HGC update

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2019/02/19

2019/02/26

2019/03/05

2019/03/12

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

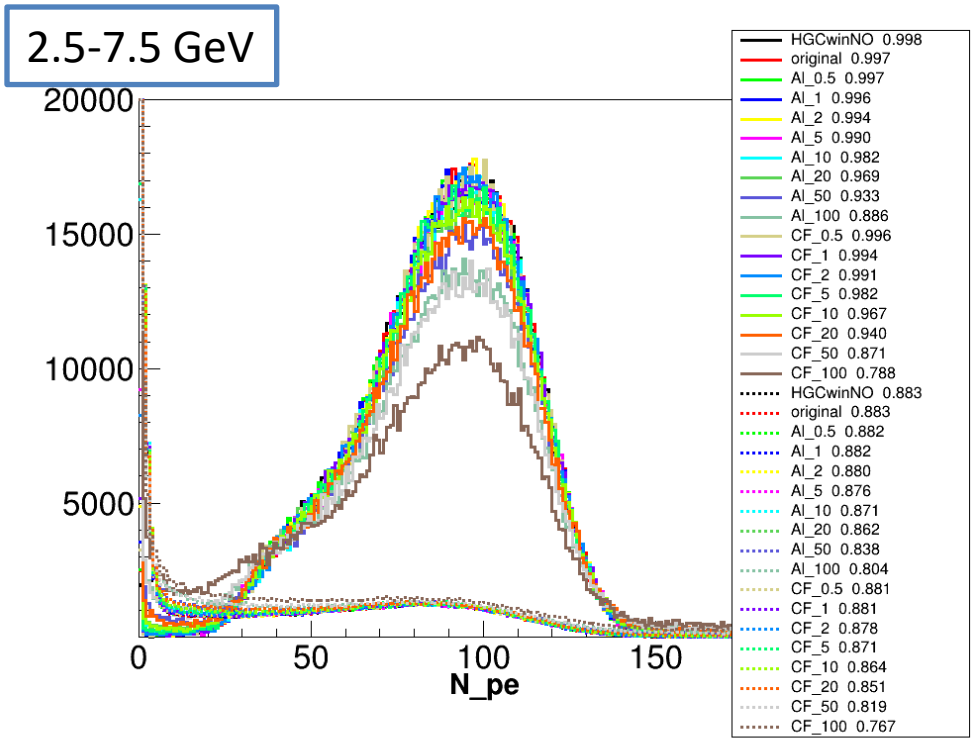
- Three different simulation
  - “single particle clean”: simulation of standalone hgc in field with evenly distributed pion and kaon from the full He3 target position
    - For current “hgc”, pion and kaon are 7-15deg and 1.5-7.5GeV and solenoidv8 field
    - For future “hgc_moved”, pion and kaon are 7-15deg and 2.5-7.5GeV and solenoidv9 field
  - “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
- Other note
  - Software using jlab_version=1.3 and pass8 data
  - current “hgc” is designed for 8-15deg and future “hgc_moved” is designed for 7-15deg
  - “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 Production threshold in non-sensitive material is 1mm

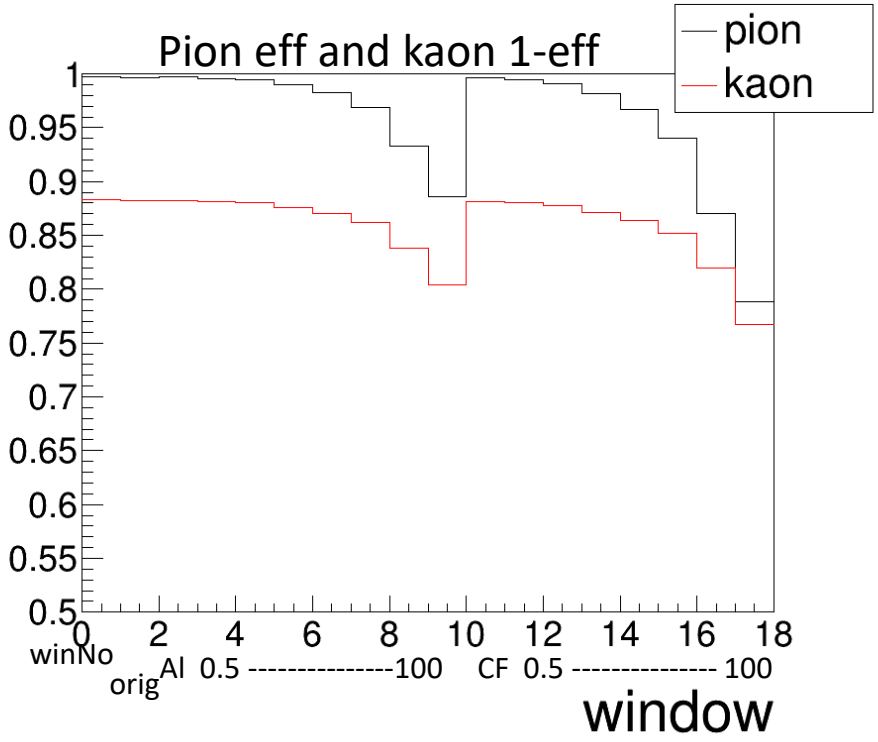
"single particle clean" with "hgc_moved"

eff at target

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

- hgc cut > 5 pe, Pion shows eff and Kaon shows 1-eff and both are the higher the better
- Al_5 and CF_2 start to show eff loss



