HGC update

Zhiwen Zhao
2019/02/19
2019/02/26
2019/03/05
2019/03/12
2019/03/19

info

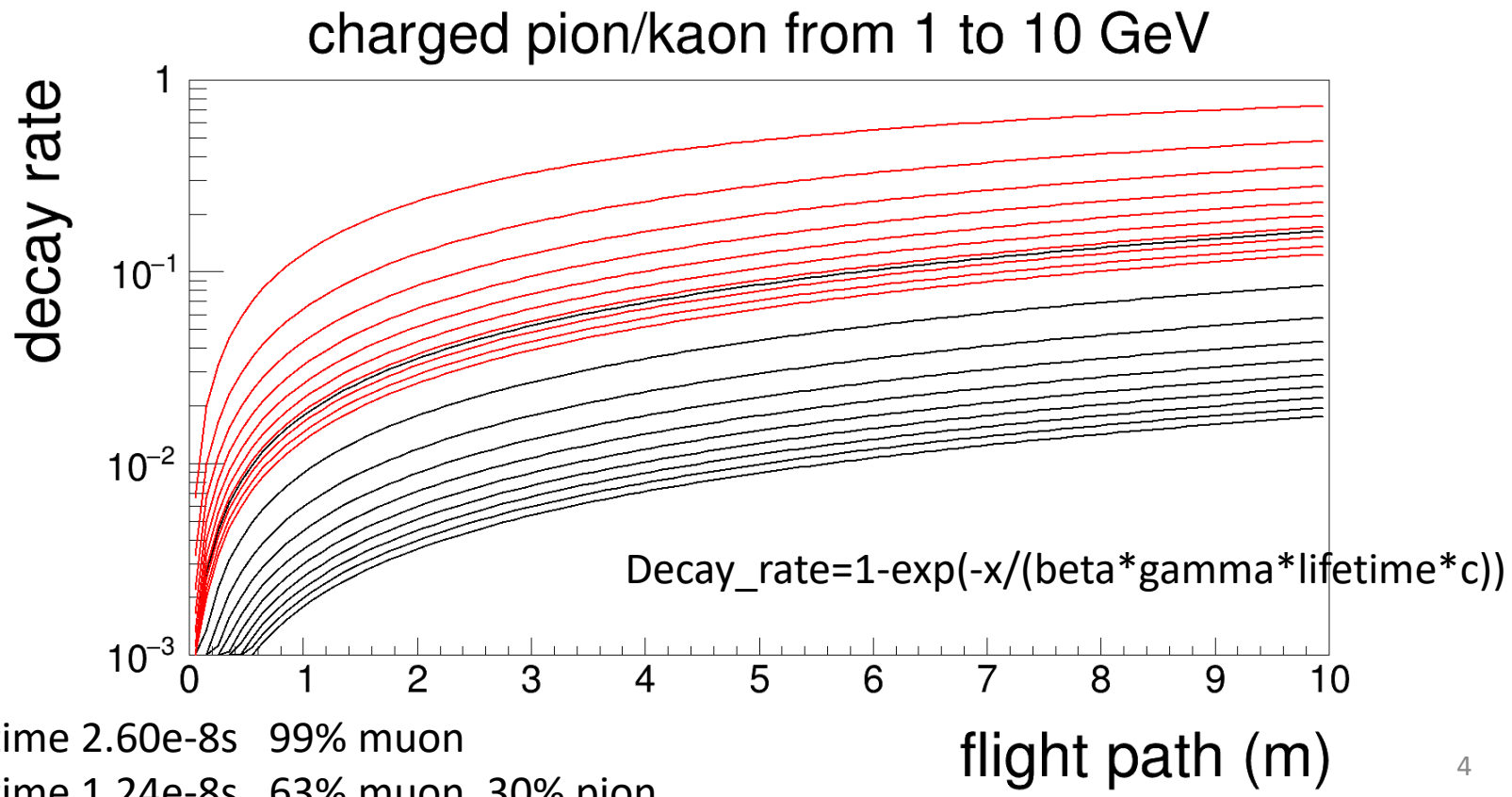
- HGC front window
  - Original : 0.043cm kevlar and 0.013cm mylar, 0.056cm, $0.002X_0$
  - CF_1: 3 mil mylar and 90 mil Carbon fiber, 0.24cm, 0.009X0 (current default)
  - Al_1: 40mil Al 2024T4, 0.1cm, $0.011X_0$
- HGC gas
  - C4F10 at 1.5atm, 100cm, $0.033X_0$
  - CO2 at 5atm, 100cm, $0.025X_0$
- LGC back window
  - 0.01cm Polyvinyl Fluoride $0.0004X_0$

Simulation note

- Three different simulation
  - “single particle clean”: simulation of standalone hgc in field with evenly distributed pion and kaon from the full He3 target position
  - “single particle dirty”: simulation of full SIDIS_He3 setup in field with evenly distributed pion and kaon from the full He3 target position
    - For current “hgc”, pion and kaon are 7-15deg and 1.5-7.5GeV and solenoidv8 field
  - “beam on target”: simulation of full SIDIS_He3 setup with 11GeV e- on target
- HGC change (future “hgc_moved” in longer endcap comparing to current “hgc”)
  - 20cm downstream
  - Cover 7-15deg instead of 8-15deg
  - Use 2D solenoidv9 field instead of 2D solenoidv8 field
- Other note
  - Software using jlab_version=1.3 and pass8 data
  - “single particle” simulated 1e5 pi- and 1e6 k-. All pion plots are scaled up by 10 so that they are in 1:1 ratio
  - Default Geant4 EM production threshold in non-sensitive material like windows is 1mm

Decay rate in vacuum with 6.7m flight path (from target to hgc window in current endcap)

Mom (Gev)	1	2	3	4	5	6	7	8	9	10
pim	0.113	0.058	0.039	0.030	0.024	0.020	0.017	0.015	0.013	0.012
km	0.589	0.359	0.257	0.200	0.163	0.138	0.119	0.105	0.094	0.085



pi- life time 2.60e-8s 99% muon

K- life time 1.24e-8s 63% muon, 30% pion

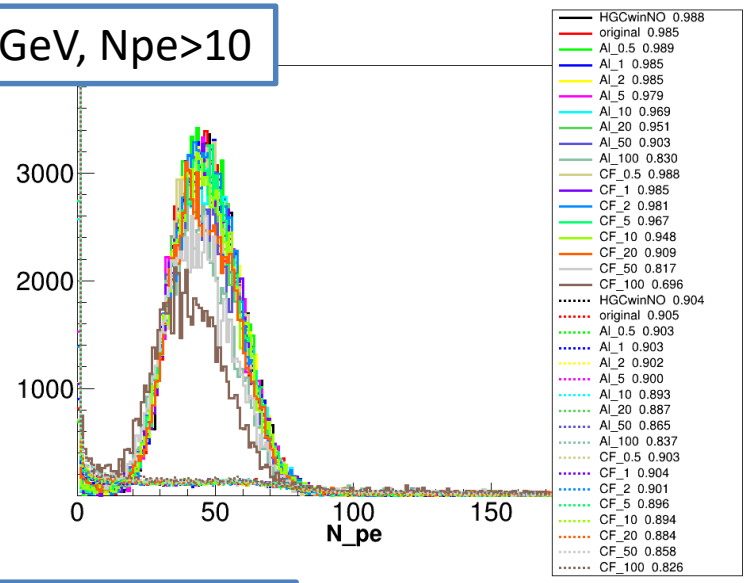
"single particle clean" with "hgc_moved"

eff at target

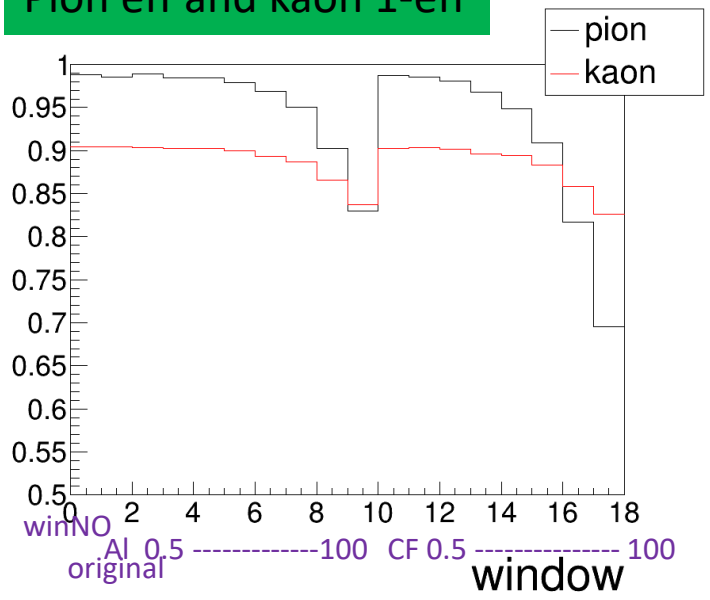
Full Vz

(The probability of a particle from target passing hgc cut)

