Electron PID Study for NC events

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- Electron PID study: identify the electrons from hadrons with high purity
  - Get the hadron/electron ratios for various kinematic regions (djangoh, eic-smear);
  - Study what resolutions are needed for PID detectors to get high electron purity;

- First step:

Get the hadron/electron ratio at the generator level using djangoh;

Question:

what does “radiation” mean in djangoh?

Djangoh: is an interface of HERACLES and LEPTO

generate events at the parton level

do fragmentation and hadronization for the hadron final state

Radiation off

generate events at parton level (HERACLES)

ichannel=1

fragmentation and hadronization, QCD corr (djangoh call LEPTO/ JETSET)

Radiation on

generate semi-inclusive events at parton level include QED corrections e.g. soft brems, virtual correction….

$$e(l) + p(p) \rightarrow e'(l') + \gamma(k) + X(p_X).$$

(HERACLES)

ichannel=1

k=0

$$E(L) + p(p) \rightarrow E'(L') + X(p_X).$$

ichannel=6

initial state radiation

$$e(l) \rightarrow \tilde{e}(\tilde{l}) + \gamma(k),$$

$$\tilde{e}(\tilde{l}) + p(p) \rightarrow e'(l') + X(p_X)$$

ichannel=7

final state radiation

$$e(l) + p(p) \rightarrow \tilde{e}'(\tilde{l}') + X(p_X)$$

$$\tilde{e}'(\tilde{l}') \rightarrow e'(l') + \gamma(k)$$

ichannel=8

Compton events

fragmentation and hadronization, QCD corr (djangoh call LEPTO/ JETSET)

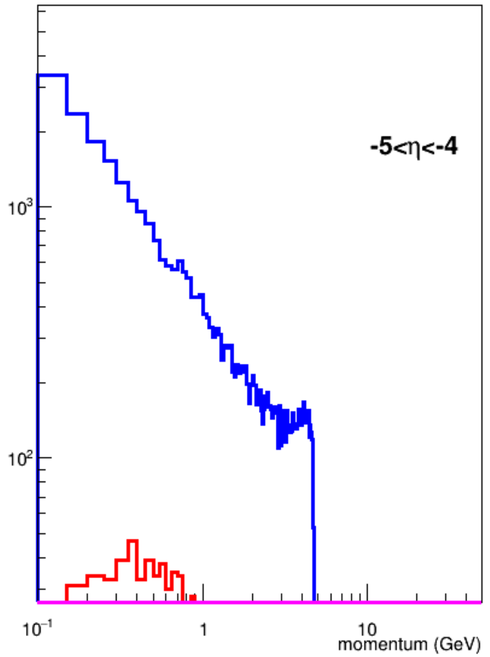
K. Charchula et al. Computer Physics Communications 81 (1994) 381-402

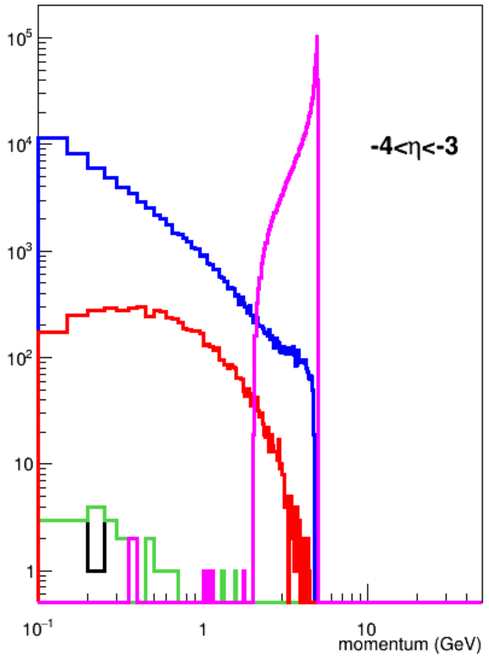
Djangoh settings used in the study:

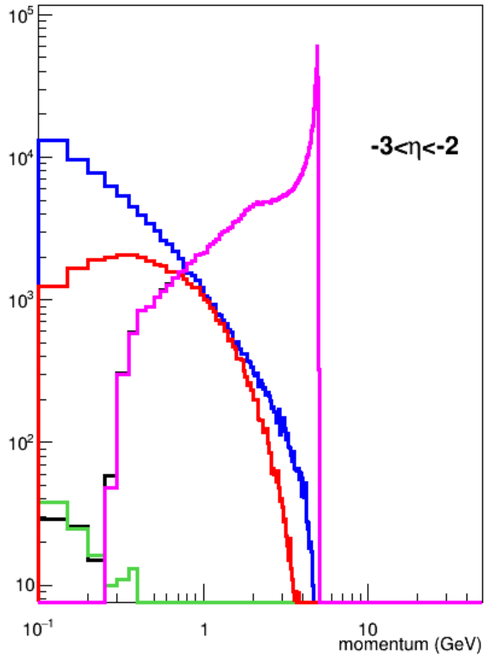
- e * p: 5 * 50 GeV, 10 * 250 GeV, 20 * 250 GeV with radiation turned on

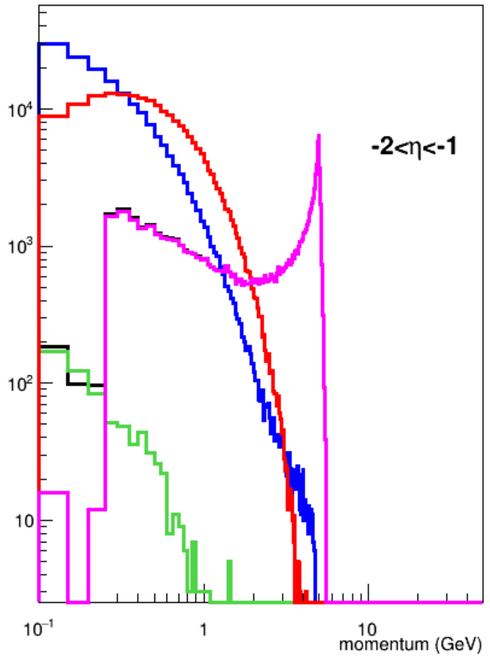
(Plots generated using Pythia: https://wiki.bnl.gov/eic/index.php/Detector_Design_Requirements)