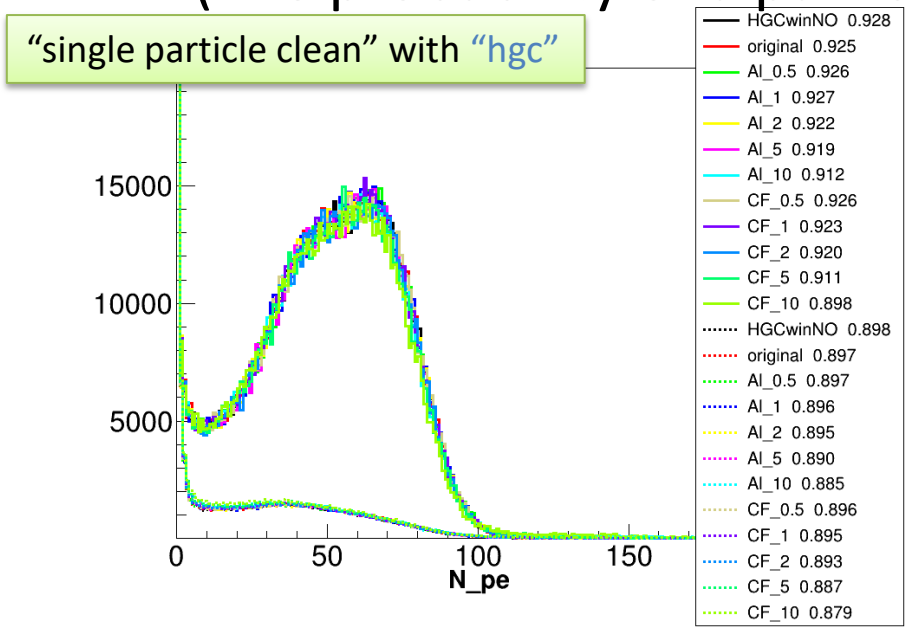


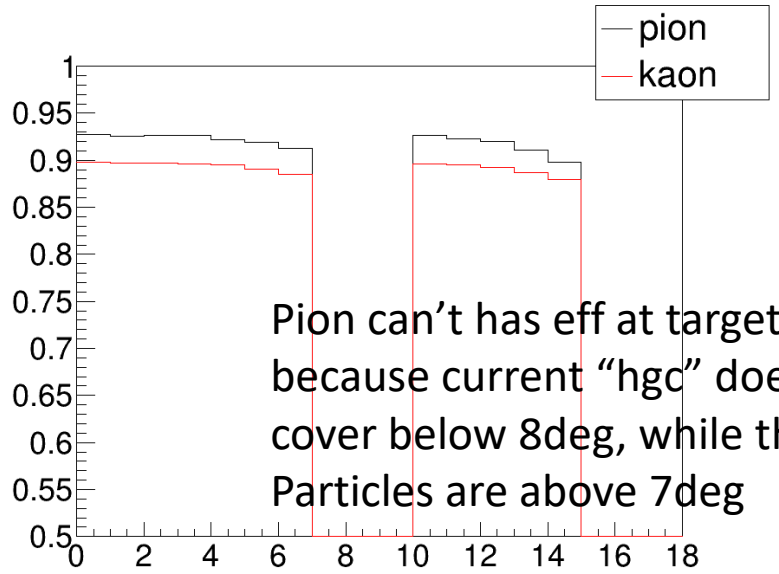
eff at target

2.5-7.5 GeV

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

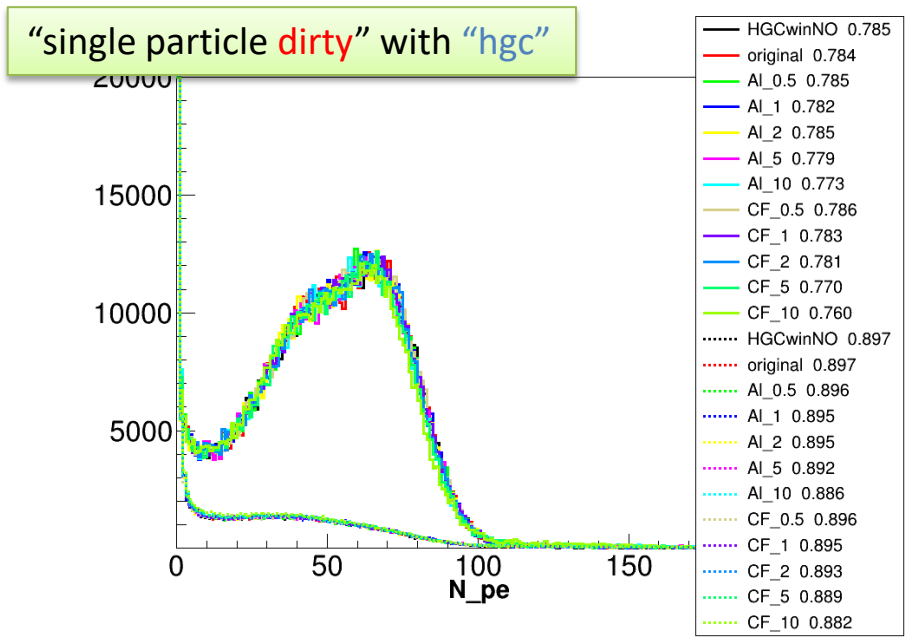
"single particle clean" with "hgc"

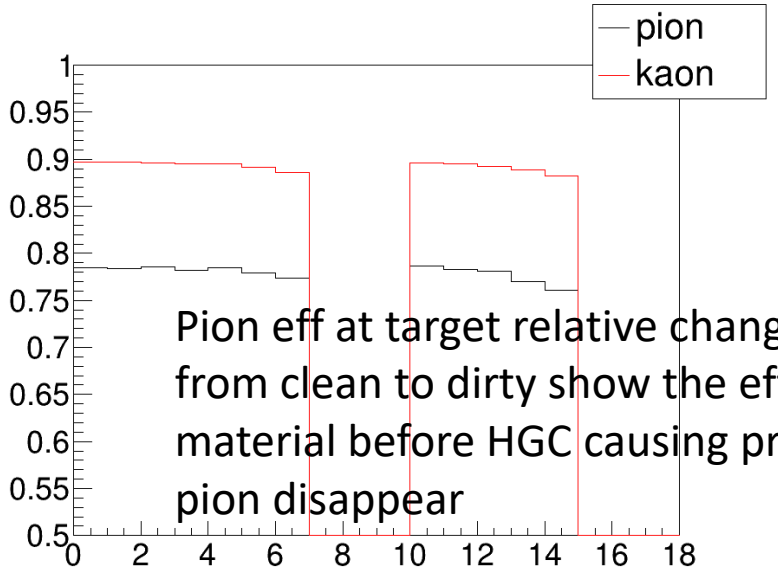




Pion can't has eff at target ~1 because current "hgc" doesn't cover below 8deg, while thrown Particles are above 7deg

"single particle dirty" with "hgc"





Pion eff at target relative change from clean to dirty show the effect of material before HGC causing primary pion disappear

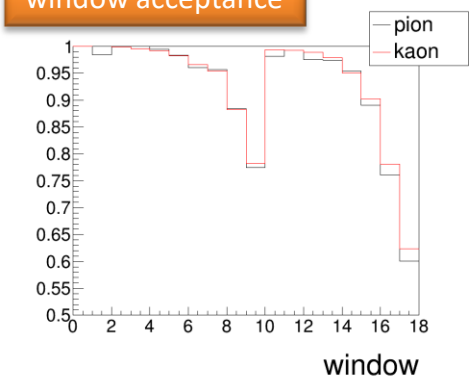
window

eff behind hgc window

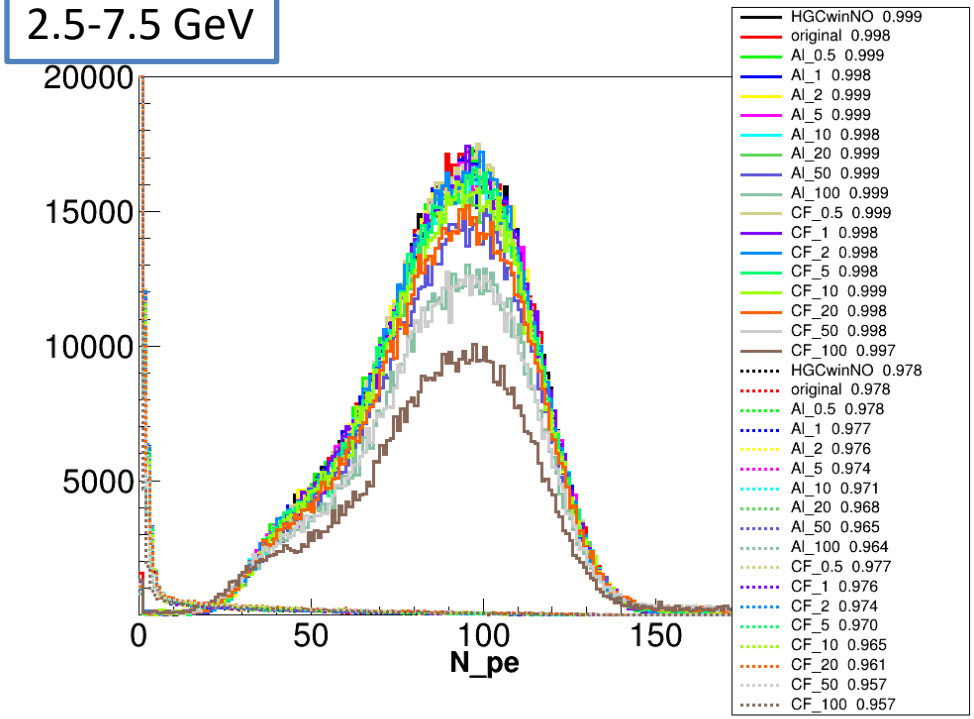
(The probability of a particle behind hgc window passing hgc cut)