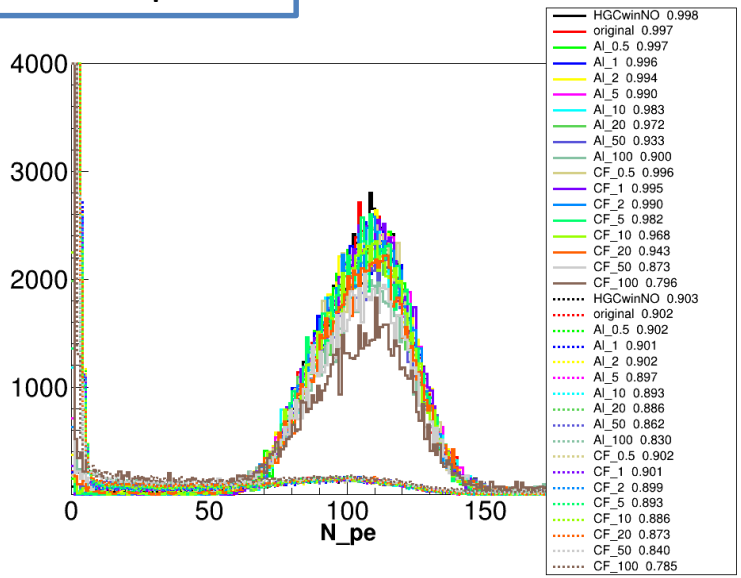
2.5-3.0 GeV, Npe>10

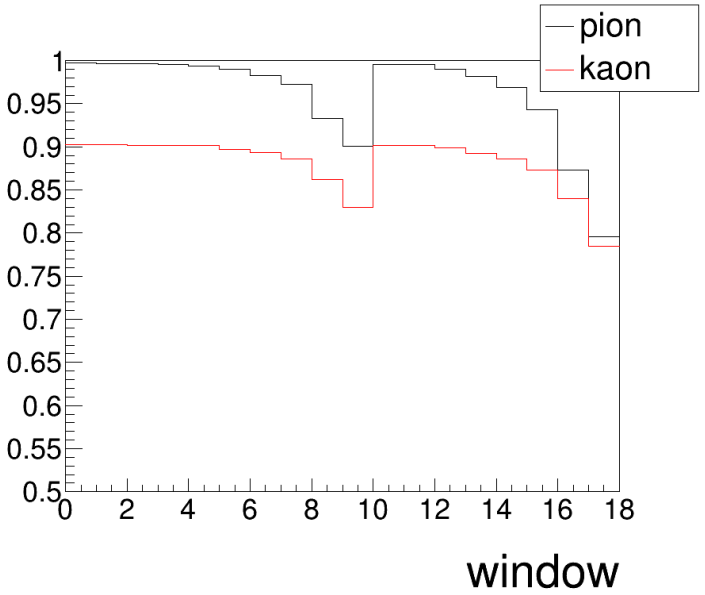


Pion eff and kaon 1-eff



7.0-7.5 GeV , Npe>30





"single particle dirty" with "hgc_moved"

eff at target

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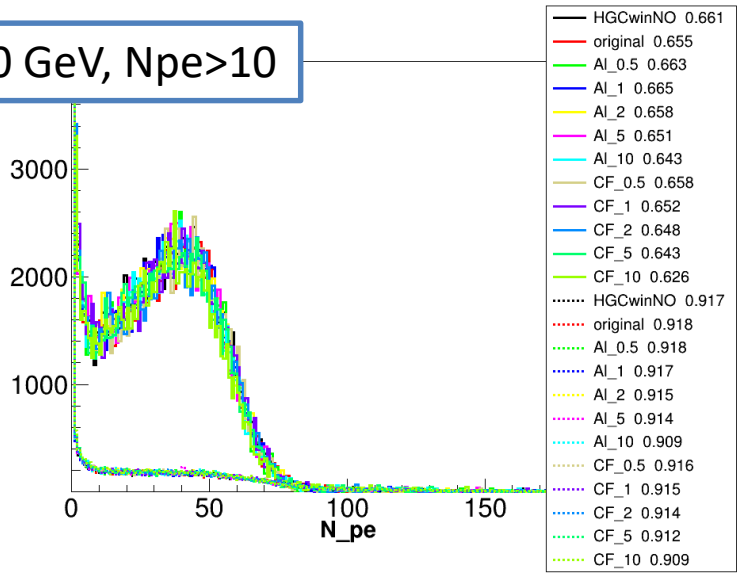

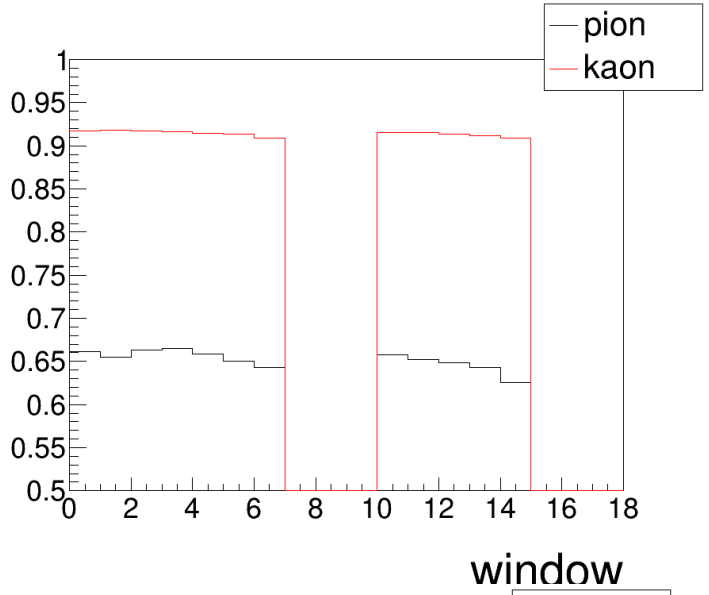

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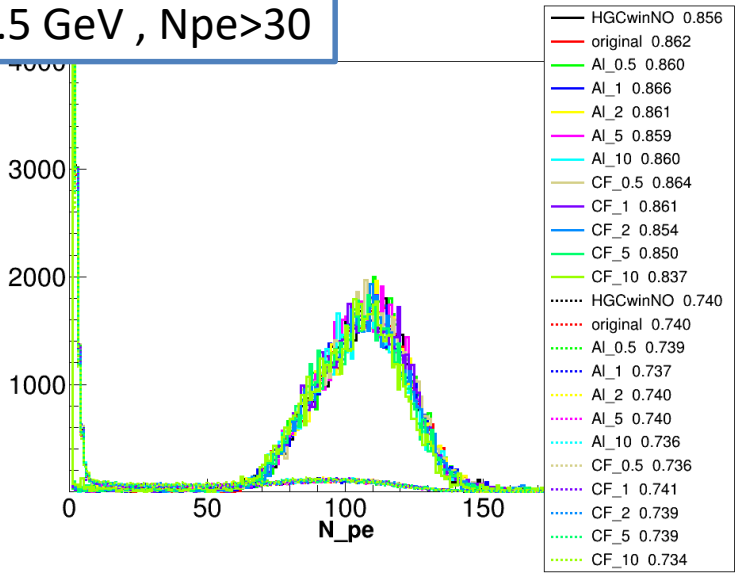
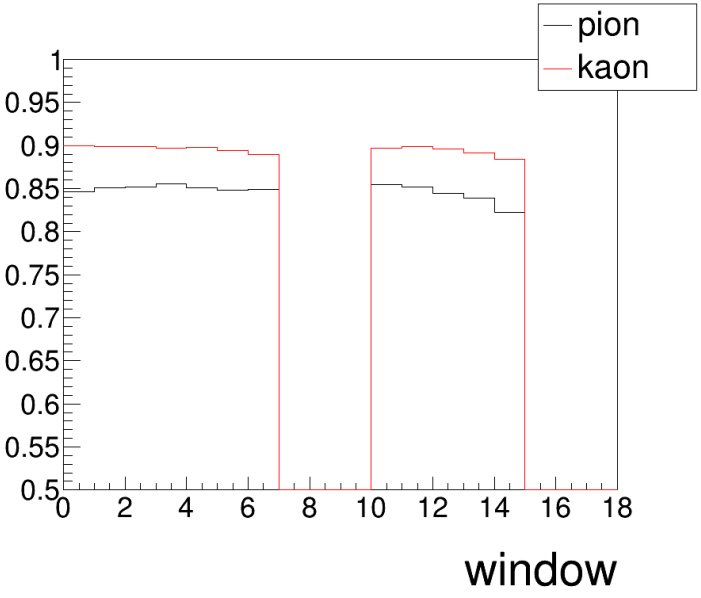




