LAMPS 검출기 R&D와 첫 실험 준비

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LAMPS 검출기 준비 일정

1. 2021년 상반기 검출기 설치
2. 2020년 말까지 기본 검출기를 완성!
3. 2019년까지 검출기 R&D 완료! (10개월)

- TPC 주변 검출기 (빔 라인, 표적, Timing, Barrel and ?)
- Barrel Counter (for ToF and Triggering)
- RPC for Time-of-Flight measurement
- Plastics for Triggering

Barrel Counter (2.0-2.5m long)

- Long Plastic Scintillator + Fine-Mesh PMT
- Long Plastic Scintillator + WLS Fiber + PMT
- Long Resistive Plate Chamber

- LAMPS : 1 명 x 3% + 0 명

- Barrel Counter : 250 mm (T) x 2000-2500 mm (L)
- 36 Segments
- RPC for 50 mm (T) / 2 Layers with 2 x 100 mm (T)

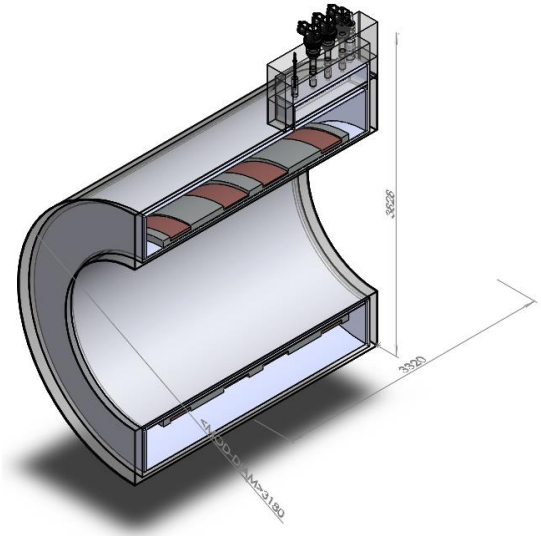
TPC Acceptance

TPC Drift Volume :

1000 mm (ϕ) x 1200 mm (L)

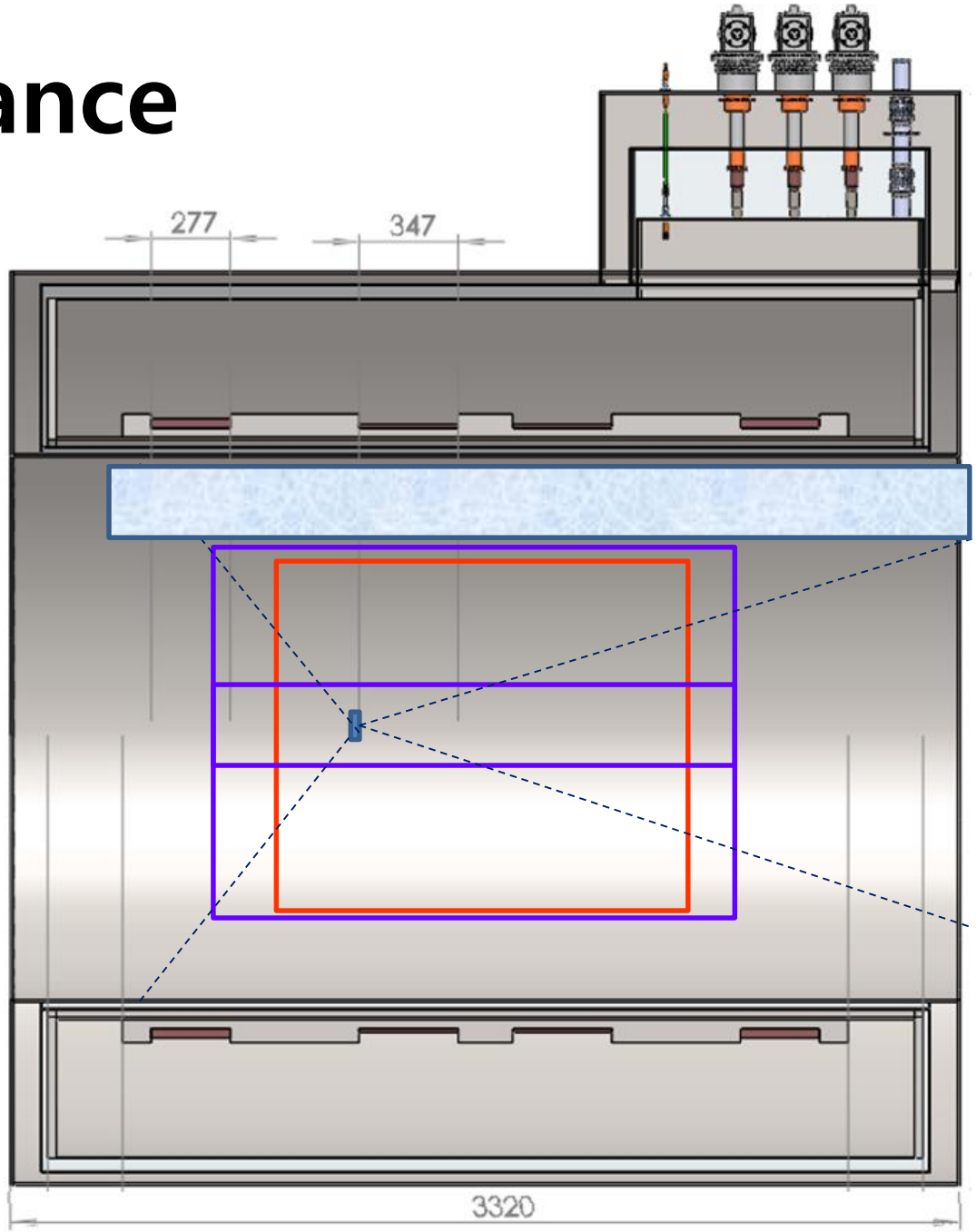
TPC Physical Volume :