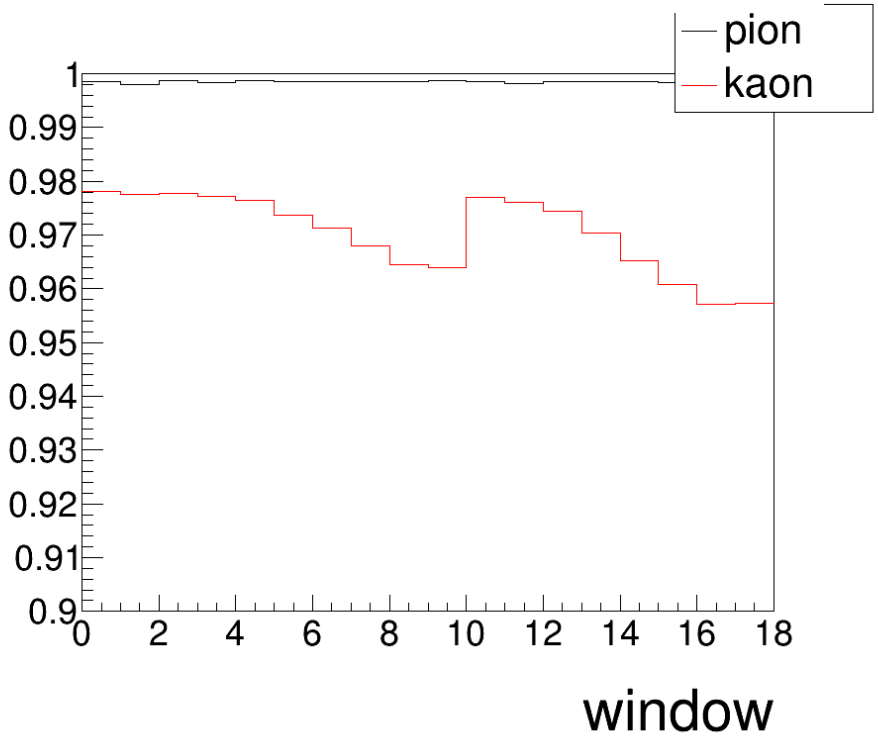
- For eff behind hgc window, pion doesn’t depend on window and kaon does with a very small range
- window acceptance (number of primary particle before/after hgc window) depends on window strongly
- eff at target is a combined result of eff behind hgc window and window acceptance while window acceptance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

window acceptance



2.5-7.5 GeV





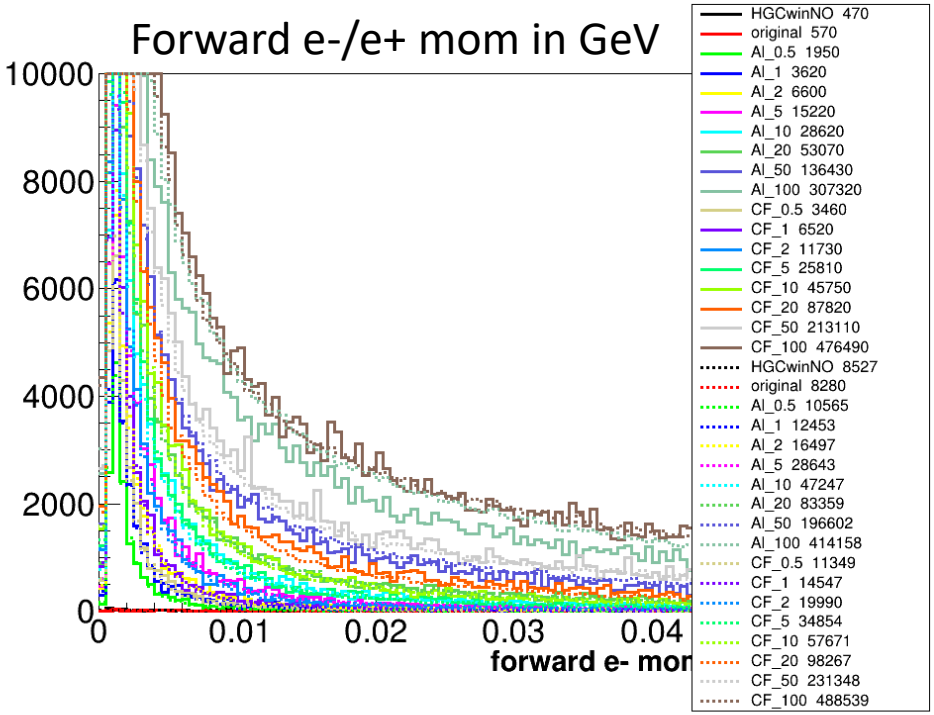
"single particle clean" with "hgc_moved"

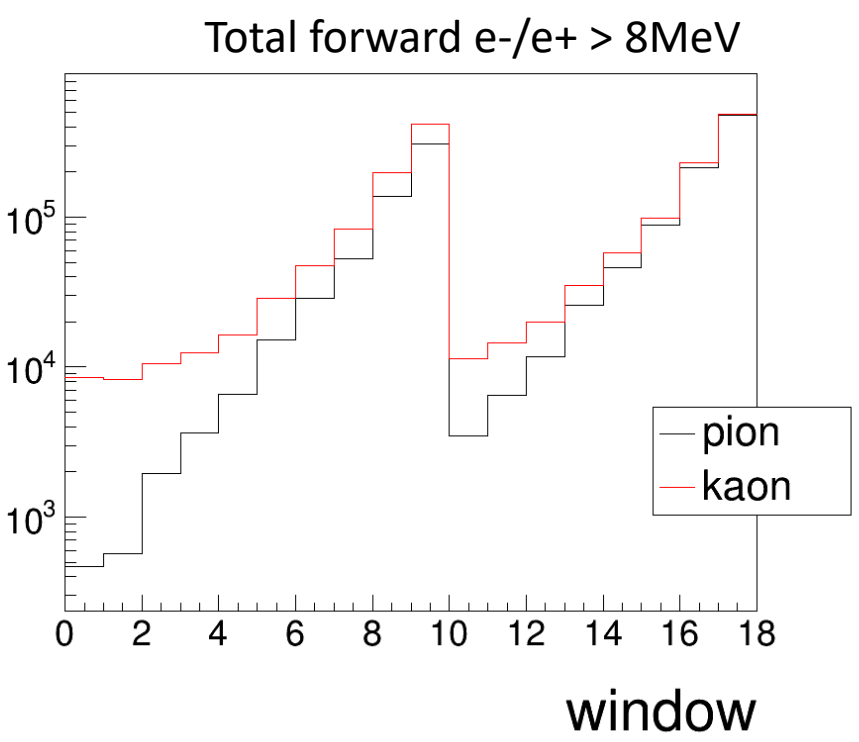
Delta ray (Forward e-/e+ right after hgc window produced by pion and kaon)