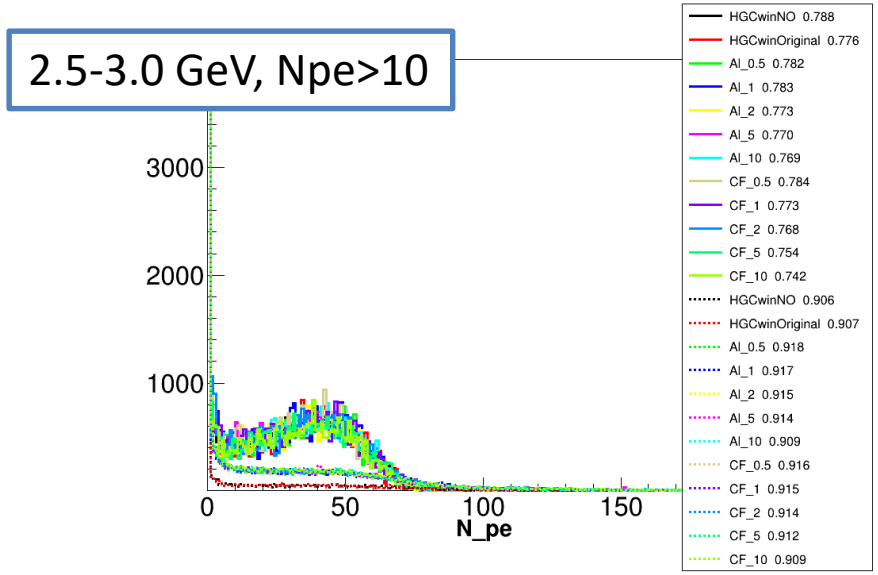
"single particle dirty" with "hgc_moved"

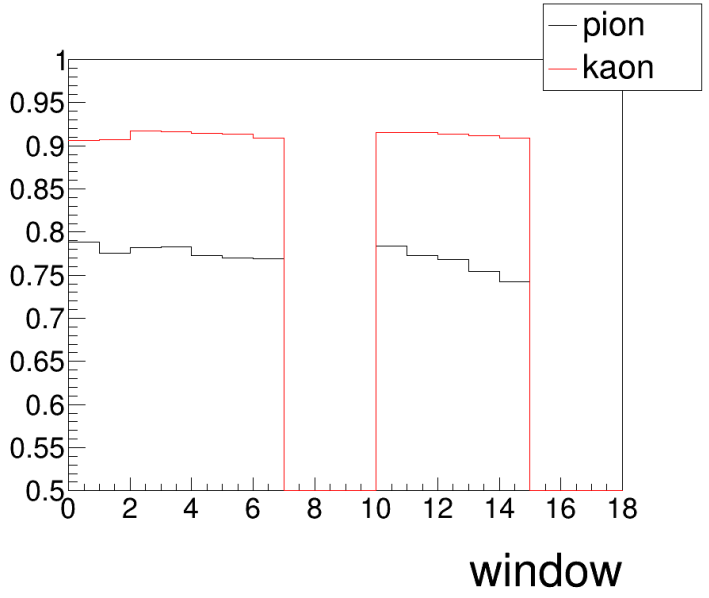
eff at target

Vz middle 10cm

(The probability of a particle from target passing hgc cut)

2.5-3.0 GeV, Npe>10





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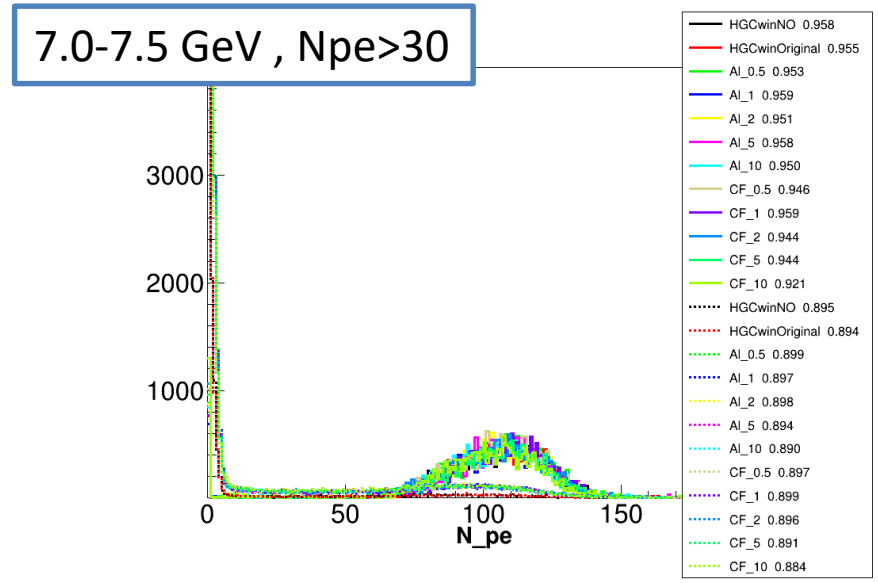
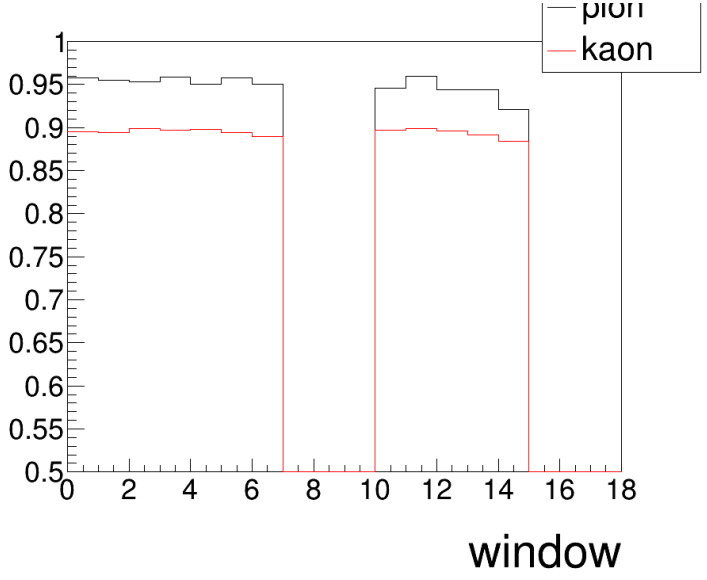
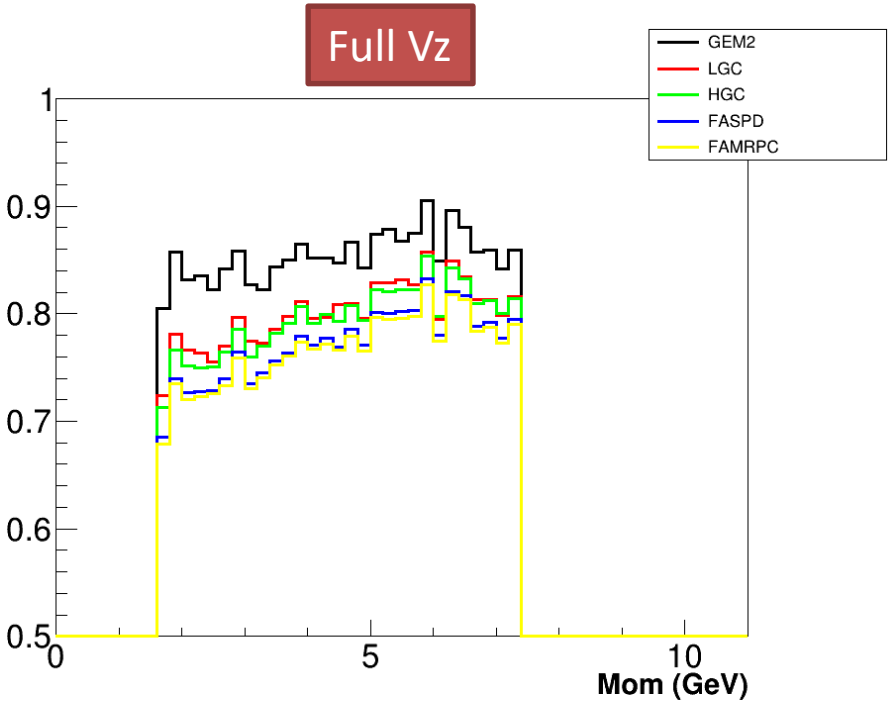
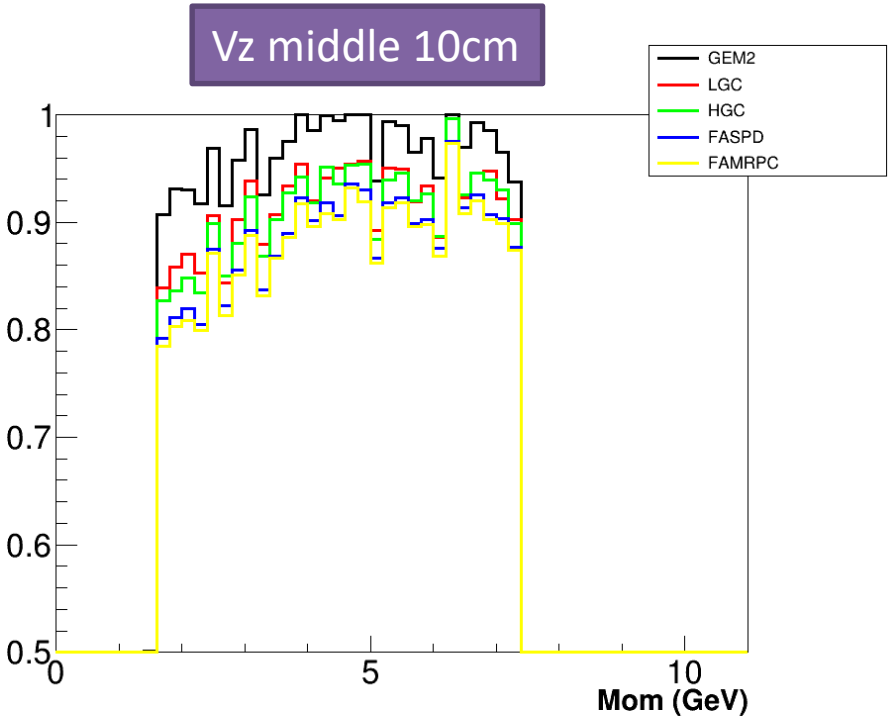