1050 mm (ϕ) x 1350 mm (L)



Barrel Counter (36? seg) :

250 mm (T) x 2000 mm (L)



Anticipated Timeline for Barrel Counters

- Start Counter : Thin plastic scintillators + MPPCs
- Barrel Counter : RPCs +

	18	19	19	19	19	20	20	20	20
Barrel 검출기		now							

	18/10	18/11	18/12	19/01	19/02
RPC	누가	계획			~~첫 Prototype 테스트?~~
Plastics	누가	계획			
Drift Chamber?	누가	계획			

Revised Timeline for Barrel Counters

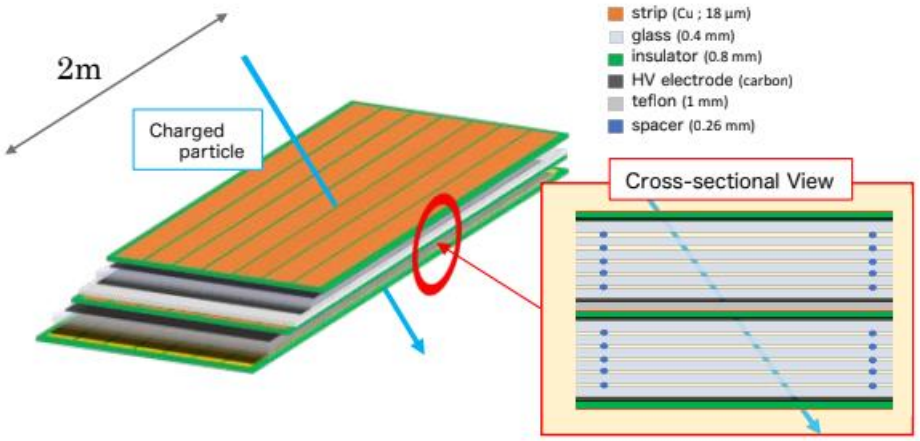
- Start Counter : Thin plastic scintillators + MPPCs
- Barrel Counter : RPCs +