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

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

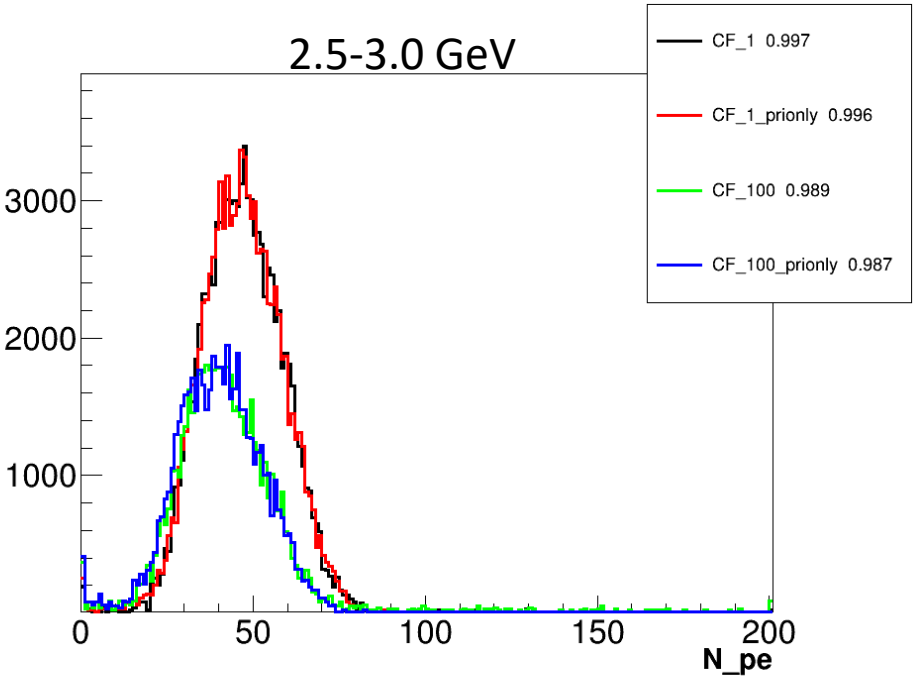
C,Al, F have equal Z/A=0.5
electron mom threshold ~8MeV for 1.5atm C4F10

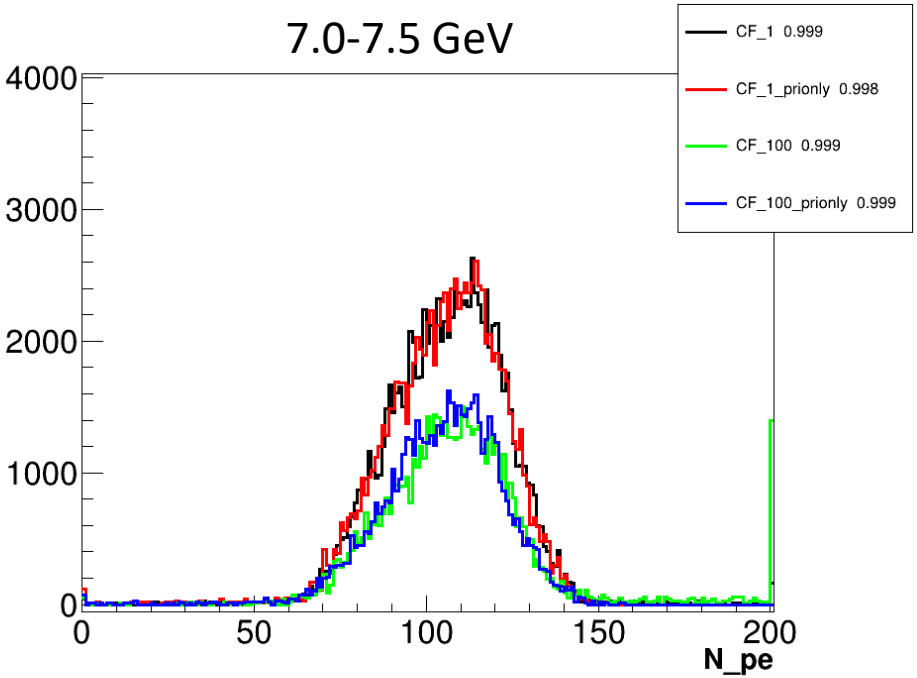




Delta ray contribute to hgc signal?