"single particle dirty" with "hgc_moved"

Pim decay



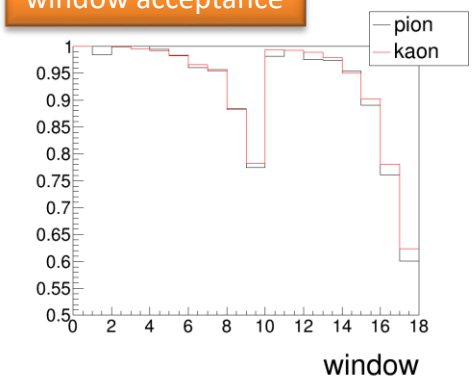


eff behind hgc window

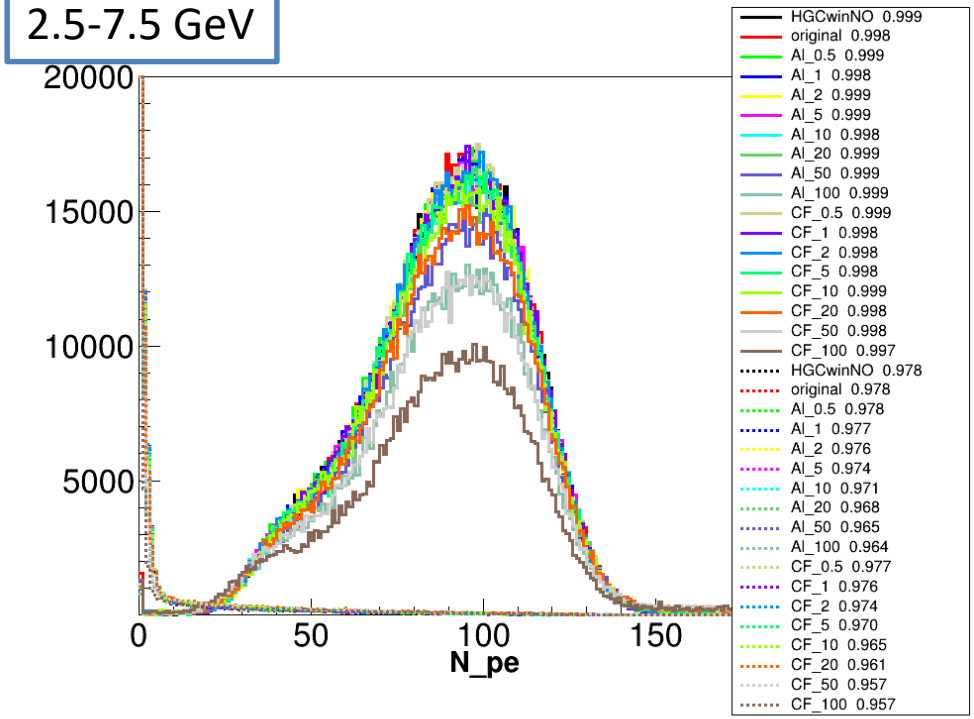
(The probability of a particle behind hgc window passing hgc cut)

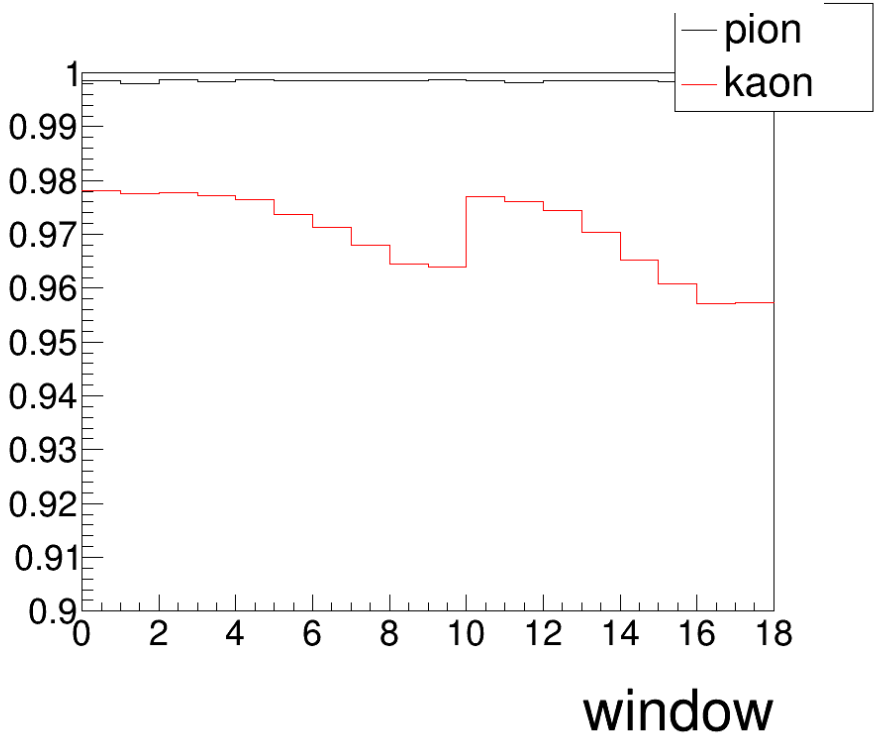
- For eff behind hgc window, pion doesn’t depend on window and kaon does with a very small range
- window acceptance (number of primary particle before/after hgc window) depends on window strongly
- eff at target is a combined result of eff behind hgc window and window acceptance while window acceptance dominates

window acceptance



2.5-7.5 GeV



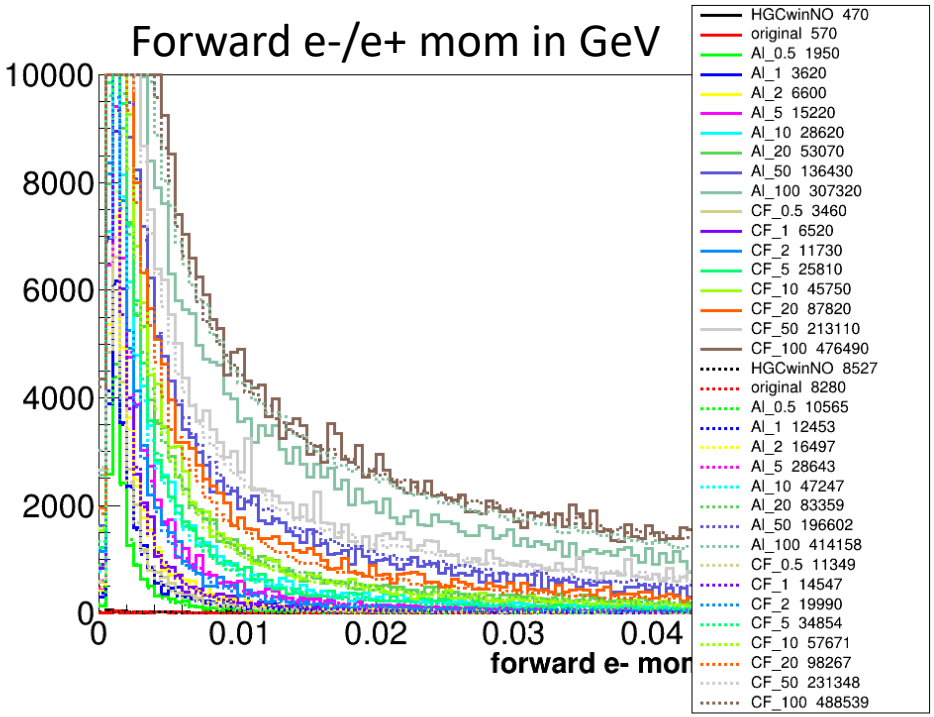


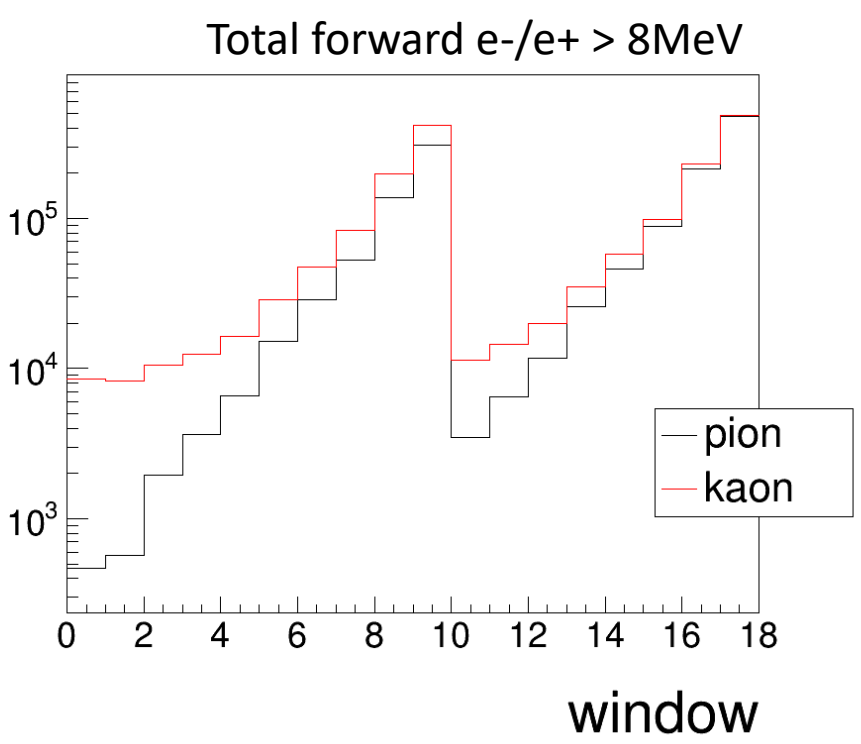
Delta ray (Forward e-/e+ right after hgc window produced by pion and kaon)