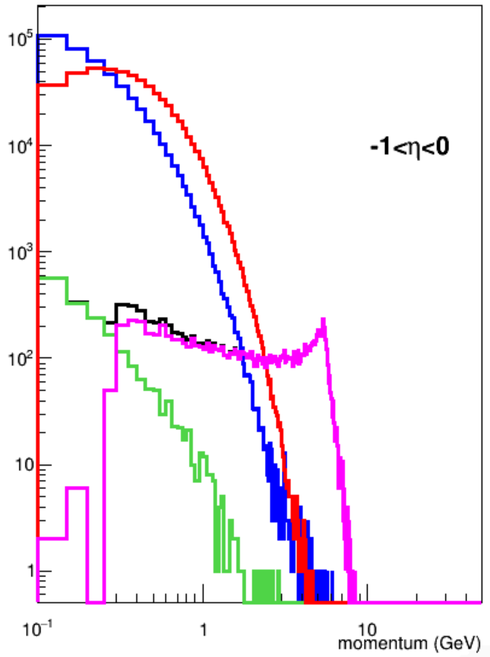
- kinematic cut:
  - $0.0001 < x < 1$
  - $0.001 < y < 0.95$
  - $0.1 < Q2 < 10^5$
  - $W > 1.4$
- events: 2500000
- for other settings, use the numbers given in https://wiki.bnl.gov/eic/index.php/DJANGOH

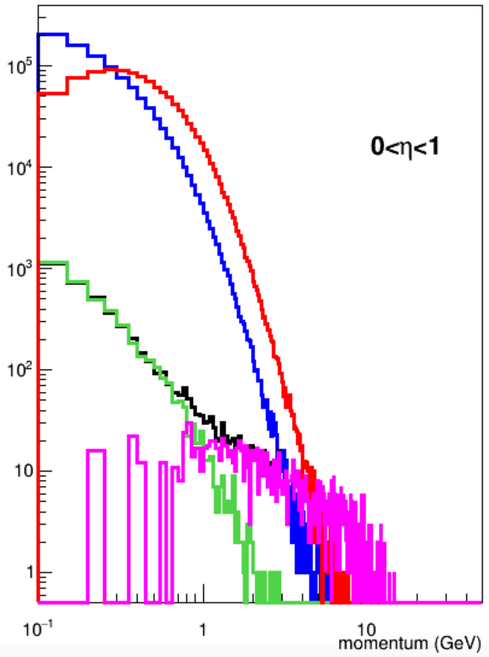


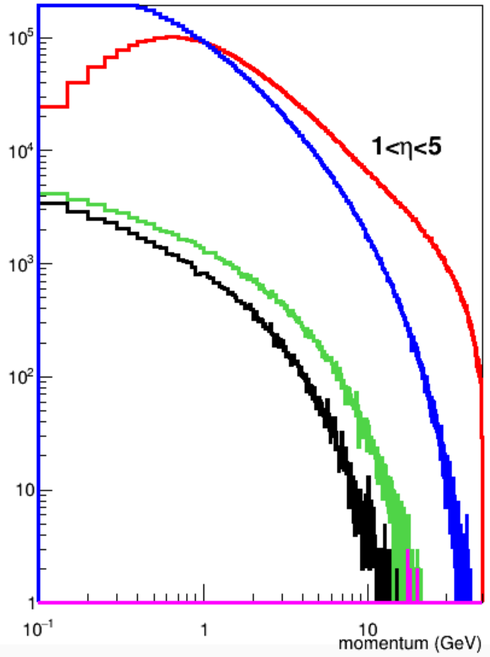












5 GeV * 50 GeV with Radiation on

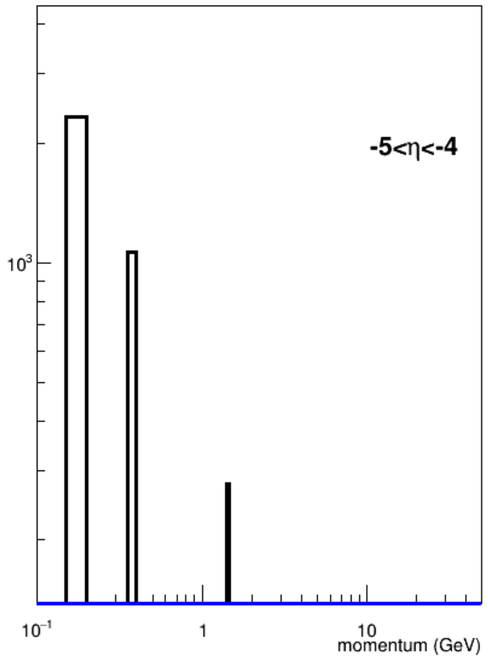
electron

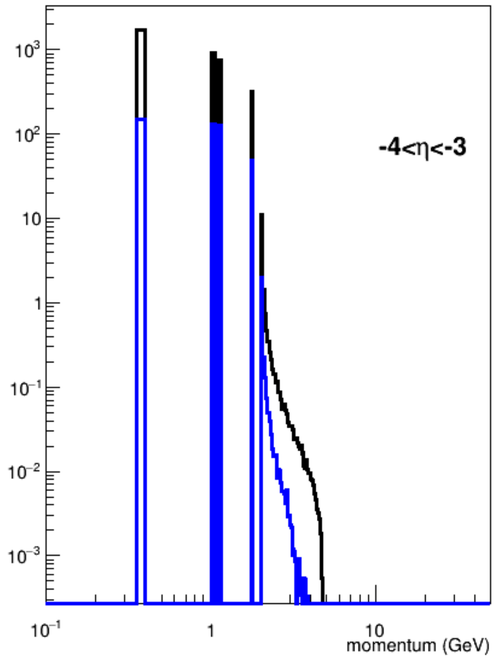
hadron ($\pi^{\pm}$, $K^{\pm}$, p, n)