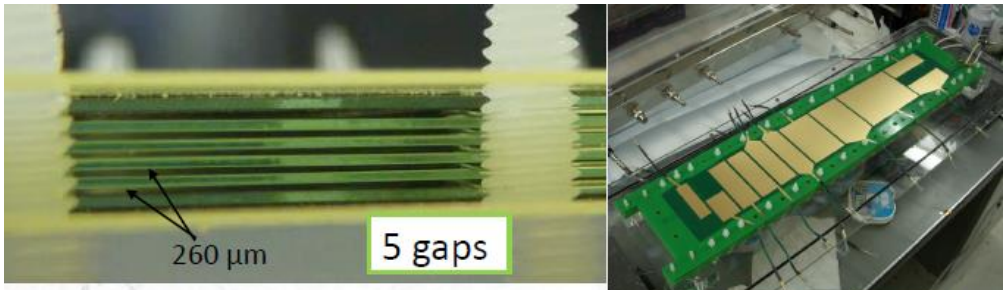
	19	19	19	19	20	20	20	20
Barrel 검출기	now							

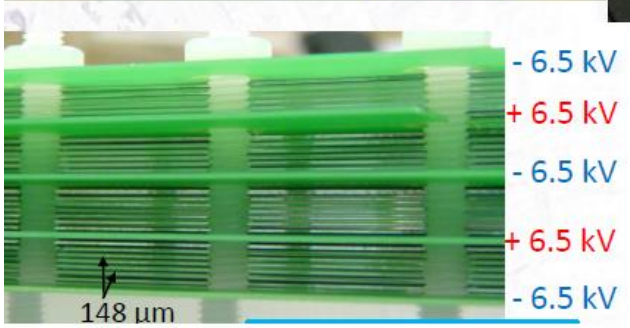
	19/02	19/03	19/04	19/05	19/06
RPC	계획	계획			첫 Prototype 테스트?
Plastics	계획	계획			
Drift Chamber?	준비	준비			테스트

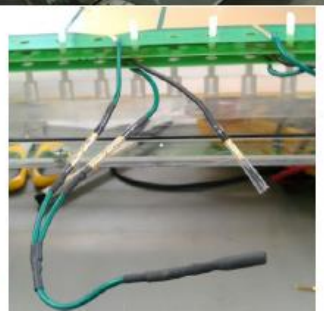
Barrel Counter

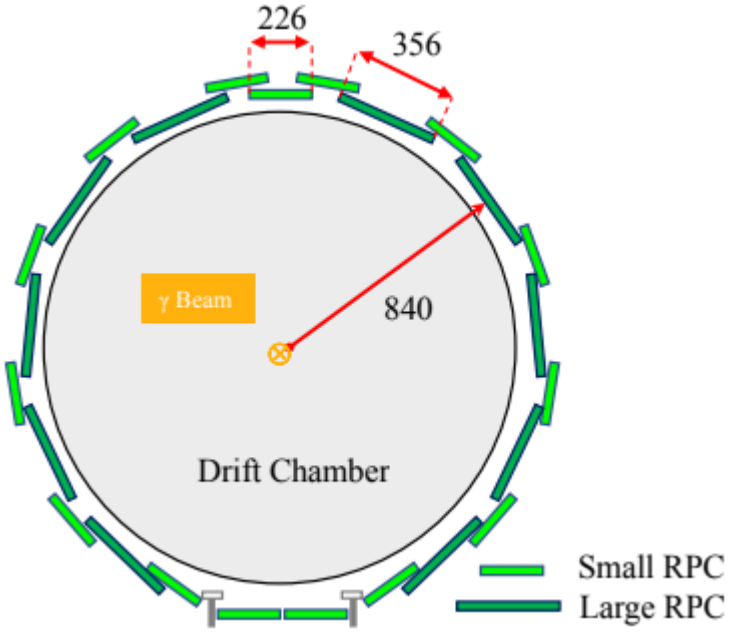
- Barrel RPC @ LEPS2
- 2-m long RPCs
- RF noise problem
- 50-60 ps timing resolution