- For 1e6 primary particle, delta ray per primary particle << 1

$$\frac{d^2N}{dTdx} = \frac{1}{2} K z^2 \frac{Z}{A} \frac{1}{\beta^2} \frac{F(T)}{T^2}$$

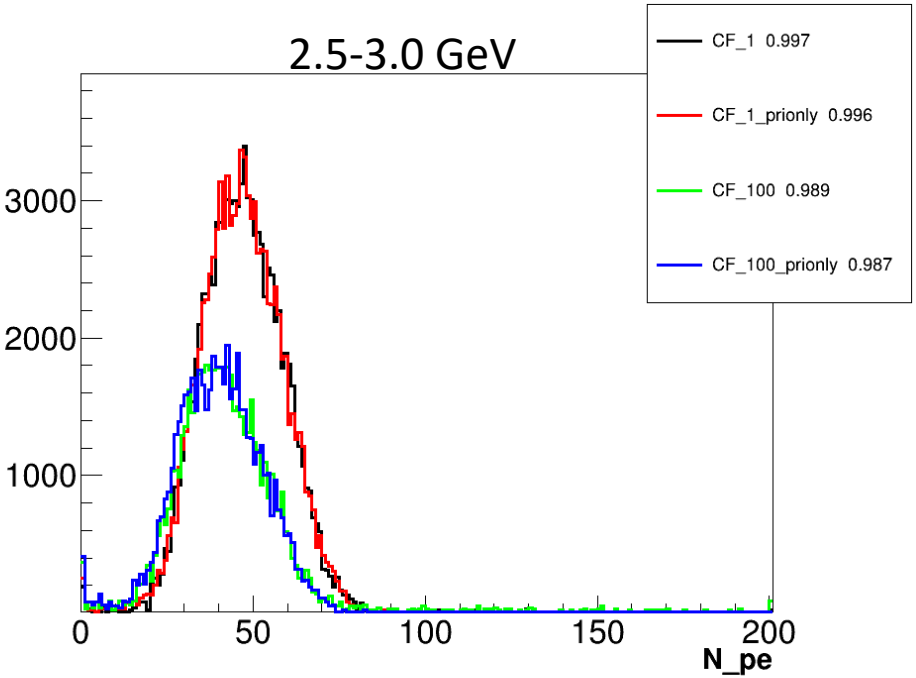
C,Al, F have equal Z/A=0.5
electron mom threshold ~8MeV for 1.5atm C4F10

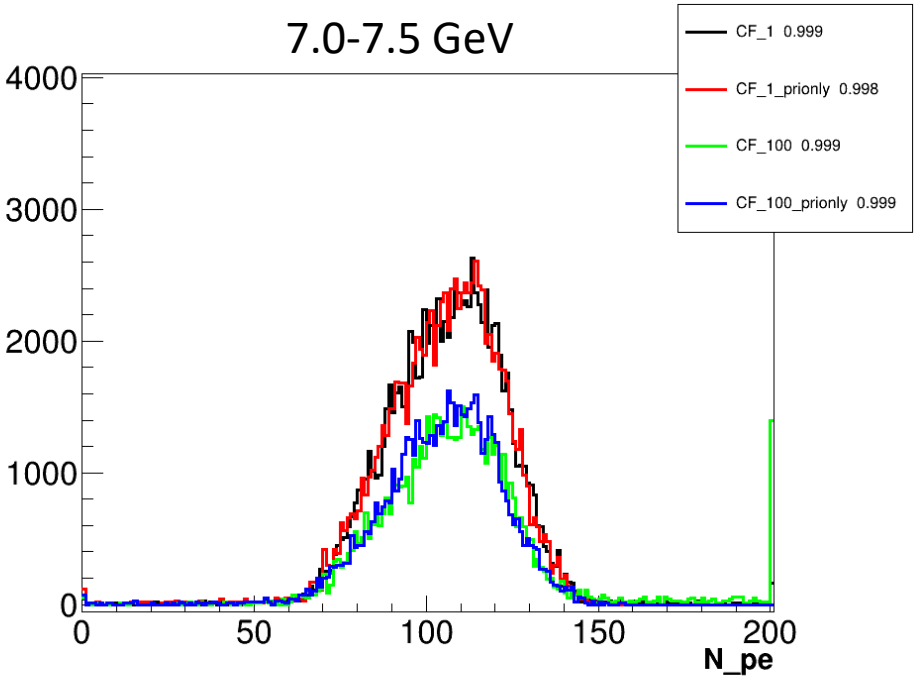




Delta ray contribute to hgc signal?

- Compare pion “eff behind hgc window” between detected Cerenkov photons from any source and from primary pion only
- hgc cut > 5 pe
- Both CF1 and CF100 show primary pion give dominating signal