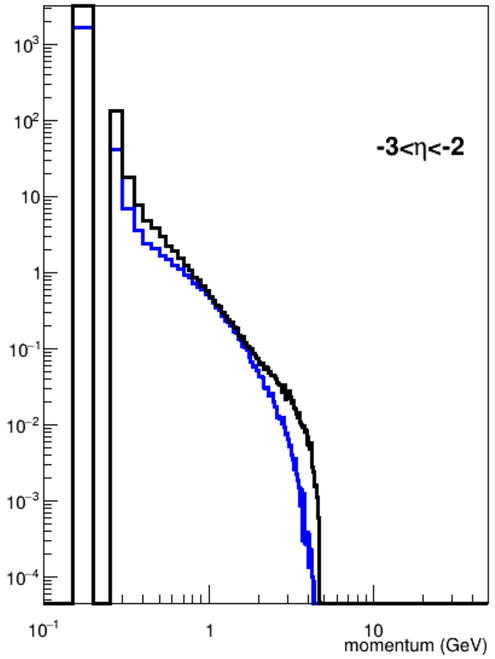
photon

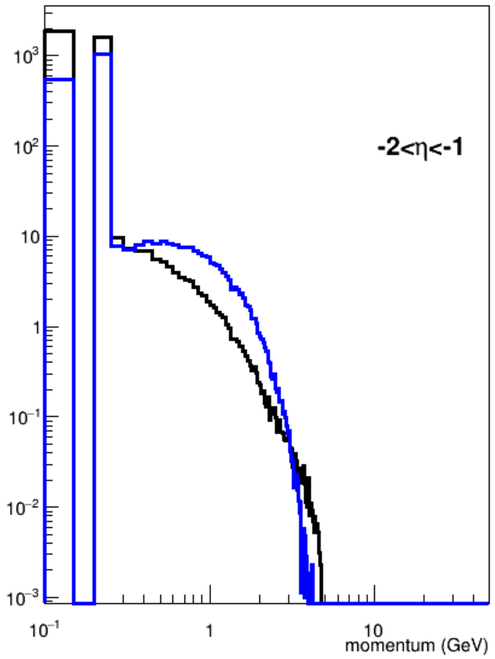
positron

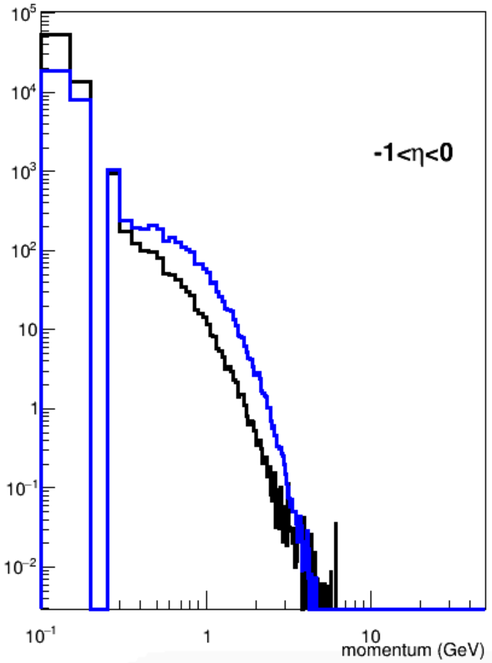
electron - positron

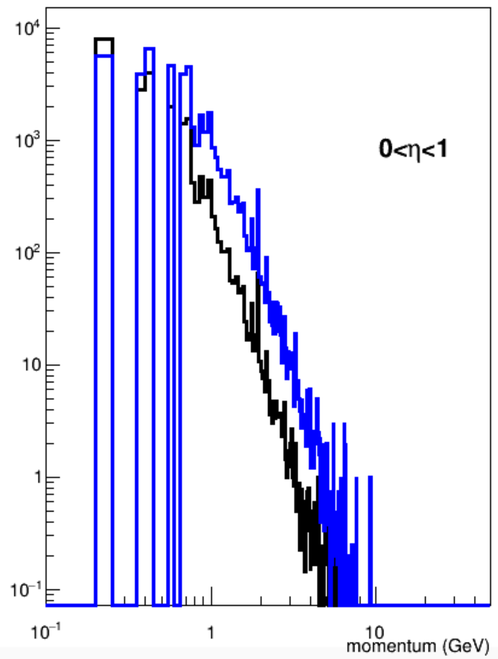


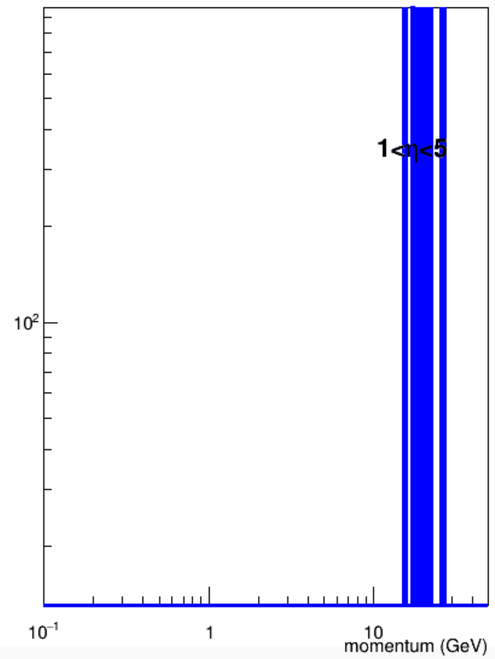










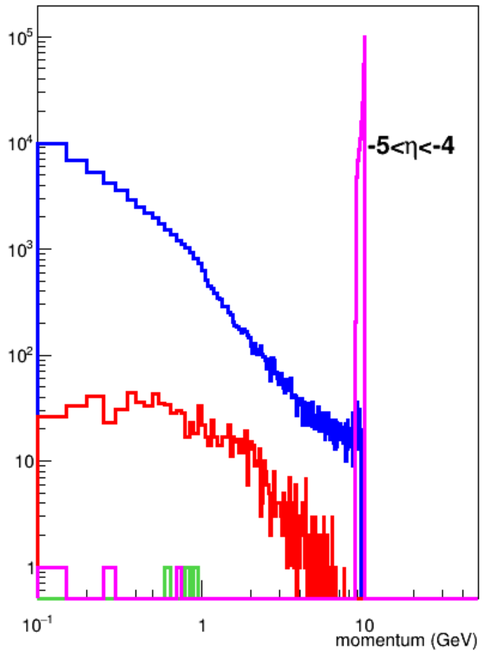