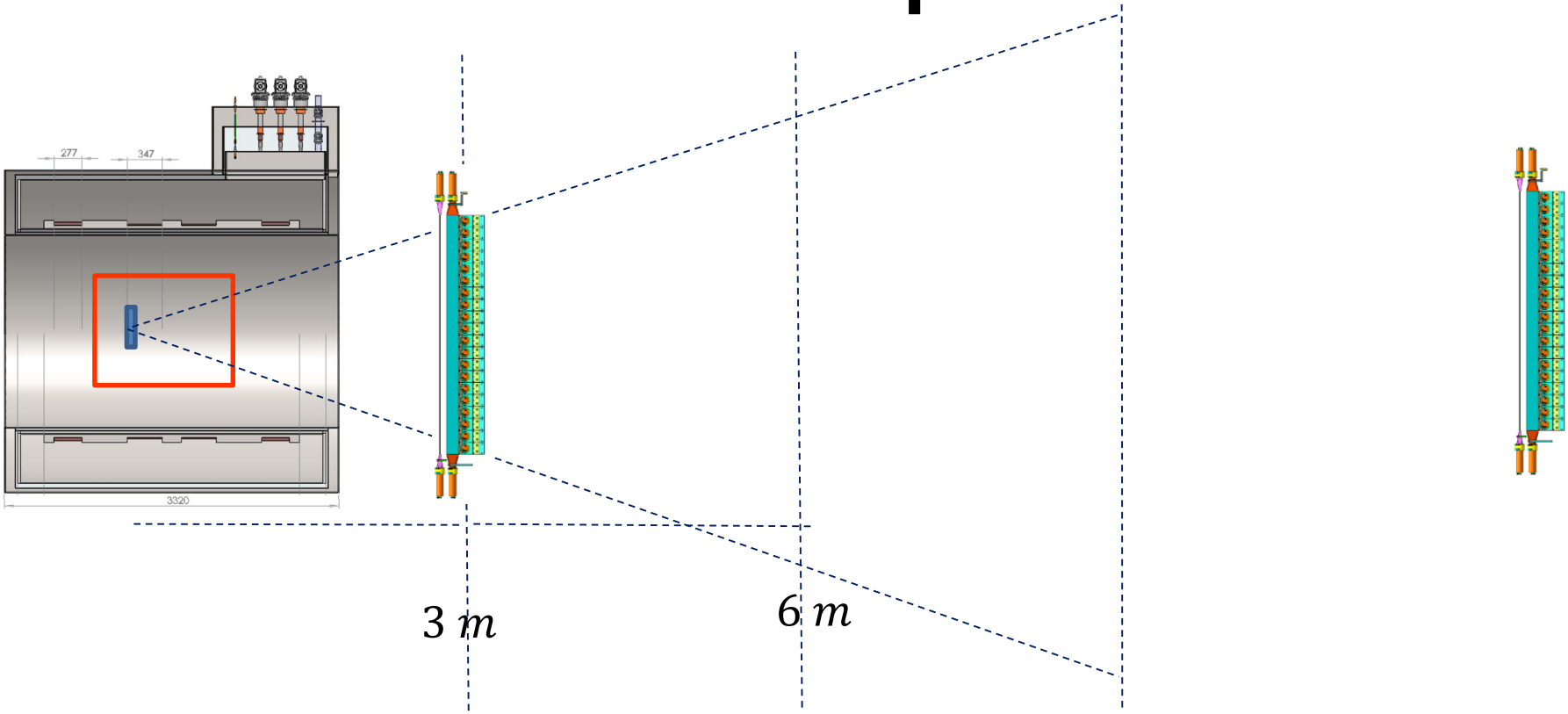








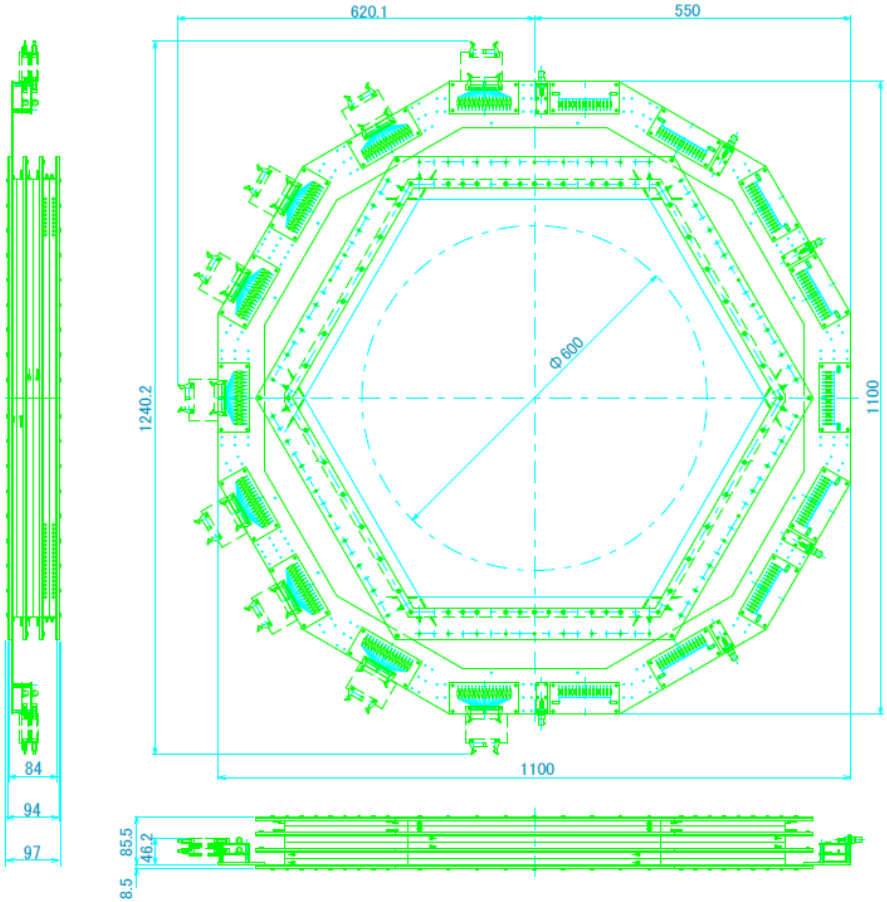
Forward Acceptance



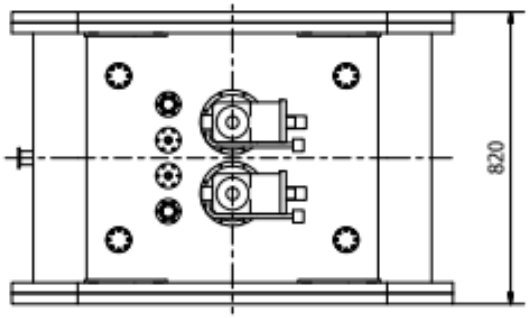
- No tracking devices for particles at forward angles (< 30º).
