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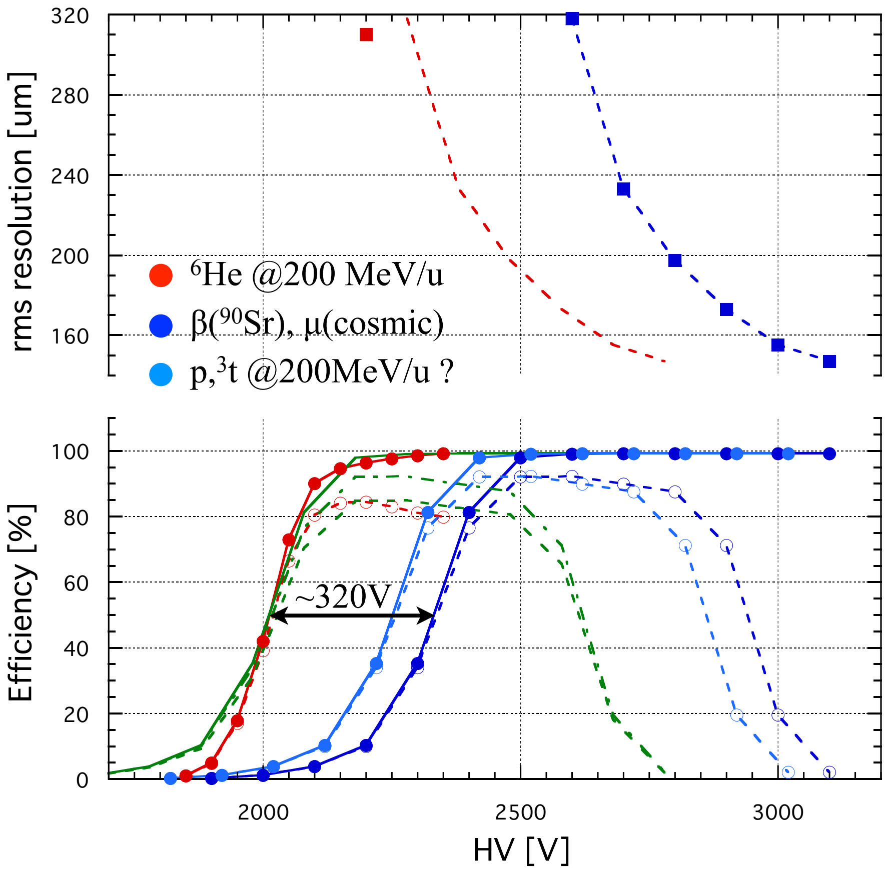
Memo
on
Z=1 & 2 detection in FDC2
for S19 & S34

FDC2 for Z=1

- ^{18}O campaign
  - S19
    - α & p in FDC2 (if possible without using PDC's)
  - S34
    - t in FDC2
  - in both experiments : no ^{8}He beams in FDC2
- Gas
  - "heavy particles" in April/May runs : He + 60% CH_4 + 2-propanol
  - "light particle" in June/July runs : Ar + 20% CH_4 + 2-propanol
    - gas exchange will be started right after Seaster run
- Status/Histiry
  - efficiency & resolution have been studied using FDC2-prototype (FDC2P)
  - We had no experience to detect Z=1 in FDC2
    - FDC2 has higher (HV) noise compared to FDC2P above ~2.3 kV
    - Due to high (HV) noise above ~2.3 kV, we have not tried FDC2 tuning for Z=1 (~2xMIP).
- Try to get estimate on Z=1 & 2 detection in FDC2
  - using Ar + 20% CH_4 + 2-propanol (P20)
  - combining existing data from FDC2 & FDC2P
  - get rough estimate on the efficiency & resolution

Estimation from existing data

- Conditions
  - gas : Ar + 20% CH_4 + 2-propanol (P20)
  - V_{th}(ASD)= 0.8 V
  - cf: ΔHV(ΔG~2)~ 80 V from ASD V_{th} dep.
- Estimation from existing data
  - ● FDC2P: β-ray (^{90}Sr) & cosmic μ : ΔE= ΔE_{MIP} → estimate ● FDC2: p, ^{3}t @200MeV/u : ΔE~ 2xΔE_{MIP}
  - ● FDC2: ^{6}He @200MeV/u : ΔE~ 8xΔE_{MIP}
- ΔHV(β-He)~ 320 V
  - ΔHV(ΔG~8)~ 240 V from ΔHV(ΔG=2)~80V
  - (slightly) inconsistent ?
- HV for Z=1 & 2 @200MeV/u ?
  - HV_{est}= 2.4~2.5 KV
  - optimization necessary
    - maximizing ε_{M2}(z=2)
    - minimizing ε_{tot}(z=1)
  - efficiency
    - ε_{tot}(z=1) > 95% ?
    - ε_{M1}(z=2) < 60% ?
  - resolution (/plane)
    - σ(z=1) > 300 um ?



FDC2 tracking resolution

- σ=300 μm (/plane) in six X-planes of FDC2 : assumed
  - (w/o including multiple scattering)
  - σ_x(@FDC2 center)~ 130 μm
  - σ_θ(FDC2)~ 5 mrad
  - cf: multiple scattering for 200 MeV proton
    - L_R(P20)~ 127 m
      - L/L_R(FDC2 gas)~ 7×10^{-3}
    - σ_θ(FDC2 gas)~ 2.5 mrad

p & α in p(^{8}He,pα)4n

- Energy loss in P20

particle	energy	ΔE	ratio1	ratio2
MIP	MIP	1.0		
p	200MeV	2.07	1.0	
p	400MeV	1.42		1.0
α	200MeV/u	8.30	4.0	
α	55MeV/u	20.9		14.7

- ΔE(α 55MeV/u)/ΔE(p 400MeV)~ 15 >> ΔE(α 200MeV/u)/ΔE(p 200MeV)~ 4
  - ε(M2) decreases rapidly mostly due to δ-rays
  - low energy α may produce less high-energy δ-rays
  - If 400MeV p & 55MeV/u α detection is necessary in FDC2, fine tuning of HV is necessary
    - 55MeV/u ^{4}He ← energy-degraded ^{8}He
    - 400 MeV p ← (high energy) ^{3}t ?

Tentative Summary

- Detection of z=1 & z=2 in FDC2
  - fine tuning (optimization) between 2.3 kV ~ 2.6 kV necessary
    - minimizing ε_{M2}(z=2)
    - maximizing ε_{tot}(z=1)
    - <u>prefer to have ^{3}t beam calibration run in addition to ^{8}He beam</u>
  - After the optimization, it is probably possible to get
    - z=1 : ε_{tot}(z=1) > 95 %, σ(z=1)< 350 μm
    - z=2 : ε_{M1}(z=2)> 50%
  - S19
    - detection of both p & ^{4}He in FDC2
  - S34
    - detection of ^{3}t in FDC2