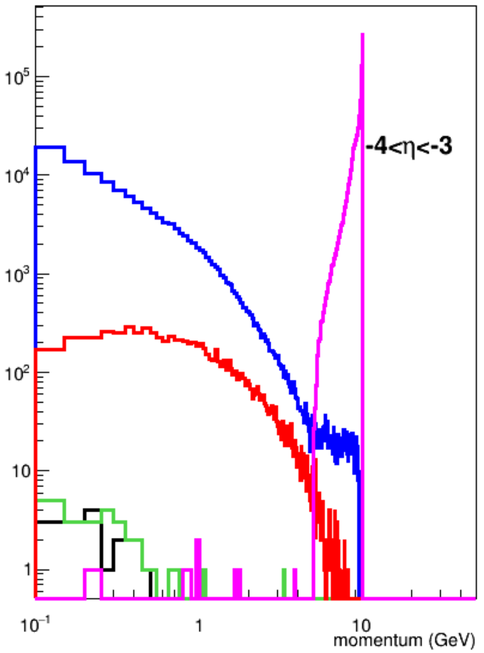
5 GeV * 50 GeV with Radiation on

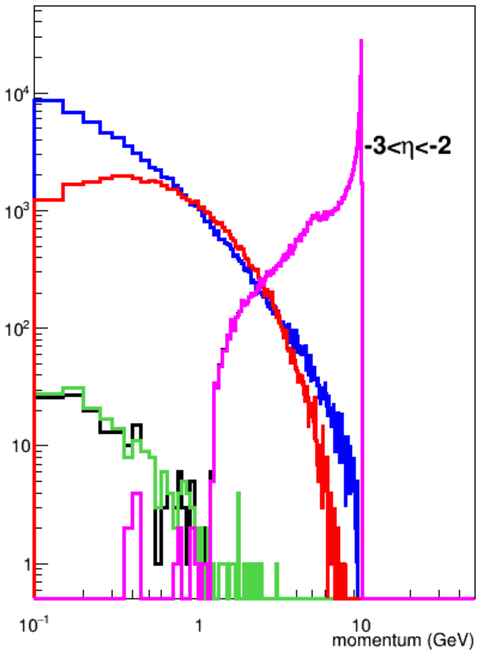
hadron/electron ($\pi^{\pm}$, $K^{\pm}$, p, n)

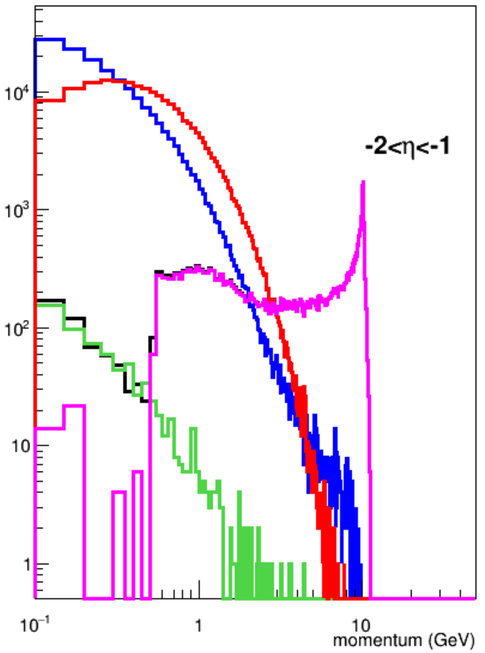
photon/electron

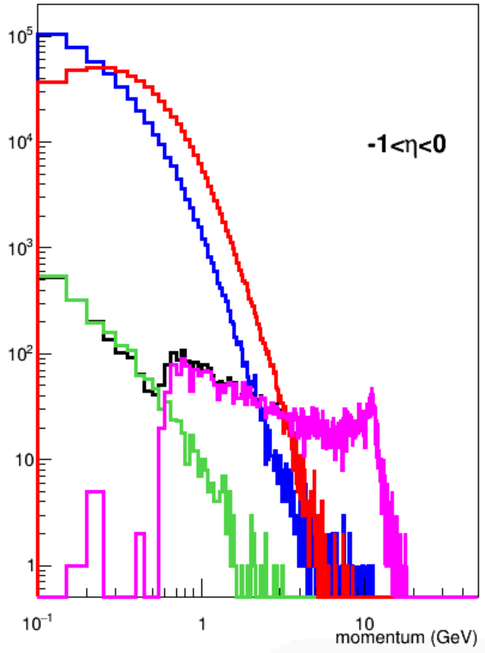
(after subtracting positron from electron)