- Do we need drift chambers?

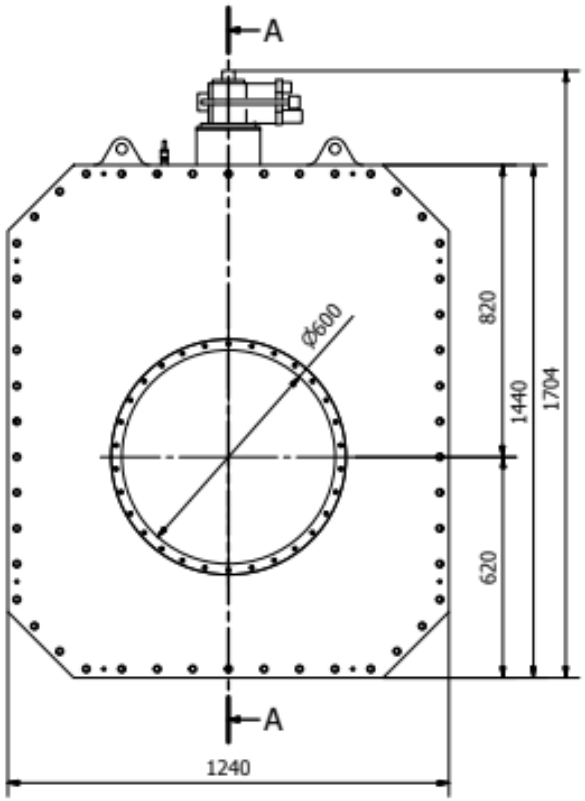
Drift Chamber

- Hexagonal DC with 3 planes of xx′, uu′, and vv′.
- Effective area of 600 mm in diameter.
- SPring-8/LEPS DC.