- 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

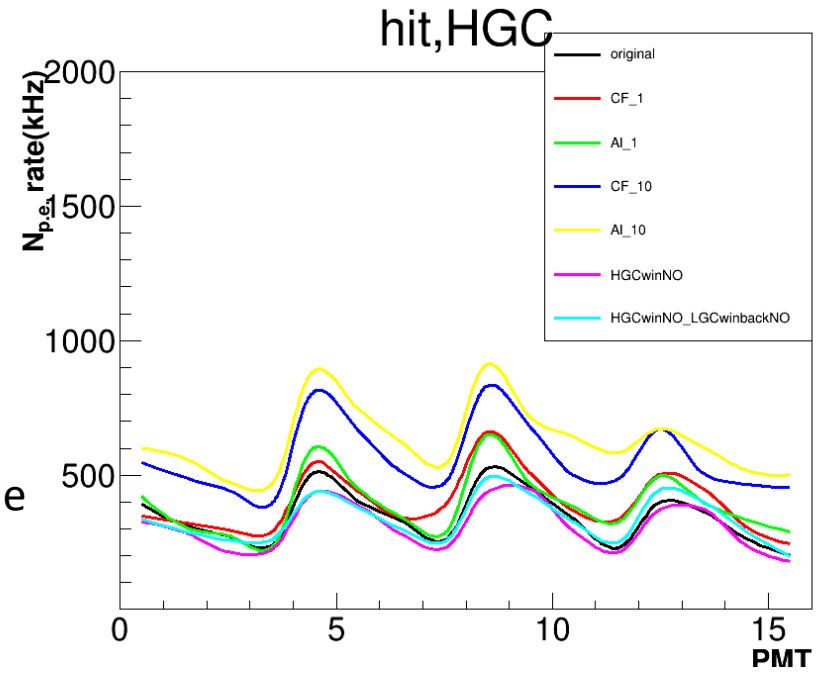


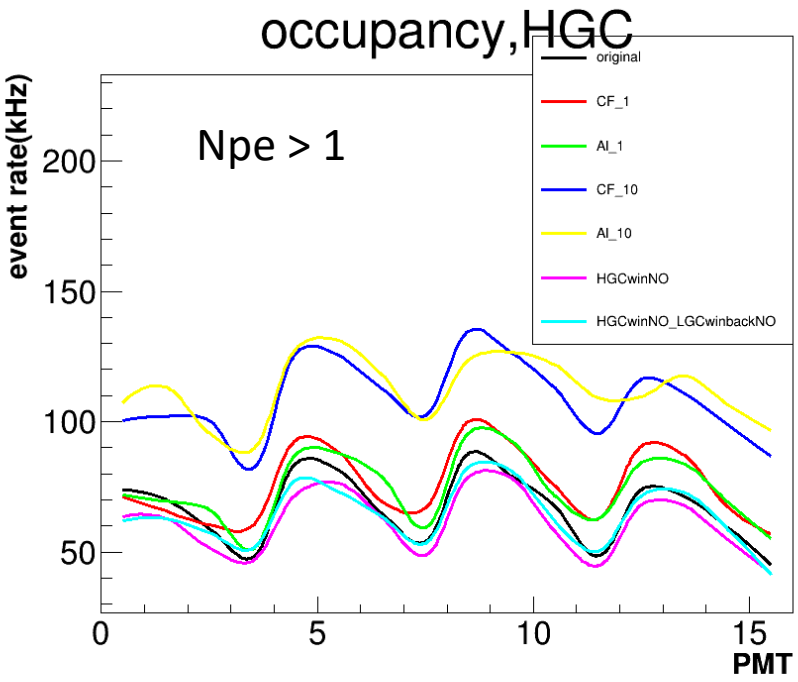


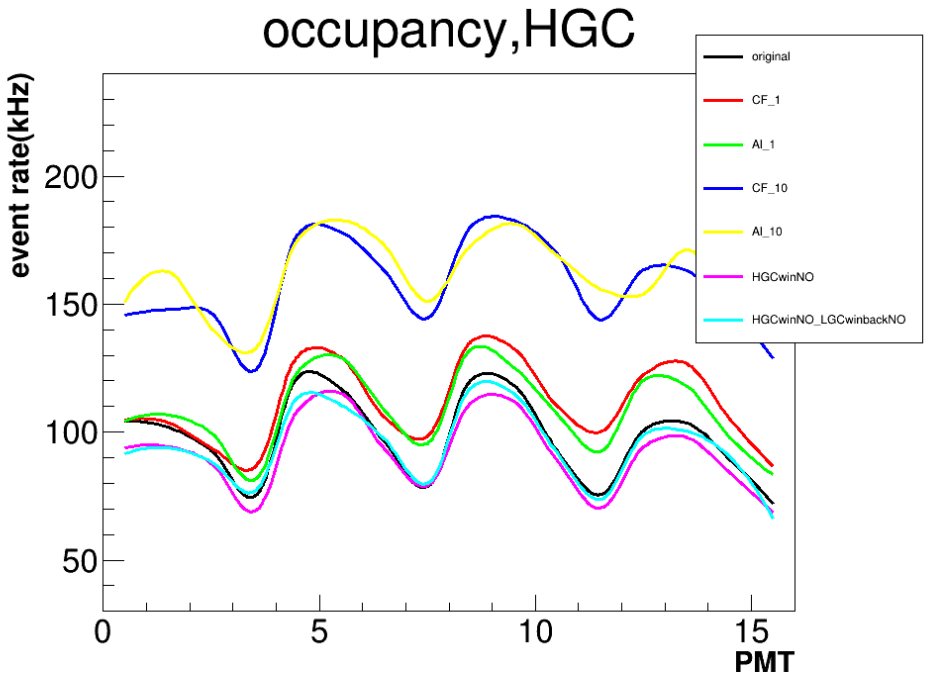
“Beam on target” with “hgc”

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

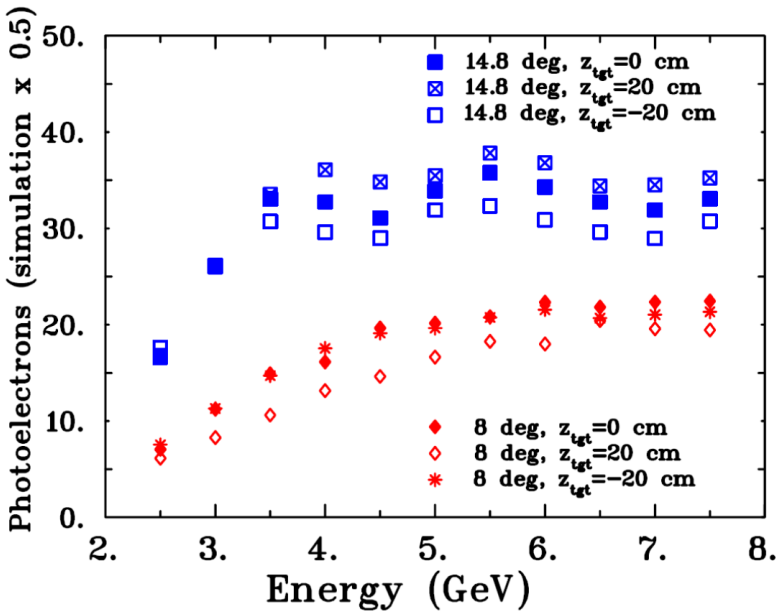


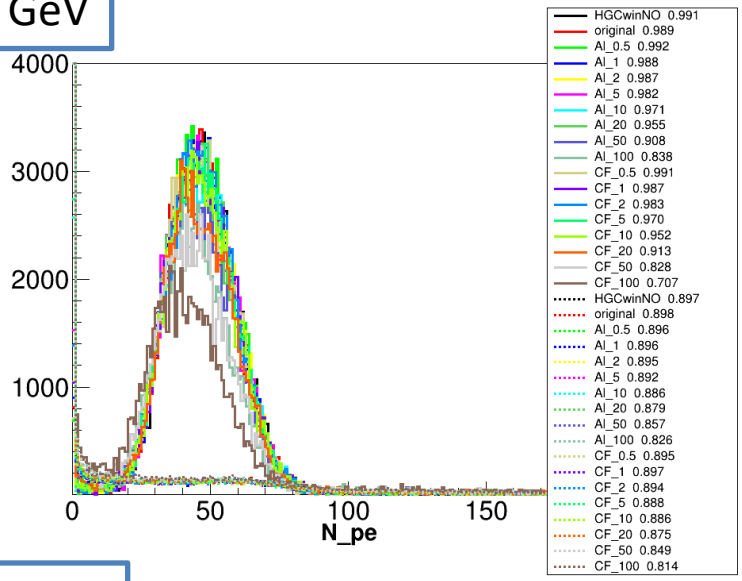
Figure 83: Simulated number of photoelectrons as a function of the pion polar angle and momentum. The results are shown for positive pions. A very similar output is obtained for negative pions.