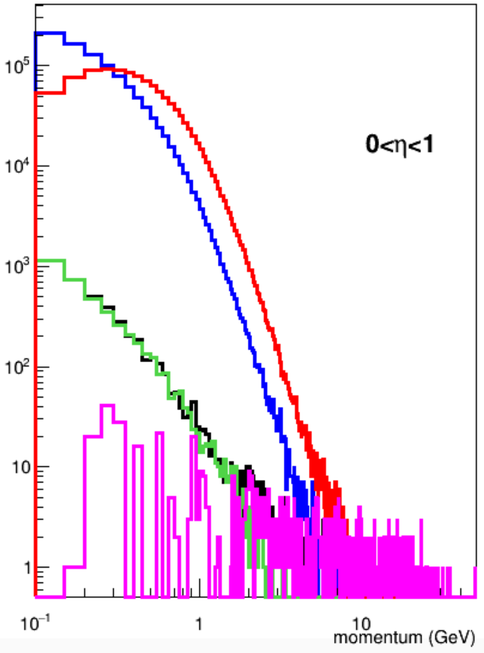


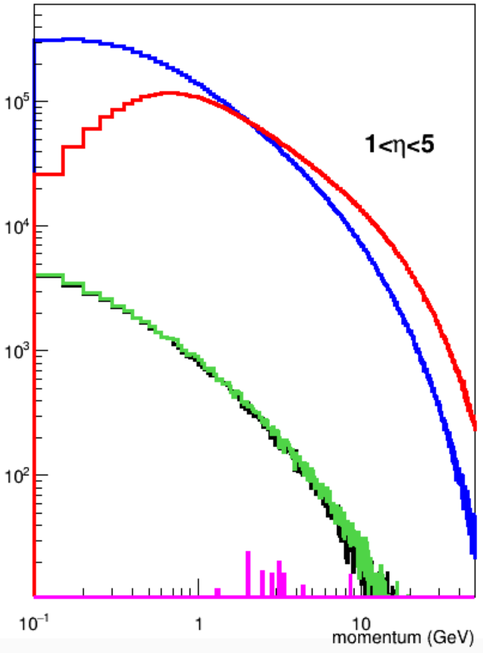












10 GeV * 250 GeV with Radiation on

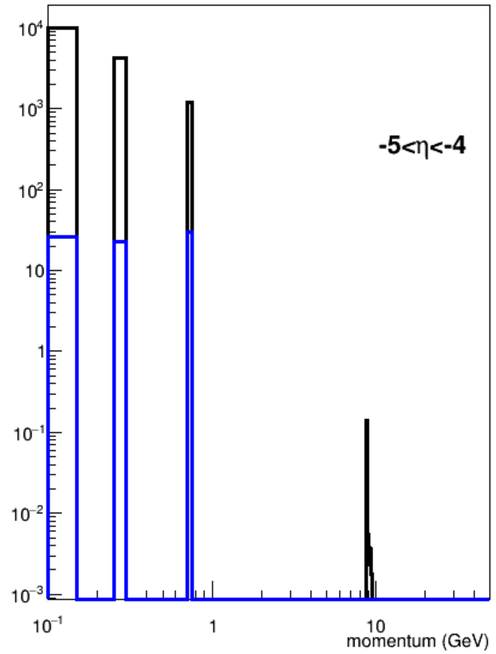
electron

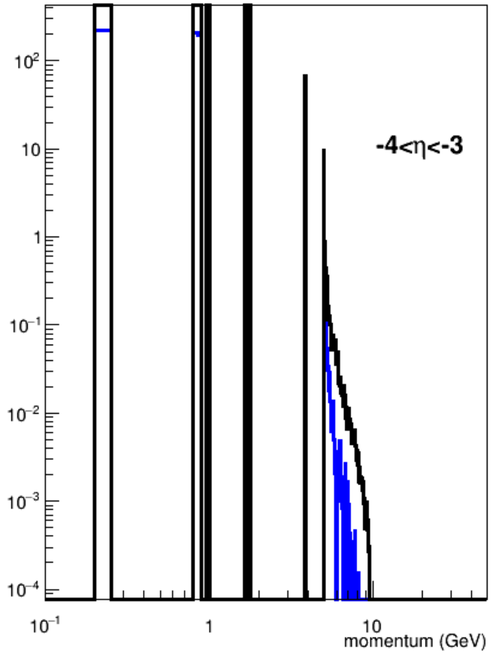
hadron ($\pi^{\pm}$, $K^{\pm}$, p, n)

