2020-02-03 - CALET TIM (Florence)

Pier S. Marrocchesi

❑ Results of proton analysis

- PASS 4 ICLIB 1.1 energy corrected charges
- Track selection
- Charge selection
- Helium background rejection
- Acceptance misidentification
- Subtraction of residual contaminants
- Energy unfolding
- Study of systematic uncertaintes
- Preliminary proton flux

inelegant
but
straight

elegant
but
tilted

elegant and straight

DATA SETS used in the proton analysis

FD data: PASS4 IClib1.1 201511 – 201910 **48 months** (201510 not used)

MC protons:
EPICS rev 22 Cosmos 8.00 Epics P9.20 spectrum E^{-1} in particle Kinetic Energy from2 GeV to 20 TeV, spectrum $E^{-2.5}$ in [20 TeV, 1 PeV]

FLUKA 2011.2c.4 [5.9 GeV, 237.5 TeV] spectrum E-1 in particle Energy - Isotropic Sphere R-100cm IETYPE=6

MC helium:
EPICS rev 22_Cosmos8.035 EpicsP9.26

FLUKA 2011.2c.3 [1 GeV, 17.4 TeV] spectrum E-1 in Particle Total Energy – Isotropic Sphere R-100cm IETYPE=6

MC electrons: Epics 9.20 – Cosmos 8.00 [20GeV, 20TeV] spectrum E-1 in particle Kinetic Energy

Preselection

- Goodness of KF track

  require: TASCFITFLAG = 3, 6 , 9 , 12 (KF goodness of track flag)

- Acceptance

  RECO_ACCEPTANCE = A1
  increase in GF from Acceptance A -> A1 = 419 -> 510 cm^2 sr (~21.7%)

- Trigger offline confirmation

  High Energy Trigger (HET)
  require: HET_HARDWARE_FLAG && HET_OFFLINE_TRIGGER

Consistency of shower axis with track direction

- After Pre-selection (= good-track in Acceptance && HET) a further requirement on track quality is imposed by asking consistency between the direction of the shower axis reconstructed in the TASC and the track direction (in each view).
- extrapolate the reconstructed TASC shower axis back to the track entrance point (ENTRY) and to the EXIT point in Acceptance-A1 when TASC_FITFLAG == 2 (good shower axis) => cut on the ENTRY/EXIT residuals