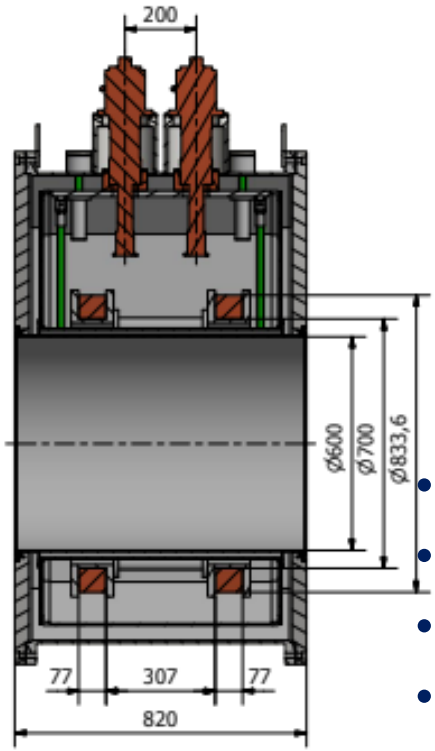


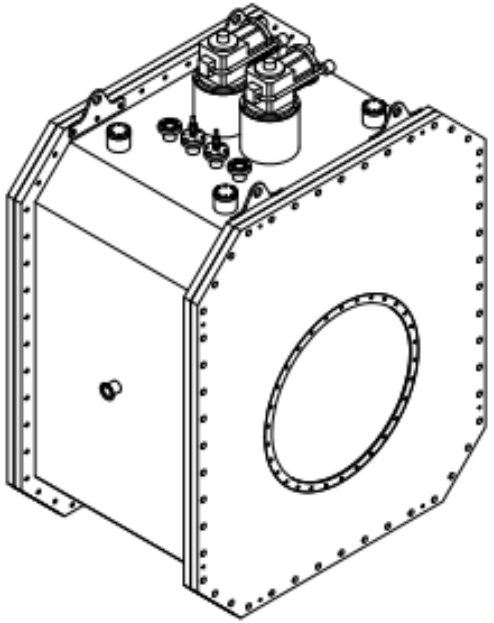
1.5 T 전도냉각형 소형 초전도전자석





NOTE
1. No of turn :1000/coil
2. Operation Current : 64A
3. Inductance : 123.5H



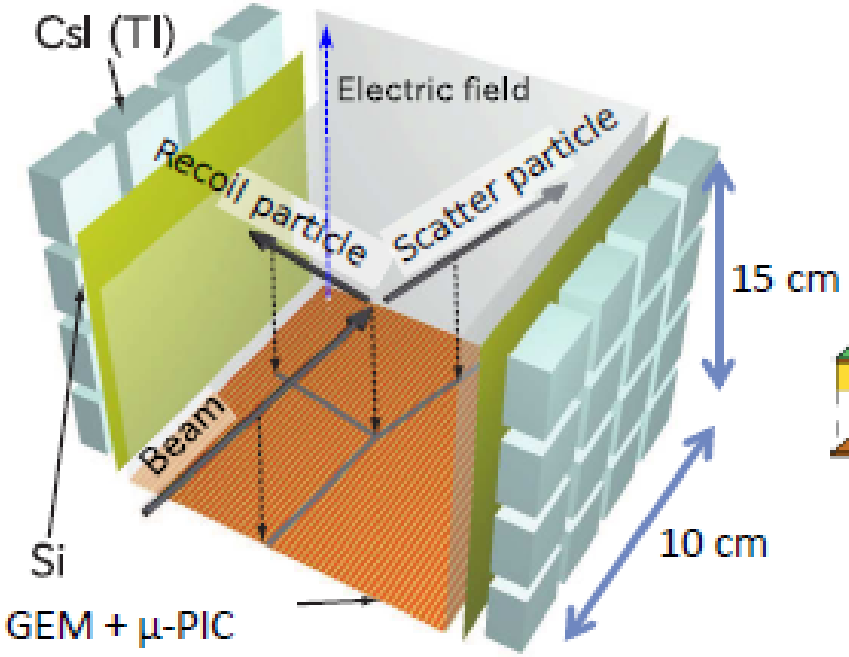


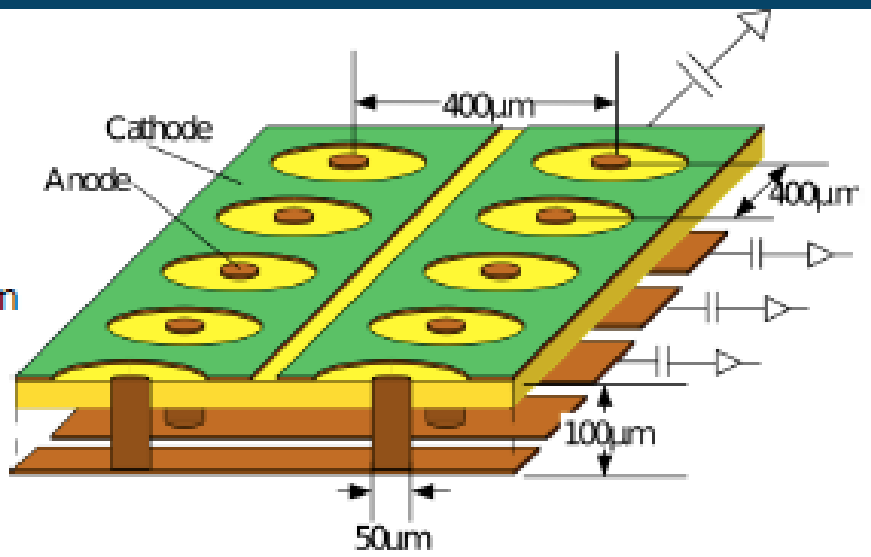
- 1.5 T at 64 A
- L = 123.5 H
- RT bore radius : 600 mm
- Two RDK-415D coolers + F-50 compressor + Chiller

Active Target TPC @ RCNP

- Osaka U Group (Kawabata 그룹)
- μPIC TPC + Silicon + CsI (MAIKo)
- μPIC 개발 + Kyoto 우주선 그룹 개발 Board ➔ (α,α') 반응 연구

Mu-pic based Active target for Inverse Kinematics . (MAIKo)