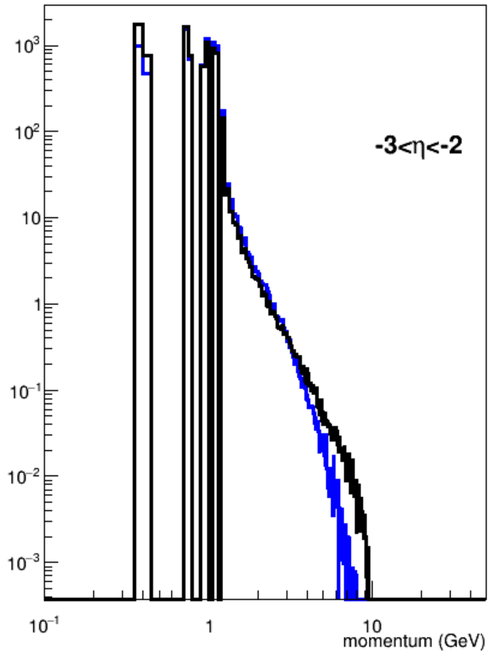
photon

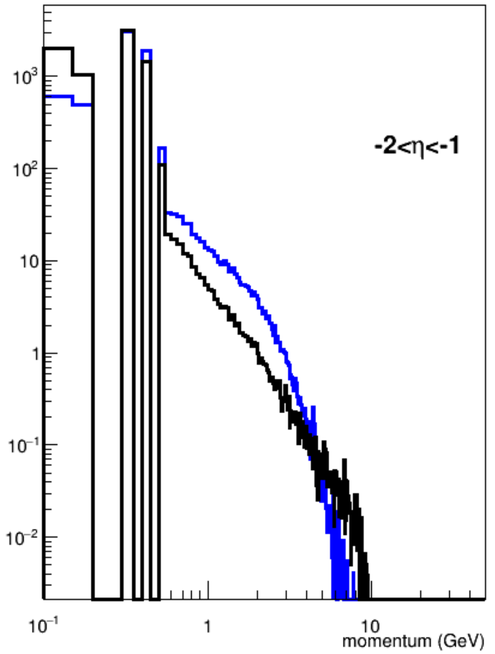
positron

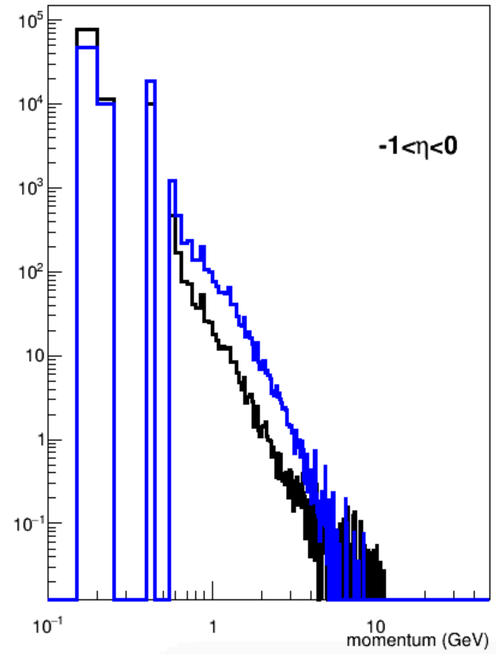
electron - positron

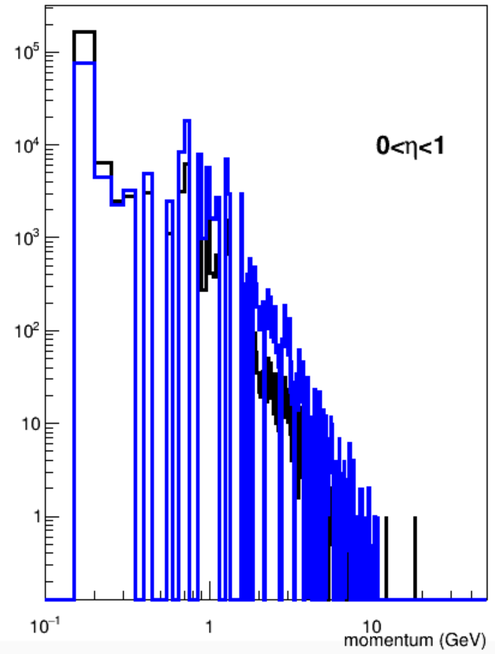


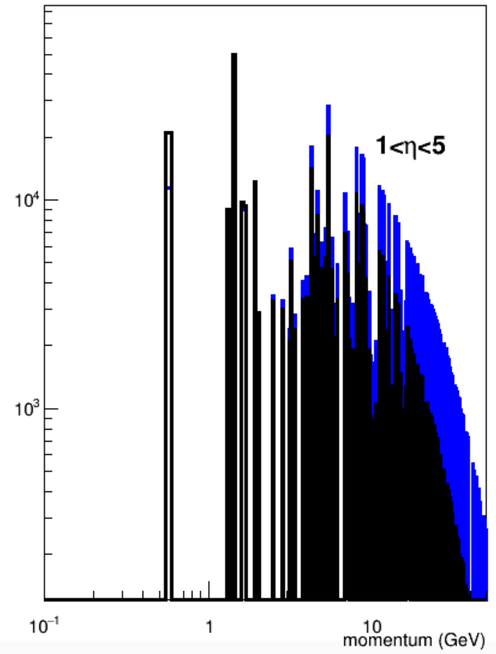












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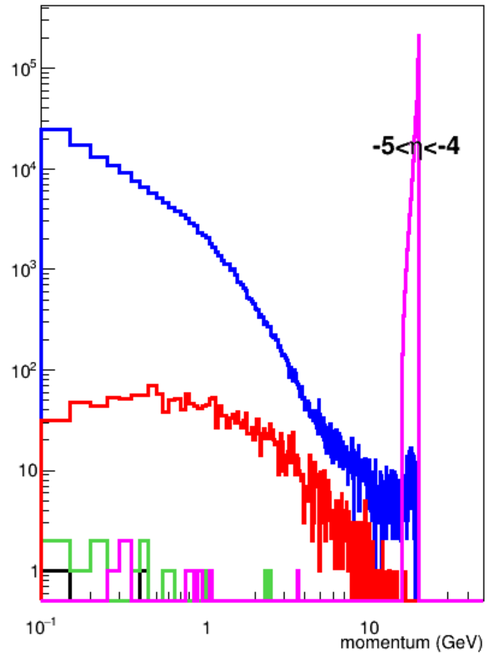
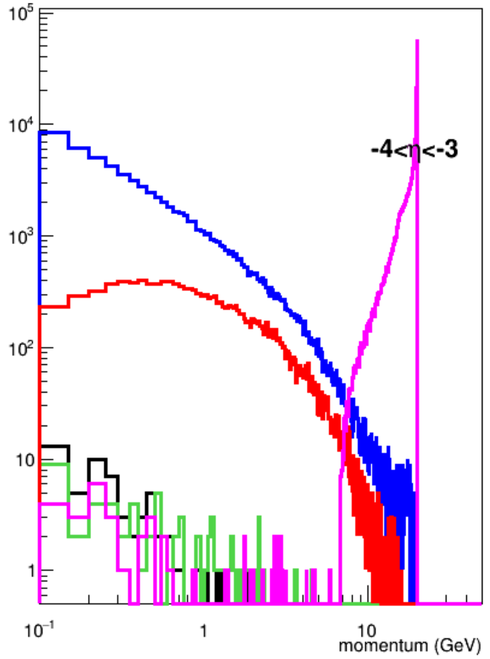
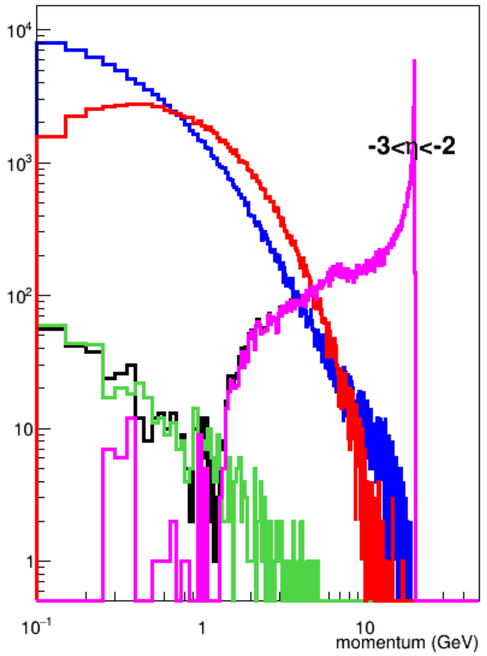
hadron/electron ($\pi^{\pm}$, $K^{\pm}$, p, n)