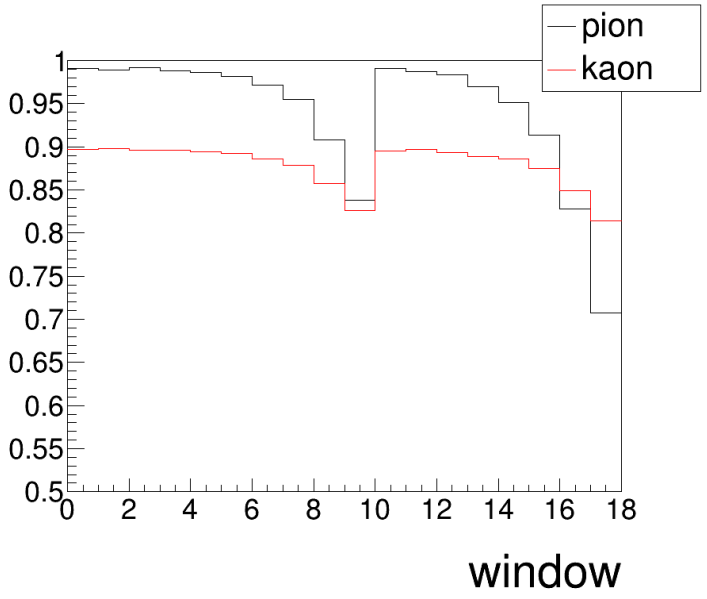
"single particle clean" with "hgc_moved"

eff at target

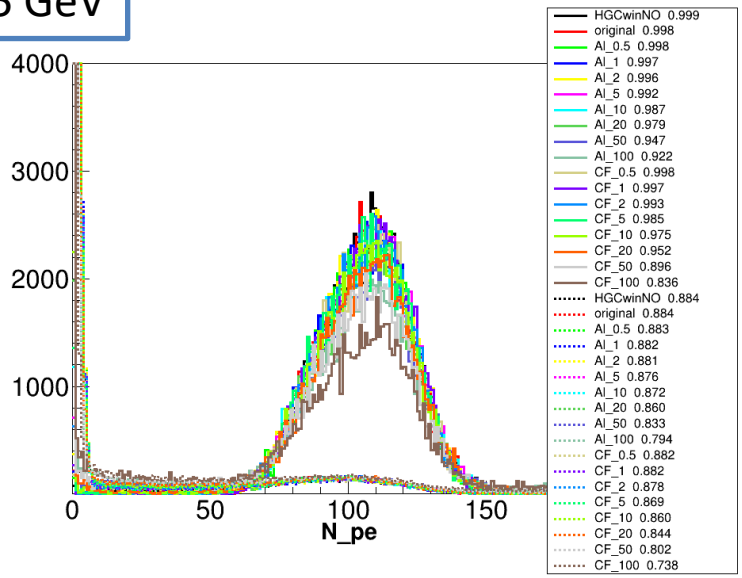
(The probability of a pion/kaon from target passing hgc cut)

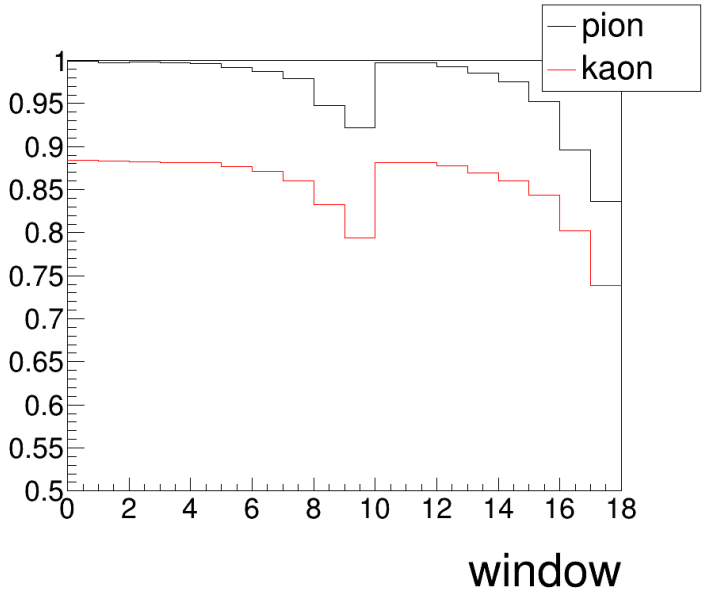
2.5-3.0 GeV





7.0-7.5 GeV





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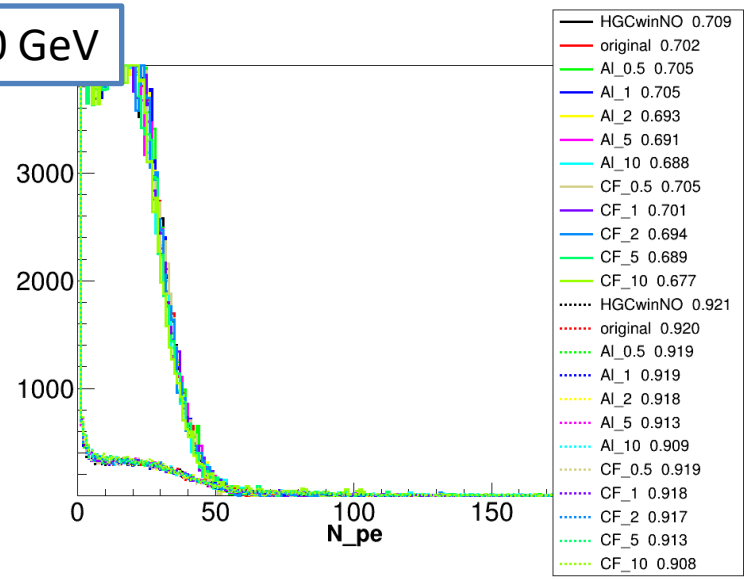