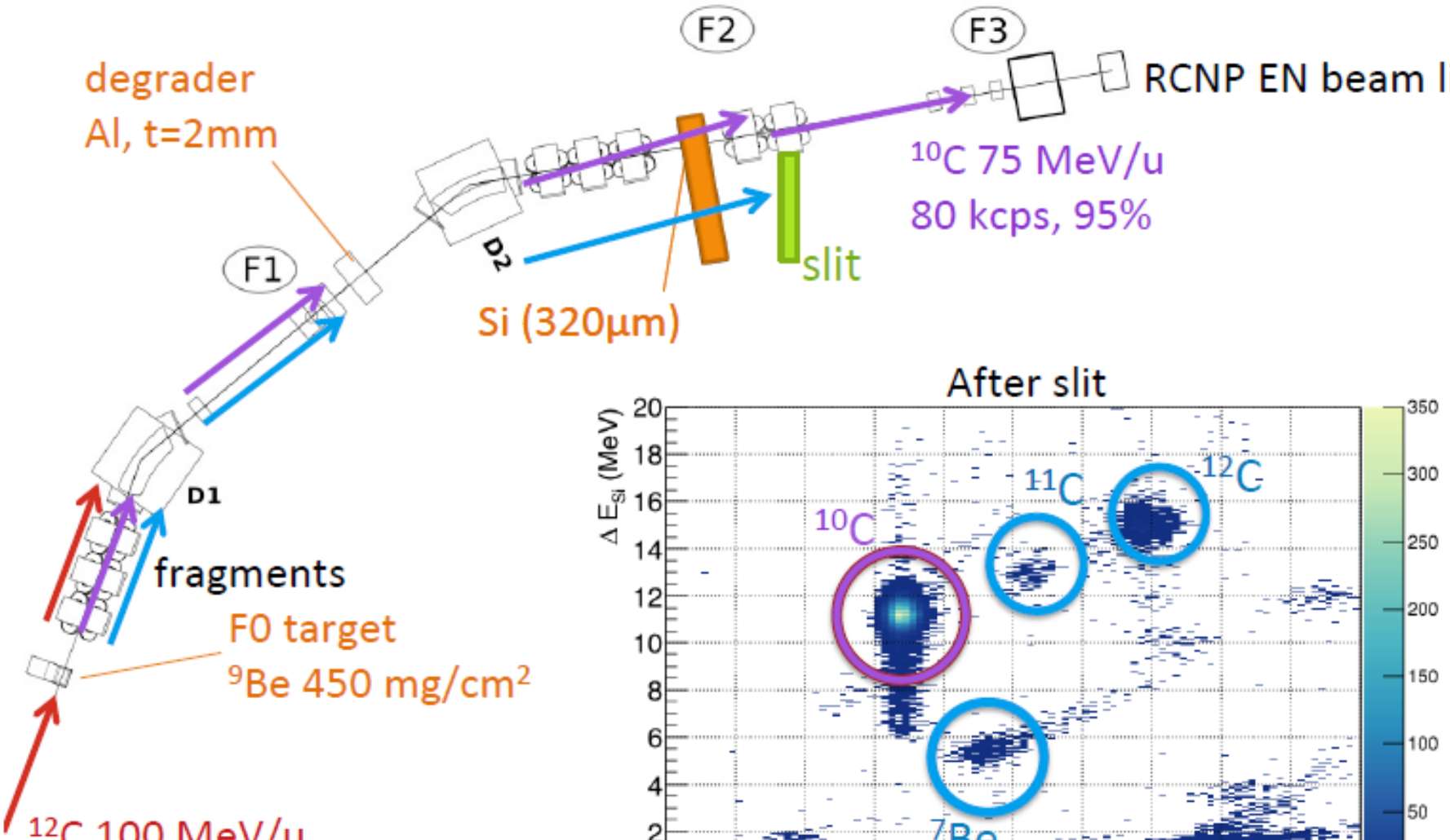




Micro-Pixel Chamber (μ-PIC)
A. Ochi, *et. al.* NIM A **478**, 196 (2002).