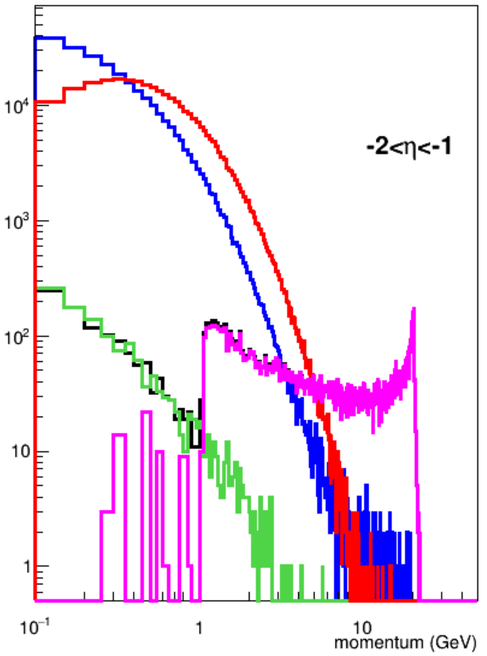
photon/electron

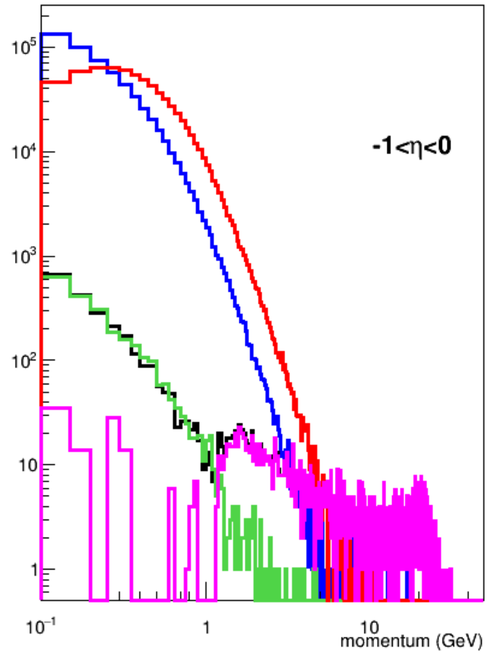
(after subtracting positron from electron)

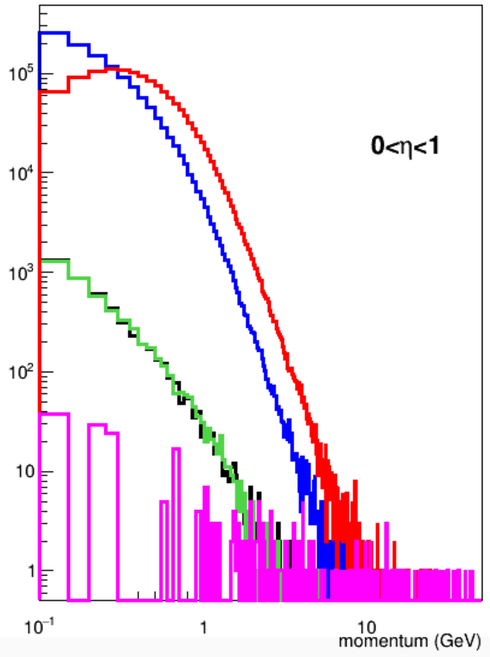


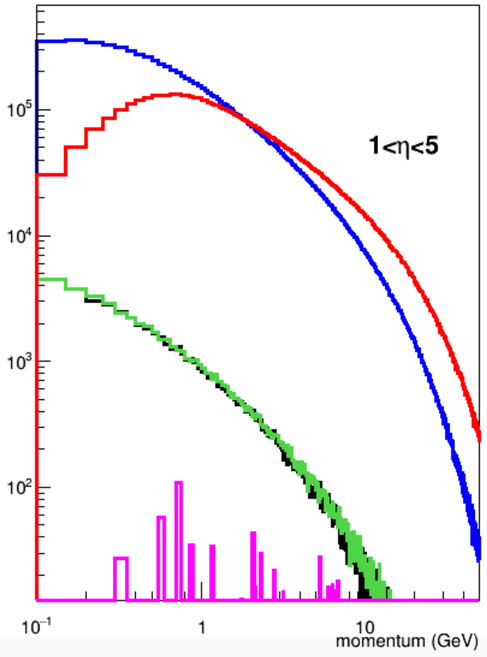












20 GeV * 250 GeV with Radiation on

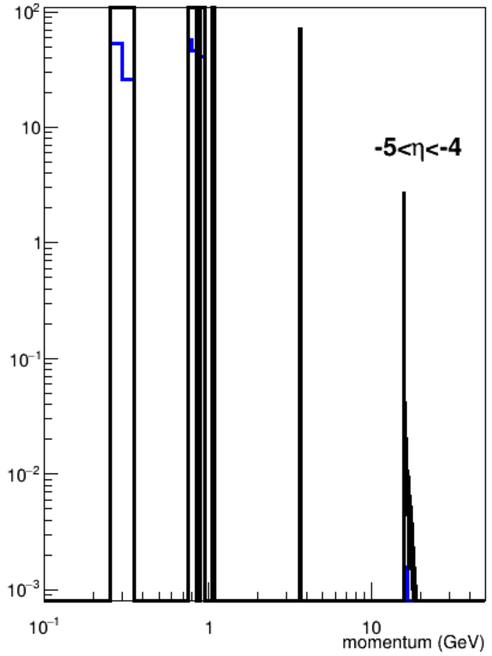
electron

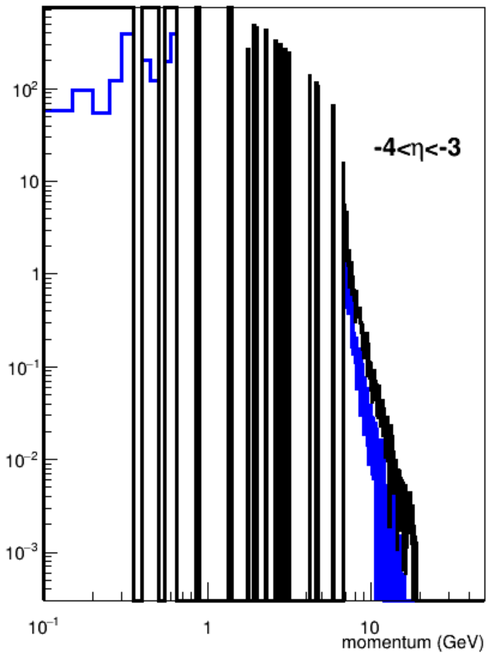
hadron ($\pi^{\pm}$, $K^{\pm}$, p, n)