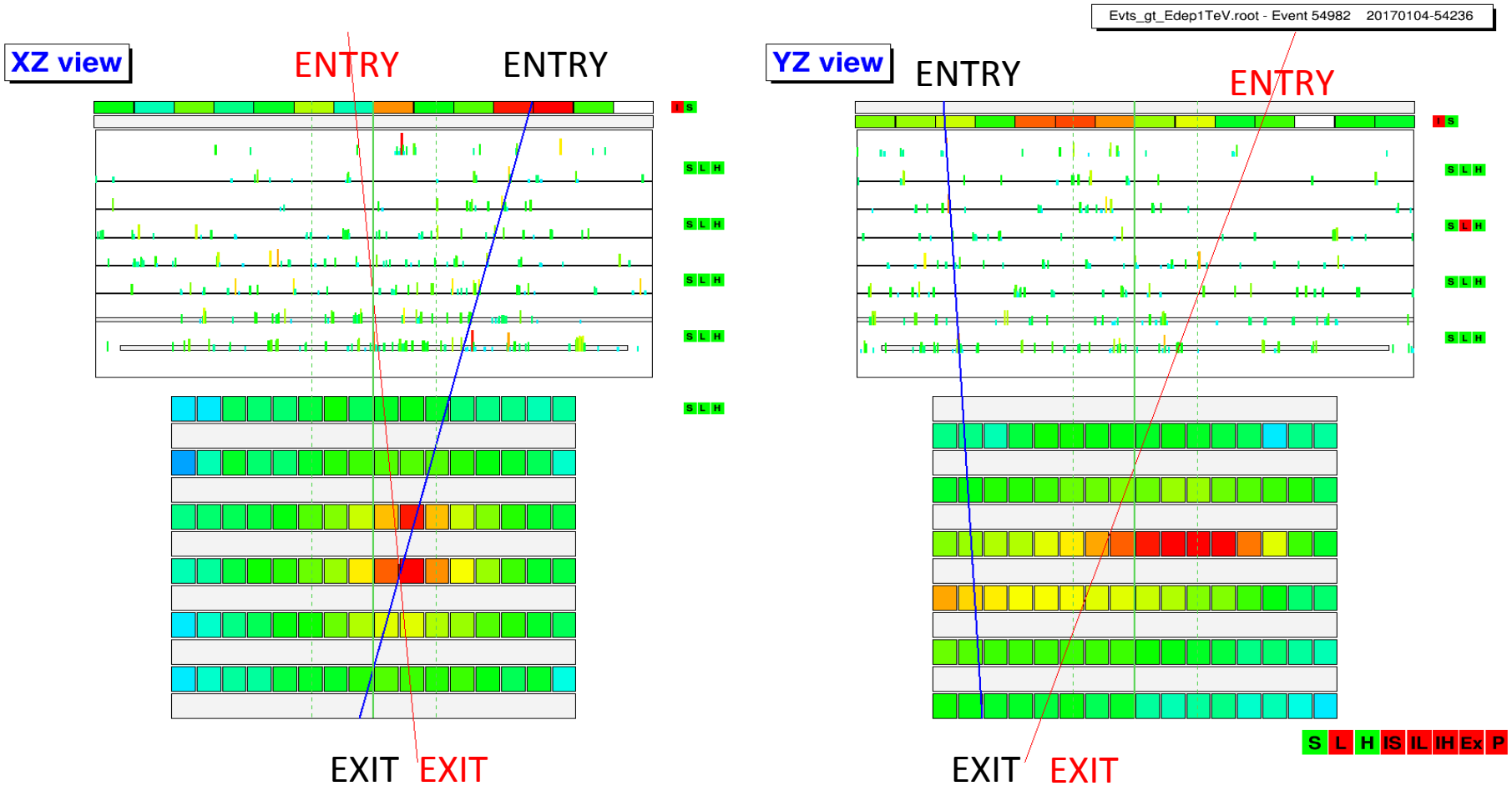
Charge Selection

- use “view oriented” charge selection to improve He rejection at low energy (< 100 GeV)
- **use IMC charge only above 1 TeV for p, He separation**

