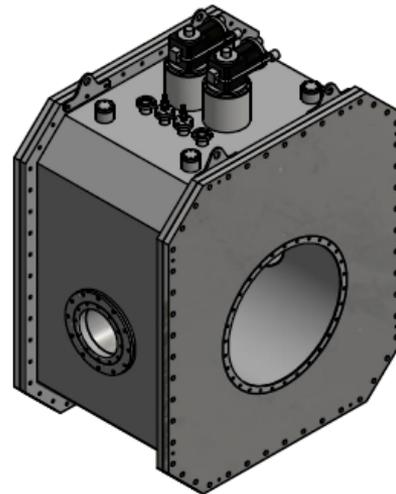


1.5 T 전도 냉각형 소형 초전도전자석



NOTE

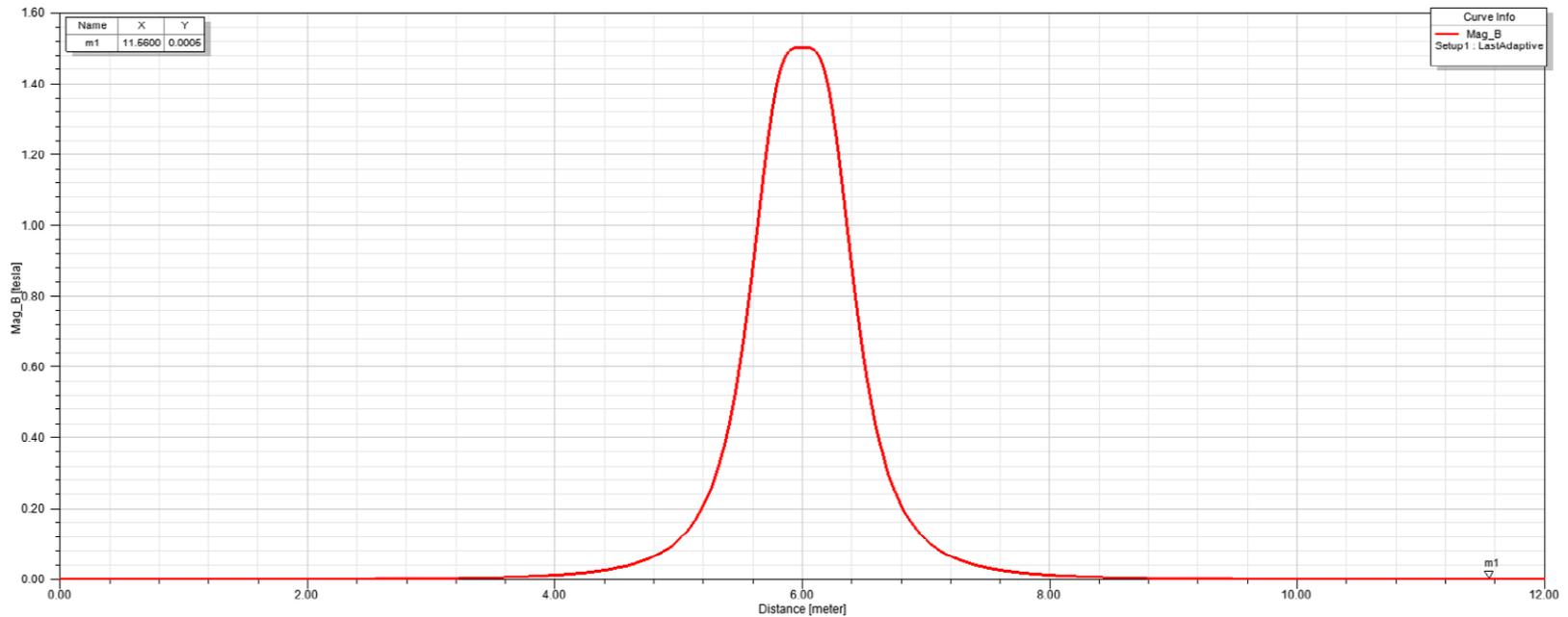
1. OPERATION CURRENT : 60A
2. INDUCTANCE : 110H
3. BORE : $\varnothing 600$, $\varnothing 204$



- 1.5 T at 60 A / L = 110 H
- RT bore radius : 600 mm
- Two RDK-415D coolers + F-50 compressor + Chiller
- Solenoid / Dipole modes

전자석

- 1.5 T일 때 축 방향 2 m 까지 100 Gauss (모터 작동 안 함)



AT TPC **시작품** 만들기 시간표

- 누가 만드나? : =< 5 명

| | 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 | → | → | → | ? |