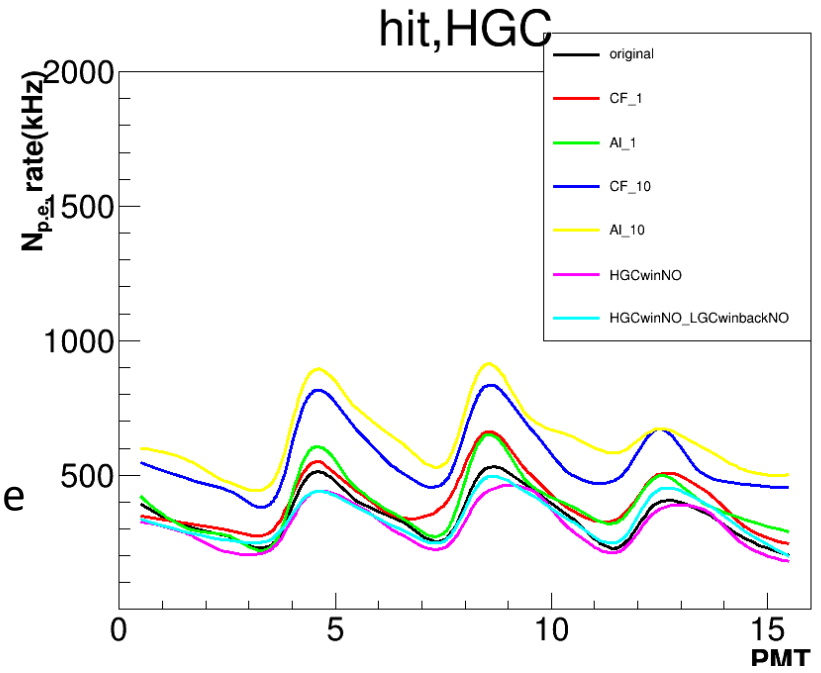


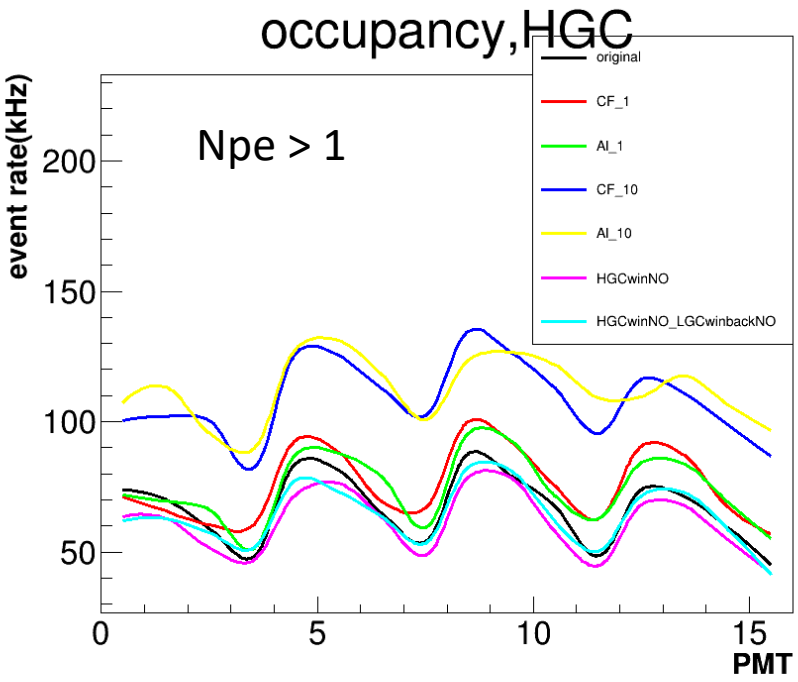


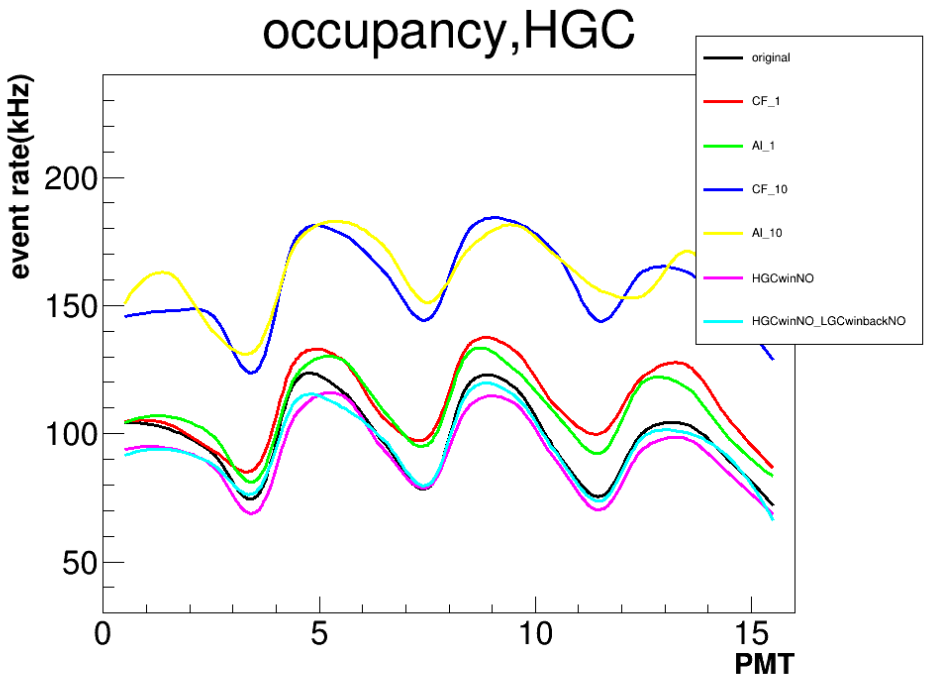
“Beam on target” with “hgc”

1000e3 kHz Npe rate per PMT and 50ns
1000e3*50e-9=0.05 pe per PMT

2 sector with 32 PMTs for each primary particle
0.05*32=1.6 pe for each primary particle







backup

Hgc plot in preCDR

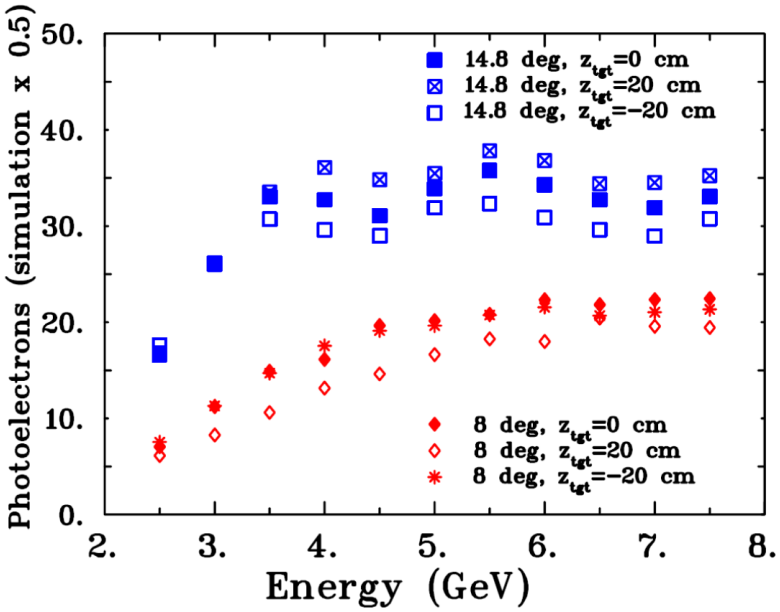


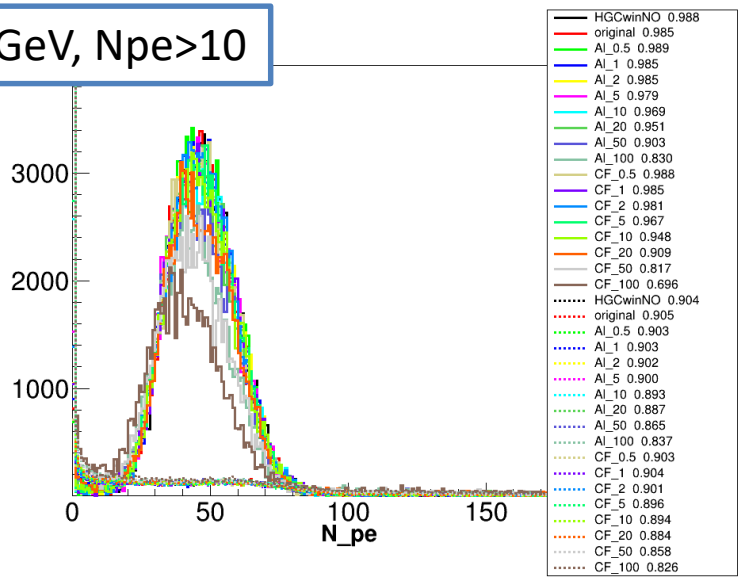
Figure 83: Simulated number of photoelectrons as a function of the pion polar angle and momentum. The results are shown for positive pions. A very similar output is obtained for negative pions.

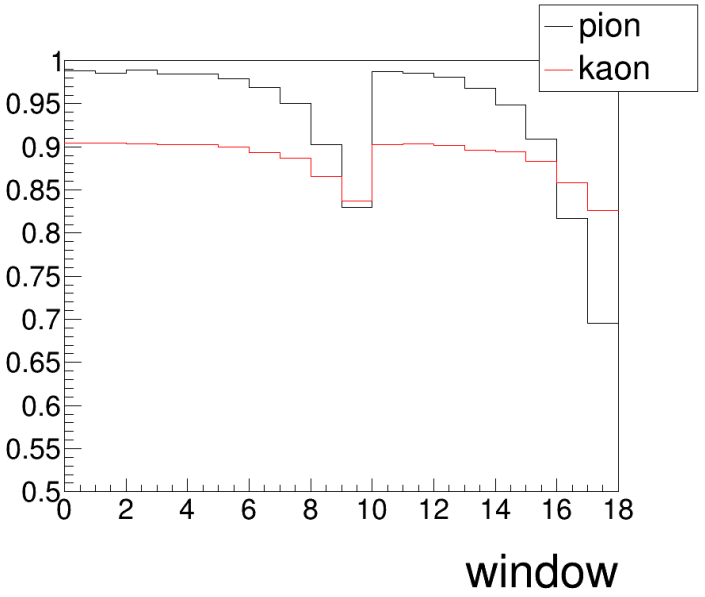
"single particle clean" with "hgc_moved"

eff at target

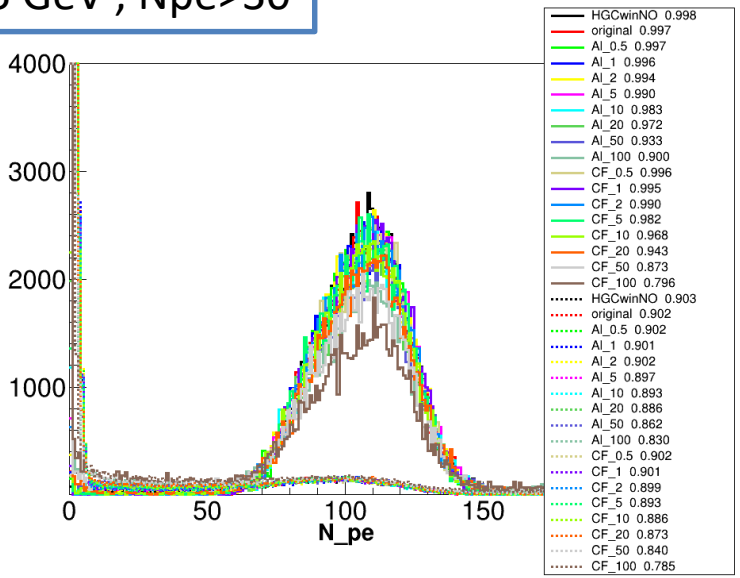
(The probability of a pion/kaon from target passing hgc cut)