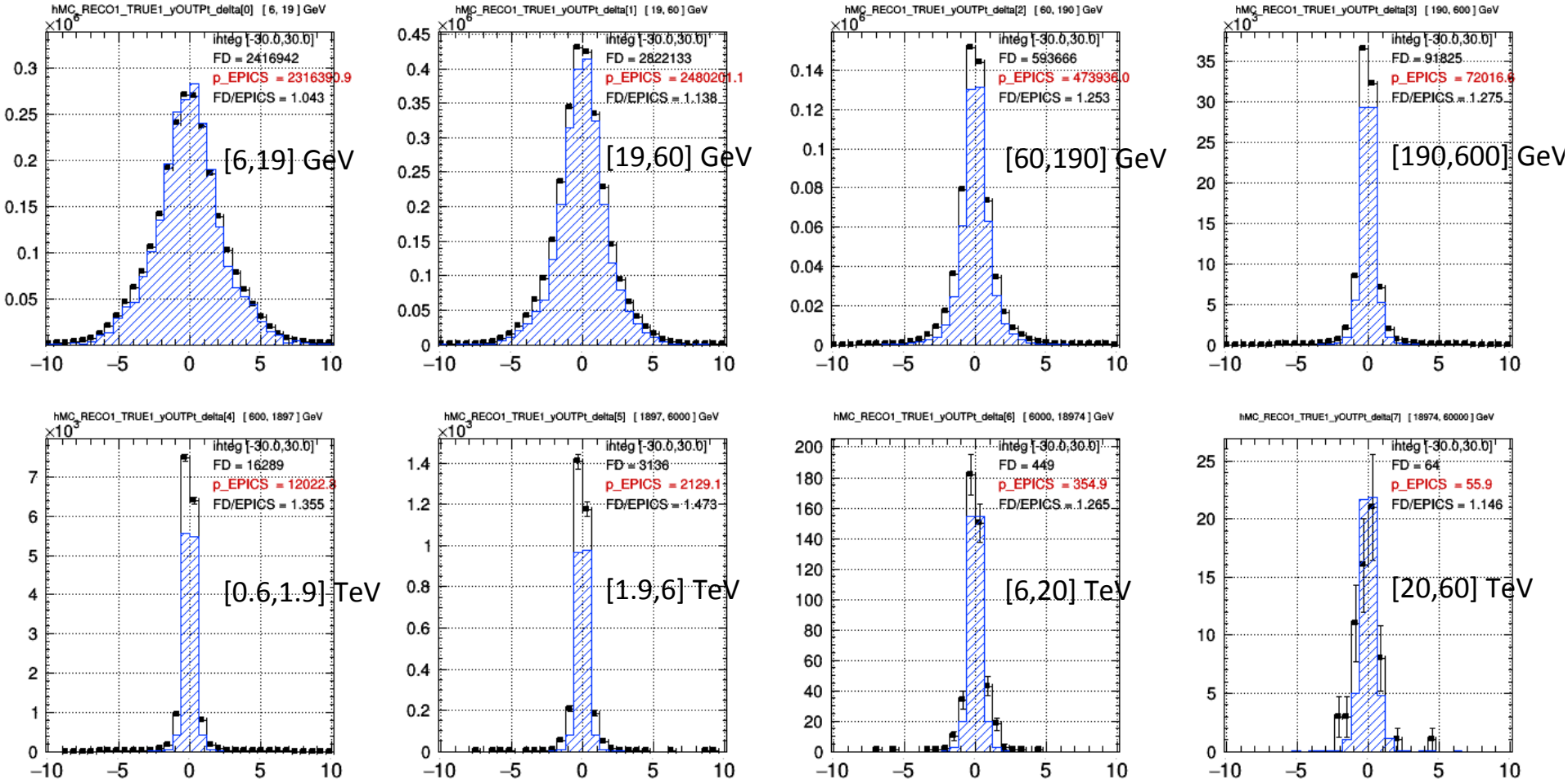
TRACKING: consistency of track vs shower axis (in each view)

- require TASCFITFLAG ==2 (i.e.: reconstructed TASC shower axis is “reliable”...)
- track and shower-axis can differ by **DIRECTION** (angular mismatch)
- but can also have a **DISPLACEMENT** => ENTRY and EXIT points in Acceptance A may differ

- Example of a background event where track and shower axis differ



Example of EXIT residuals in energy slices (blue=**EPICS**, black = **FD**)



VIEW-ORIENTED TRACK SELECTION

DIRECTION (angular mismatch) in each view — deltangX, deltangY
DISPLACEMENT => ENTRY points in acceptance — xINPt_delta, yINPt_delta
=> EXIT points in acceptance — xOUTPt_delta, yOUTPt_delta

- **DELTA_ANGLE (view-oriented)**

  TASCFITFLAG2 == 2 && |deltangX| > 15° => reco_XZ_direction_mismatch
  TASCFITFLAG2 == 2 && |deltangY| > 15° => reco_YZ_direction_mismatch

  (*) TASCFITFLAG2 means "good" reconstructed shower axis. Cut decreases to 10° at high energy

- **DELTA_IMPACT_POINT (track ENTRY and EXIT + view oriented)**

  TASCFITFLAG2 == 2 && |xINPt_delta| > delta_cut => reco_XZ_ENTRY_mismatch
  TASCFITFLAG2 == 2 && |yINPt_delta| > delta_cut => reco_YZ_ENTRY_mismatch

  (*) same definition for EXIT; delta_cut decreases to from 10 cm to 3 cm at high energy

DELTA CUT on Goodness of Tracking (in addition to FITFLAG = 3, 6, 9, 12)