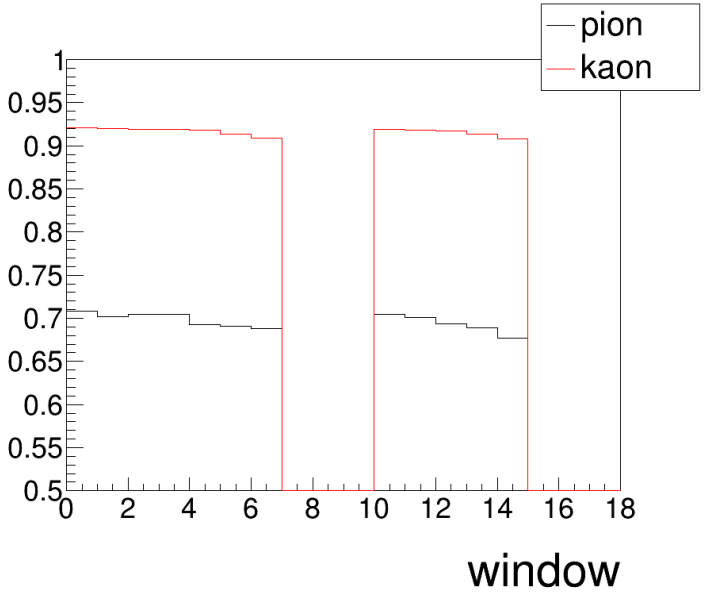

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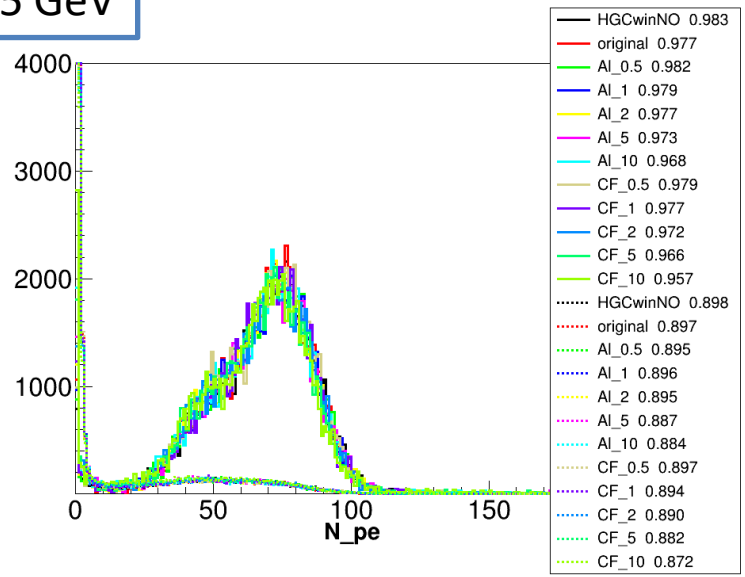

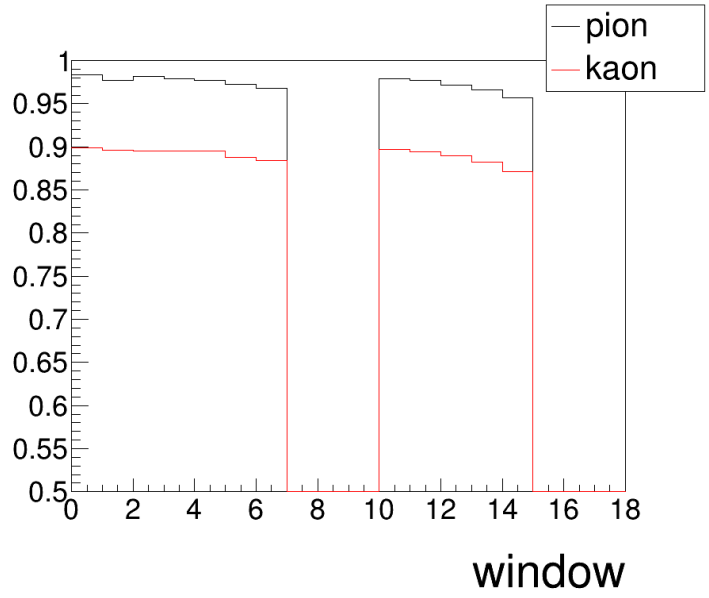

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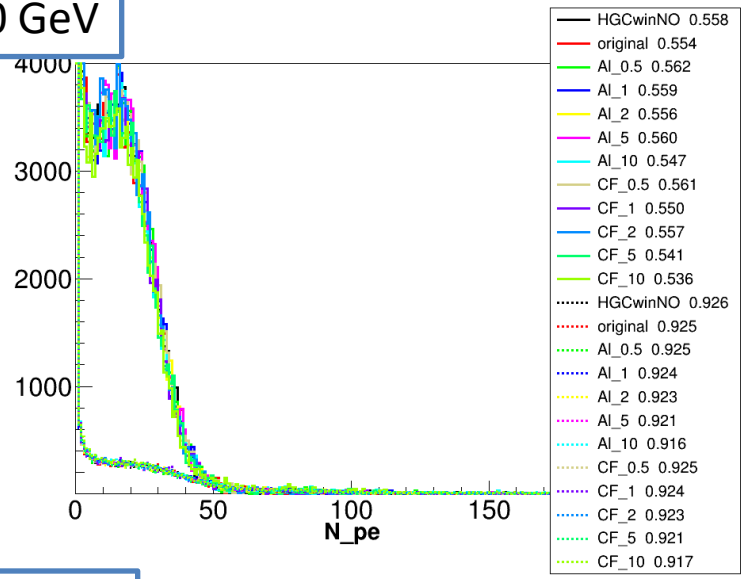

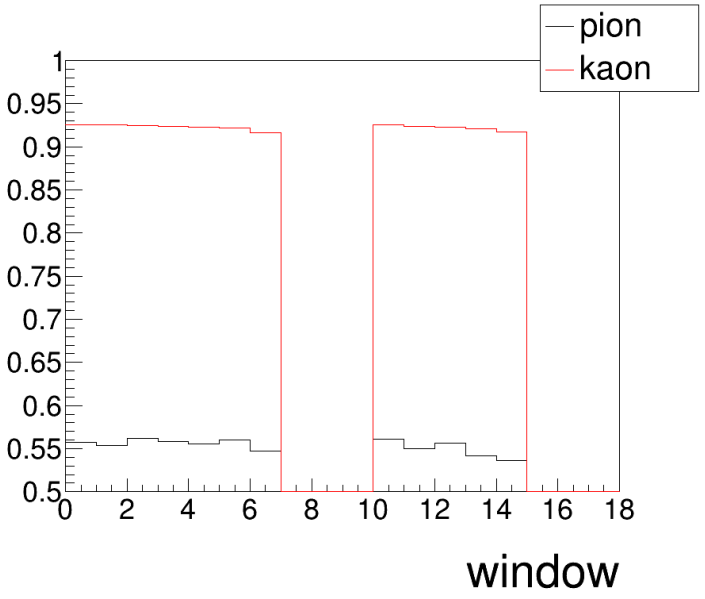

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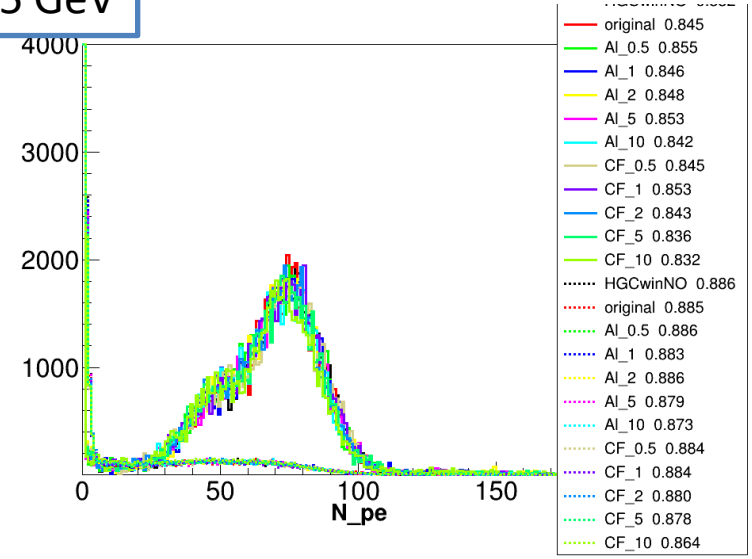