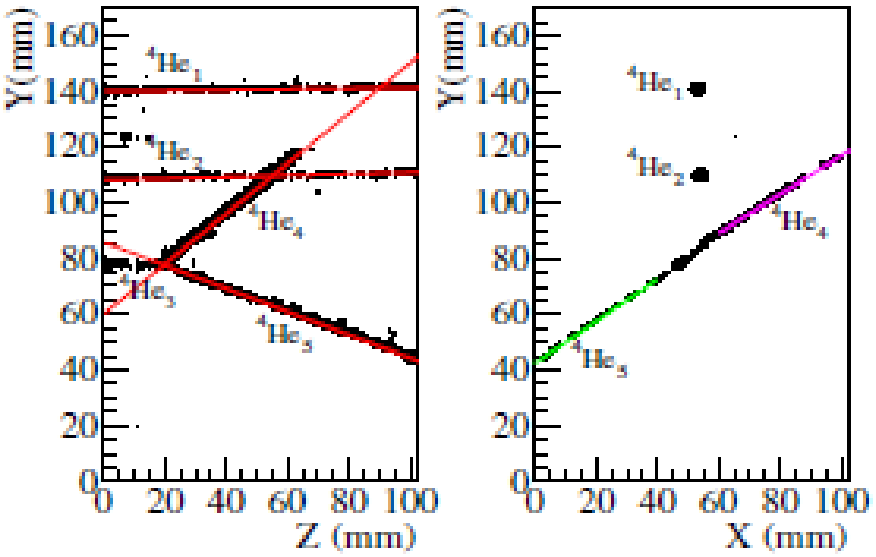
- Detection gas (He) = target gas → Detectable low-energy particles!
- Gas: He + CO_2(7%) @0.5 – 2.0 atm
- Introduce μ-PIC + GEM.
  - μ-PIC (gain~1000): 2-dimensional strip readout (400 μm pitch). 256A+256C = 512 ch.
  - GEM (gain~30): 140 μm pitch, d=70 μm, t=100 μm (thick GEM)
- TPC track → θ_α , range in the gas / Si+CsI → E_α

$^{10}C(\alpha,\alpha')$

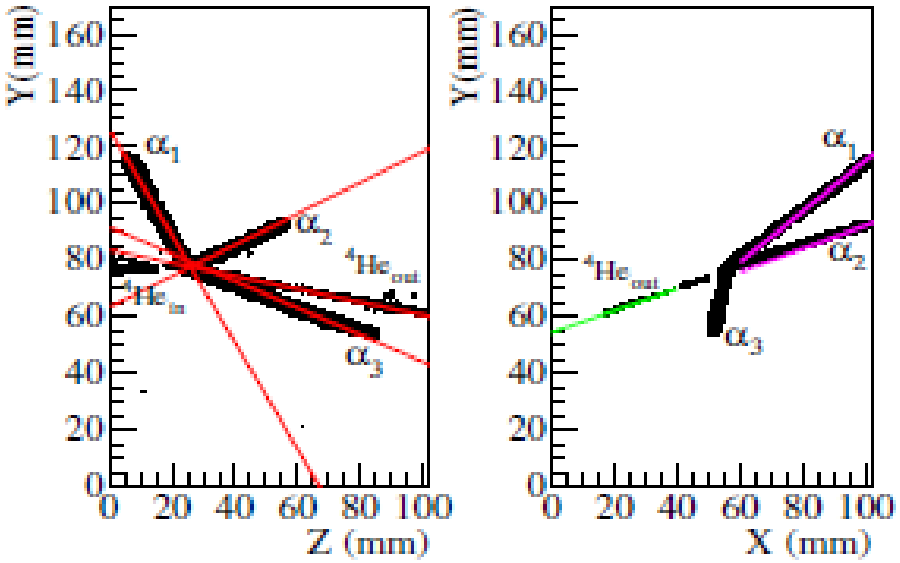


Example of scattering events

^{4}He + ^{4}He elastic



3α decay from ^{12}C*



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

To identify the ^{4}He + ^{4}He elastic scattering,
tracking algorithm to reconstruct multiple tracks are needed !

Physics Program with AT-TPC

- He을 Active Target로 이용하니 α가 관여하는 핵반응 연구가 가능. α(Beam, X)Y reaction.
- 14O(α, p)17F and 14O(α, 2p)16O at typical novae outburst temperature or higher.
- Unbound proton-rich nuclei
- 2p Emission from four known 45Fe, 48Ni, 54Zn and 67Kr ground states (pp correlation).
- α clusters in unstable nuclei : 10C and 10Be

AT TPC

- AT TPC는 단독으로 움직이는 경우 빔 파이프와 직접 연결하여 TPC 외부에 진공 챔버는 불필요.
- Silicon 검출기와 함께 사용해서 전자석 없이 TPC에선 트랙 방향만 결정하거나 Range로 에너지 결정?.
- 처음엔 GEM-TPC로, 성공 후 Micro-pattern Strip TPC으로 (국내에서 R&D).
- Osaka U Group이 GET시스템에 관심. 함께 R&D가능성 열려.