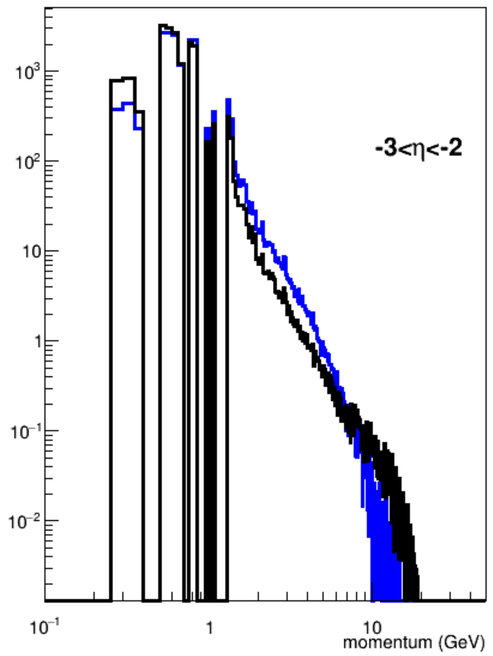
photon

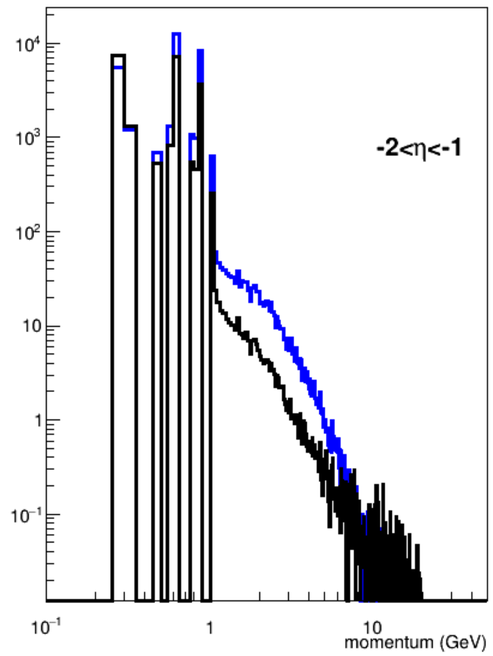
positron

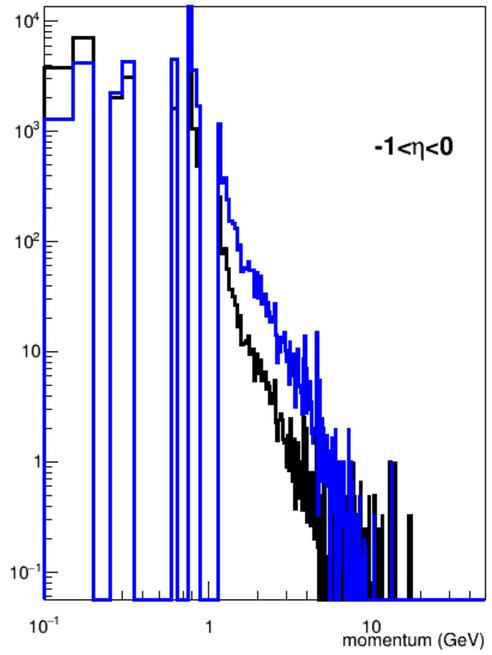
electron - positron

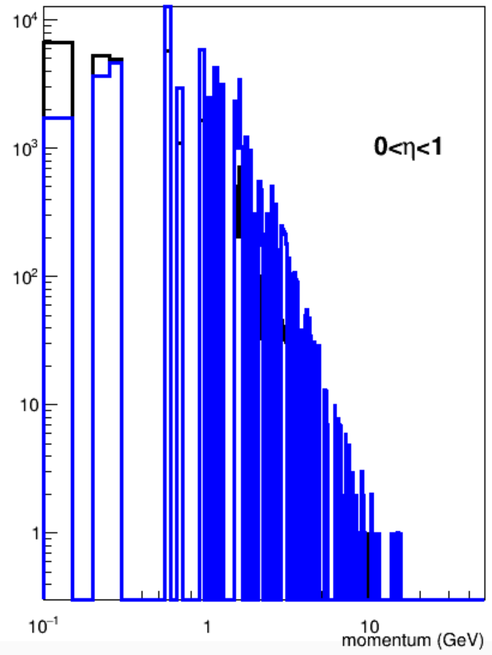


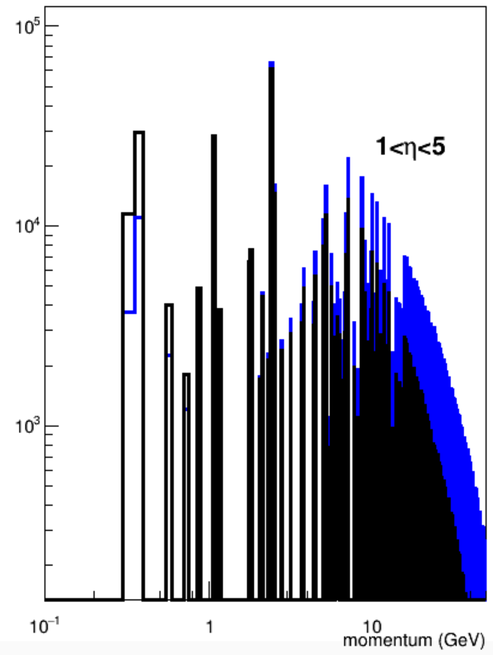












20 GeV * 250 GeV with Radiation on

hadron/electron ($\pi^{\pm}$, $K^{\pm}$, p, n)

photon/electron

(after subtracting positron from electron)

Conclusions:

- At forwarding angle and low momentum, there are lots of electrons generated from hadron decays
- For a given center-of-mass energy, the central eta has the highest hadron/electron ratio;
- For increasing center-of-mass energy, the hadron/electron ratio increases at central eta and momentum region;
- No smooth tail is seen at lower momentum. Could be due to the Q2 cut. Probably should enable the low Q2 region treatment for “STRUCTFUNC”;