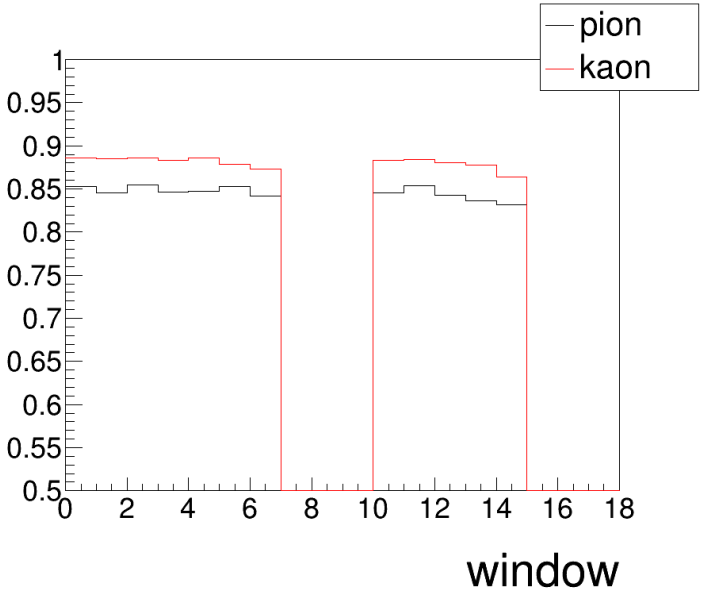

"single particle clean" with "hgc_moved"

eff behind hgc window
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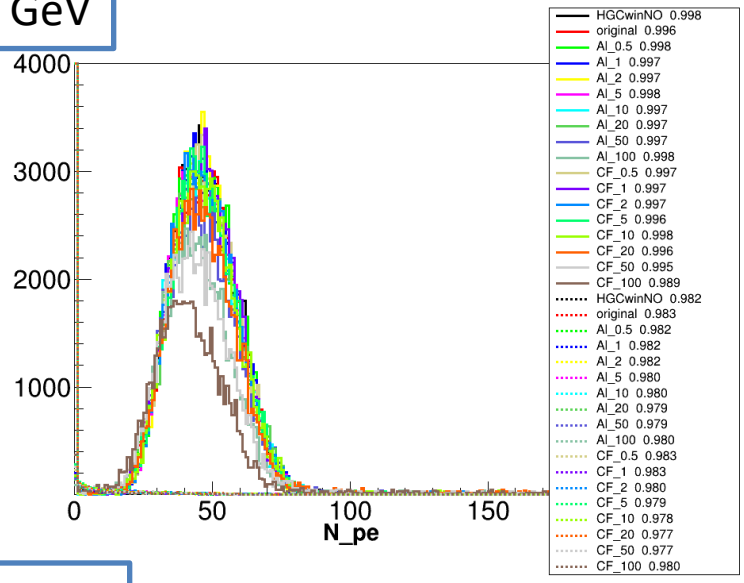

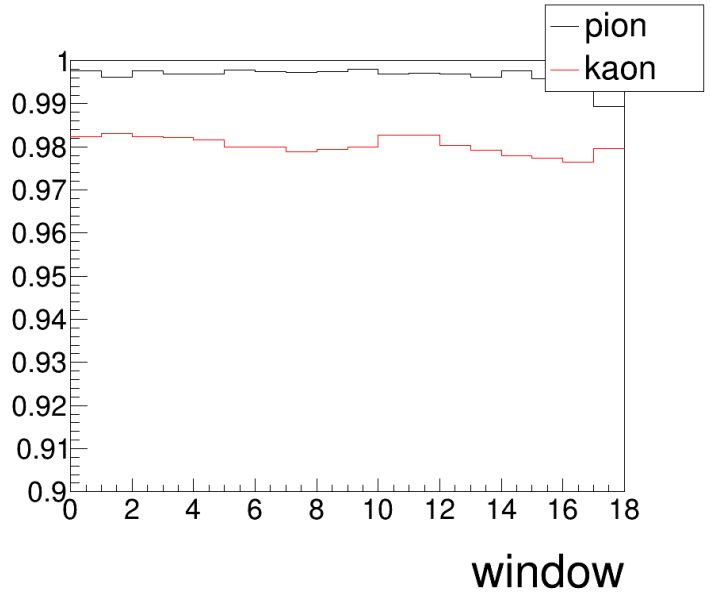

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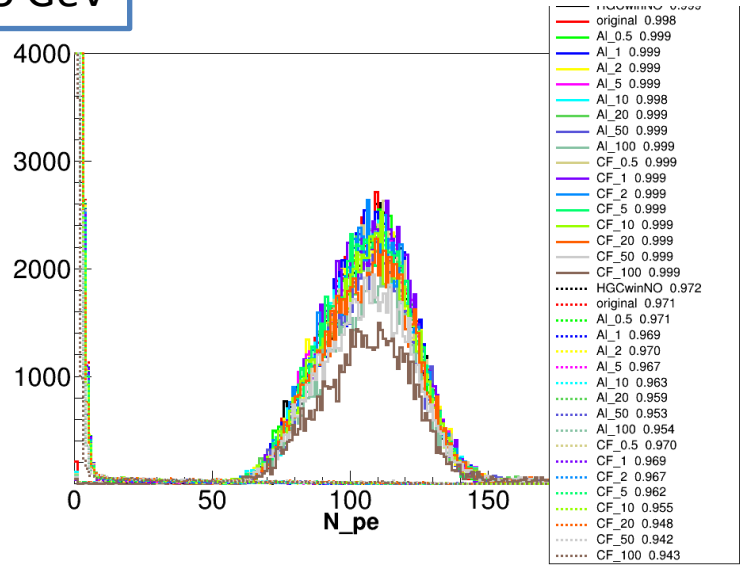

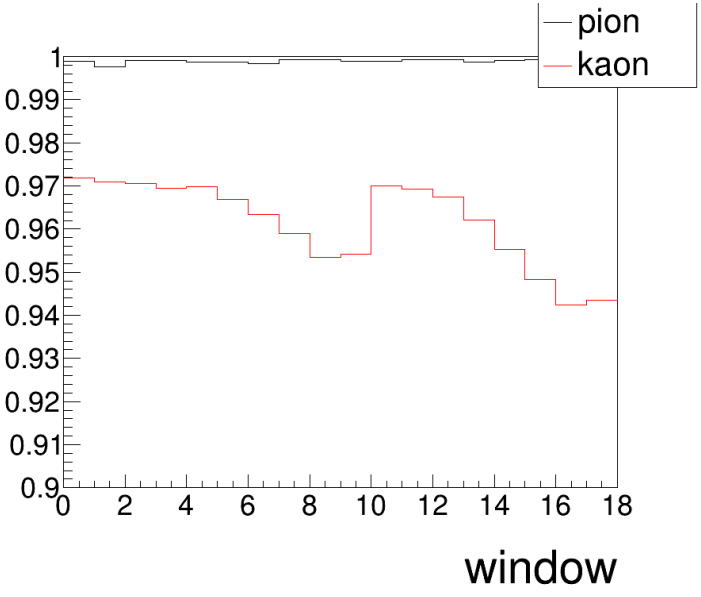

Delta ray (Forward e-/e+ right after hgc window produced by pion and kaon)

- "single particle clean" with "hgc"

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