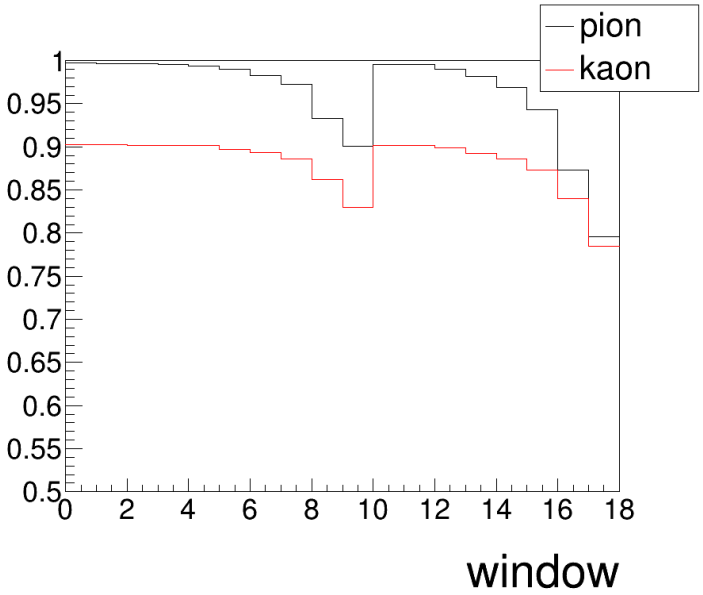
2.5-3.0 GeV, Npe>10





7.0-7.5 GeV , Npe>30



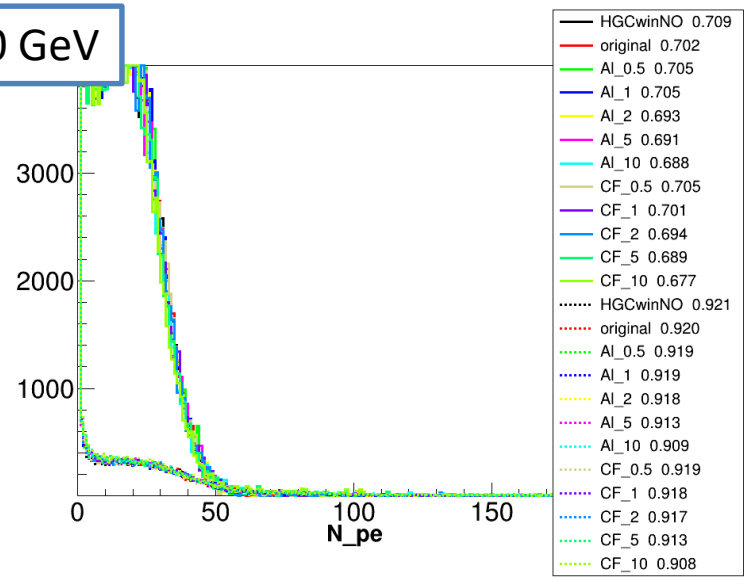


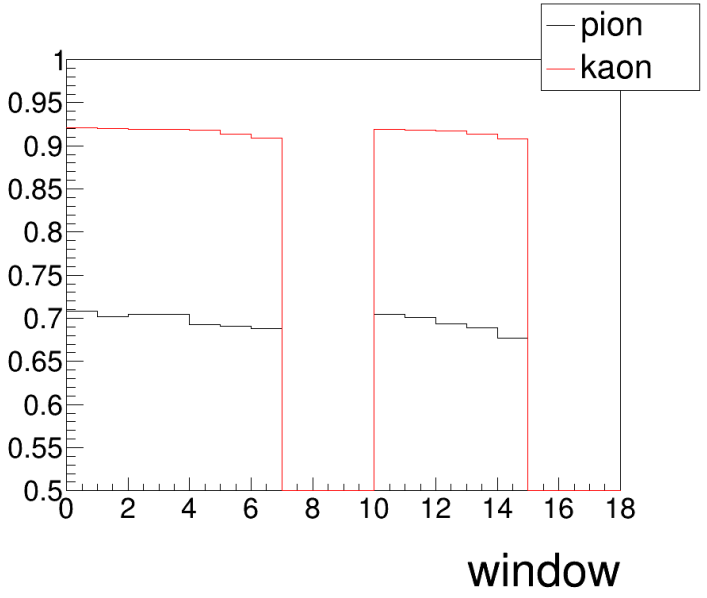
"single particle clean" with "hgc"

eff at target

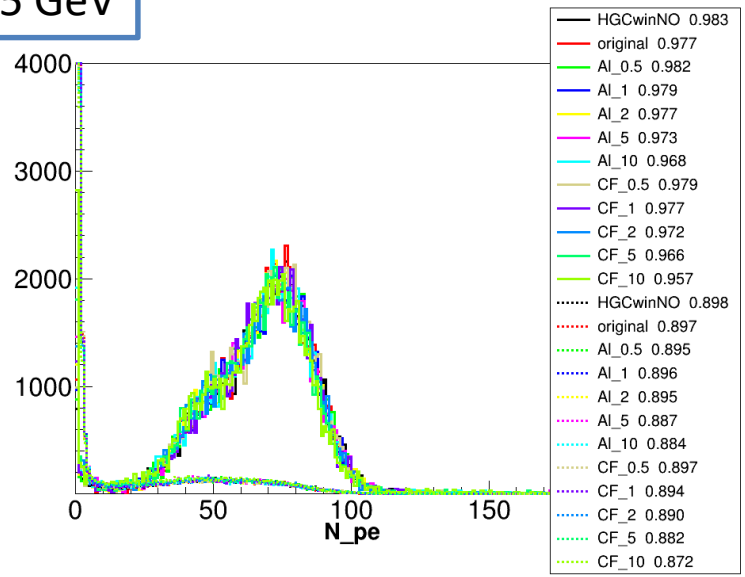
(The probability of a pion/kaon from target passing hgc cut)

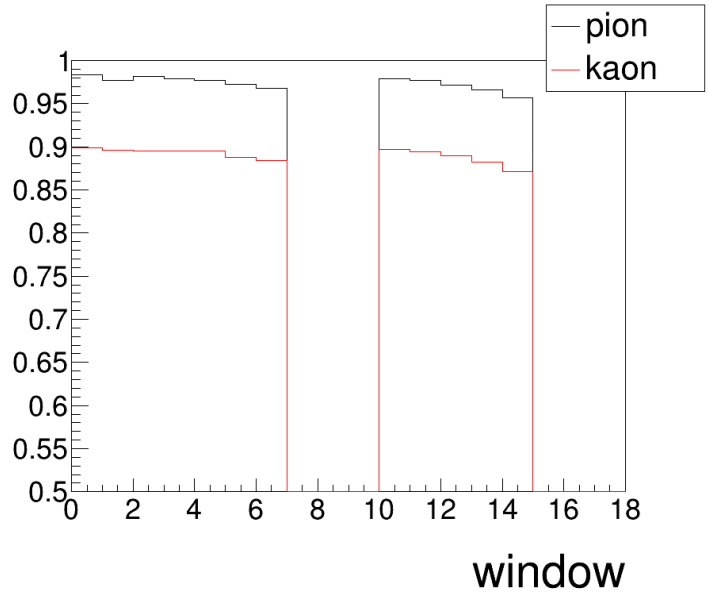
2.5-3.0 GeV





7.0-7.5 GeV



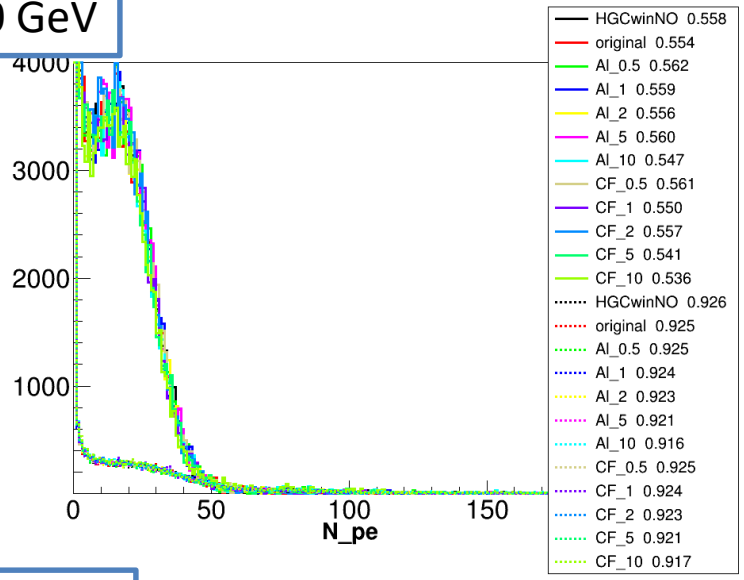


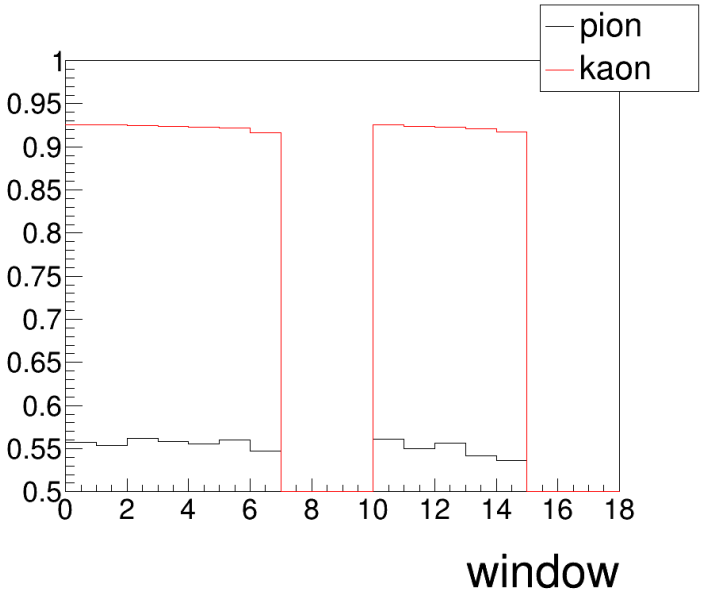
"single particle dirty" with "hgc"

eff at target

(The probability of a pion/kaon from target passing hgc cut)

2.5-3.0 GeV





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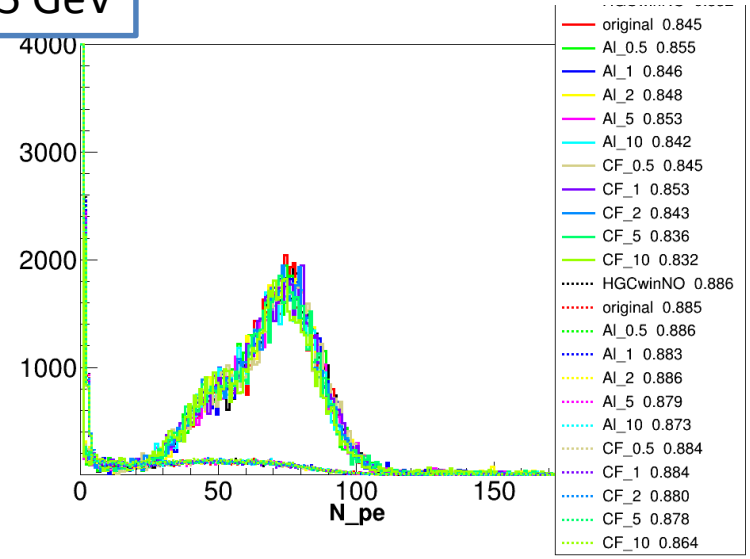
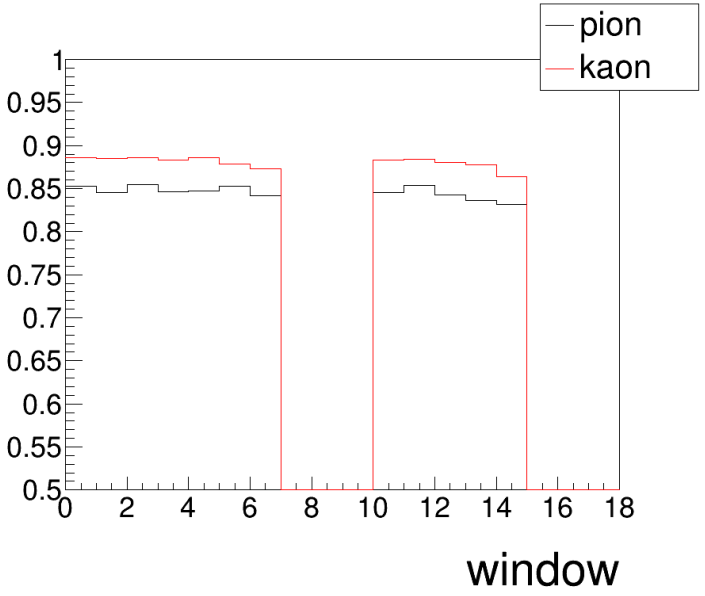
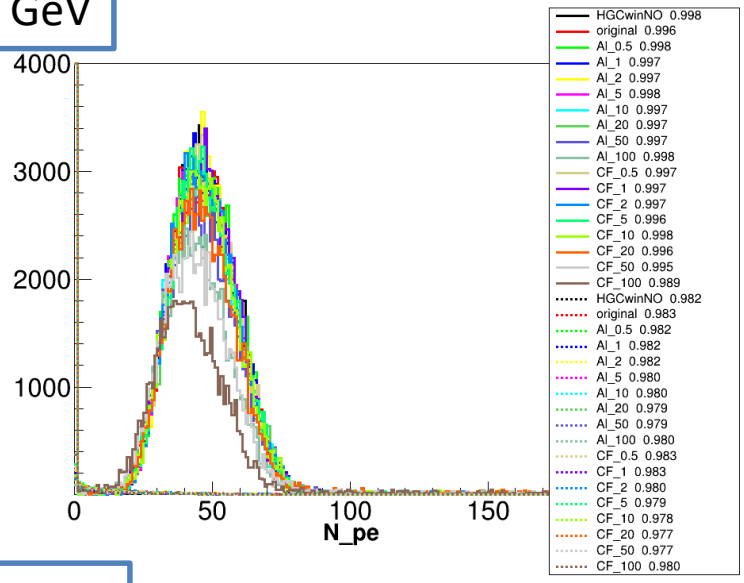


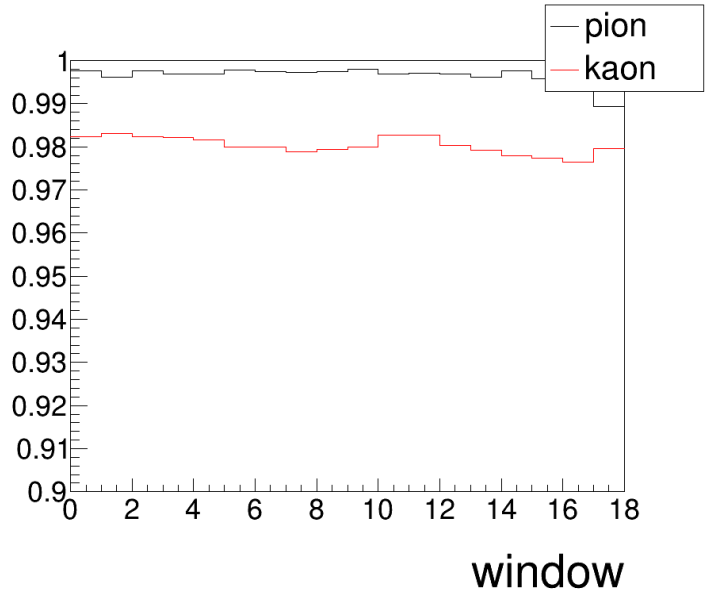


"single particle clean" with "hgc_moved"

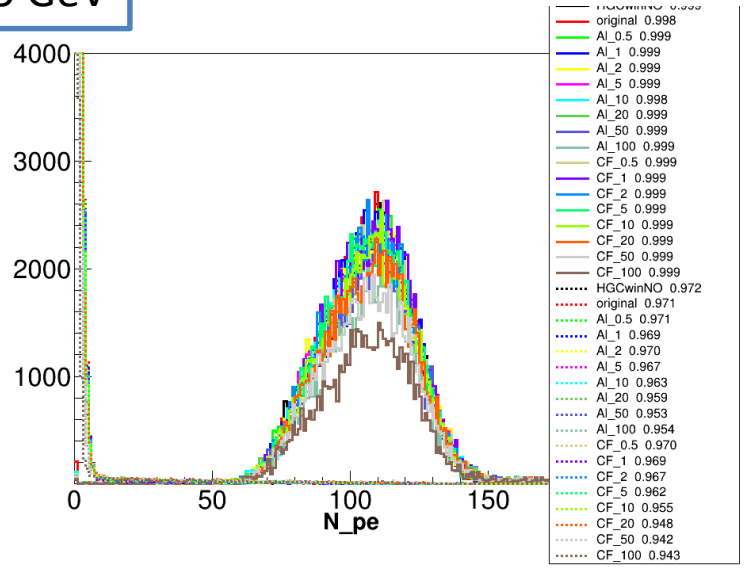
eff behind hgc window
(The probability of a pion/kaon from target passing hgc cut)

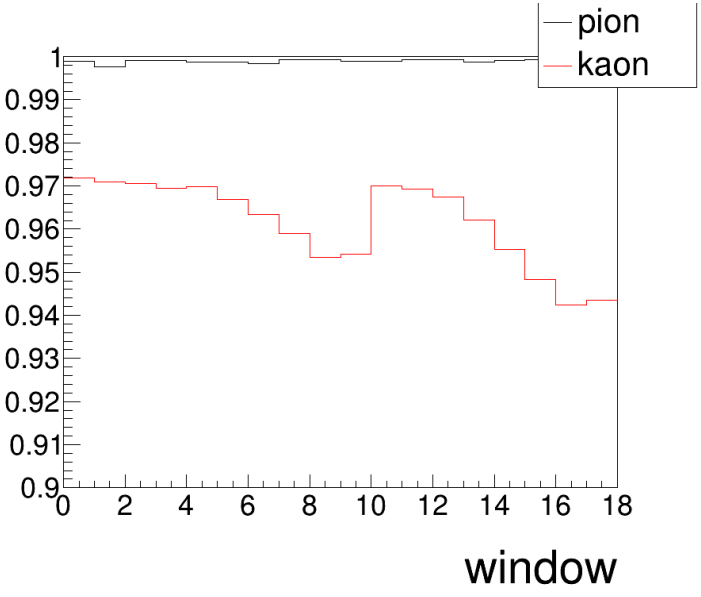
2.5-3.0 GeV





7.0-7.5 GeV





Delta ray (Forward e-/e+ right after hgc window produced by pion and kaon)

- "single particle clean" with "hgc"

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