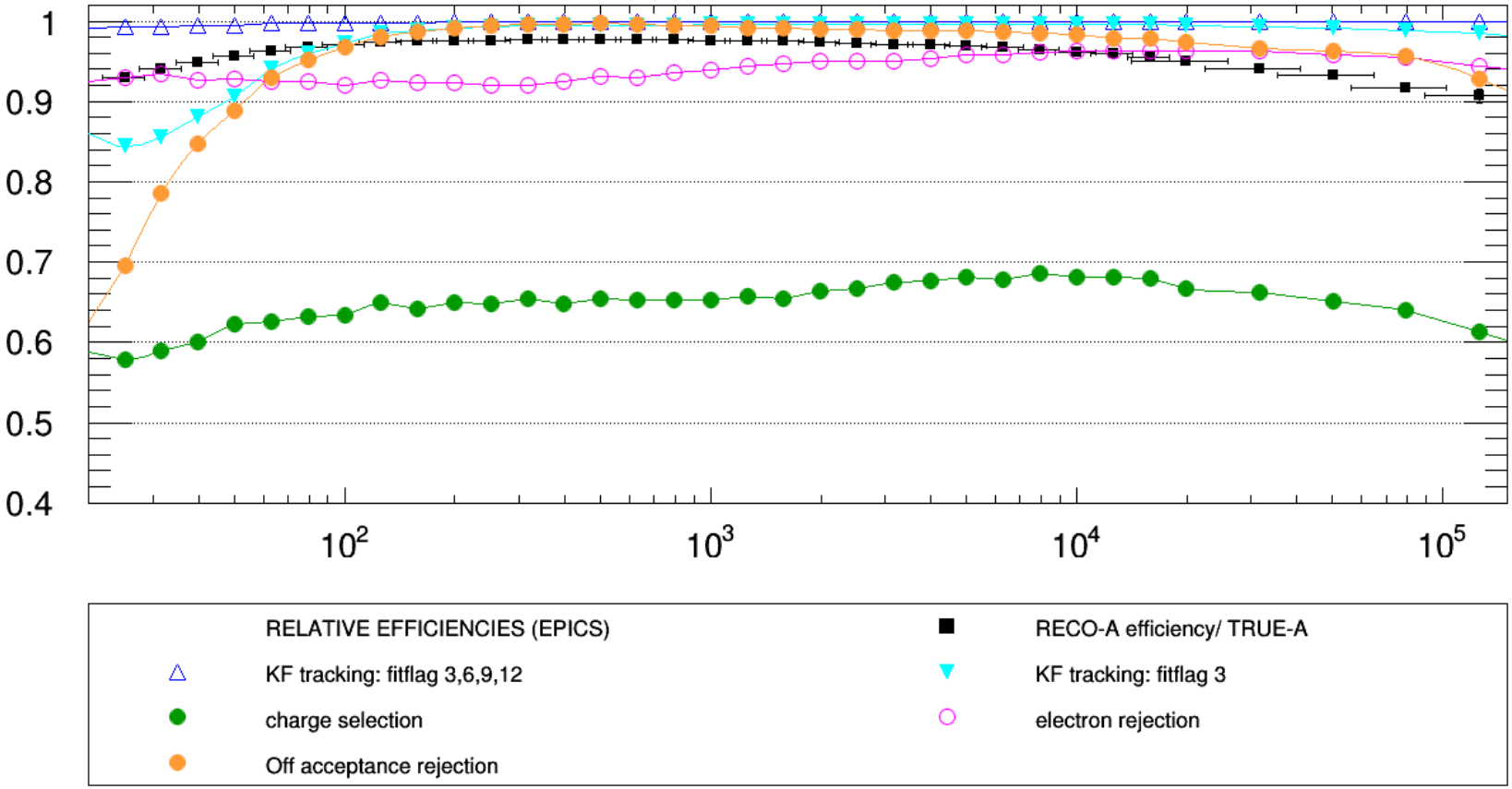
if((reco_XZ_direction_mismatch || reco_XZ_**ENTRY**_mismatch) && (reco_YZ_direction_mismatch || reco_YZ_**ENTRY**_mismatch)) **=> reject**

if((reco_XZ_direction_mismatch || reco_XZ_**EXIT**_mismatch) && (reco_YZ_direction_mismatch || reco_YZ_**EXIT**_mismatch)) **=> reject**

Efficiency of tracking and shower axis reconstruction

The KF track candidate has to be reconstructed inside the geometrical acceptance (filled black squares) and has to satisfy the goodness-of-track requirements.

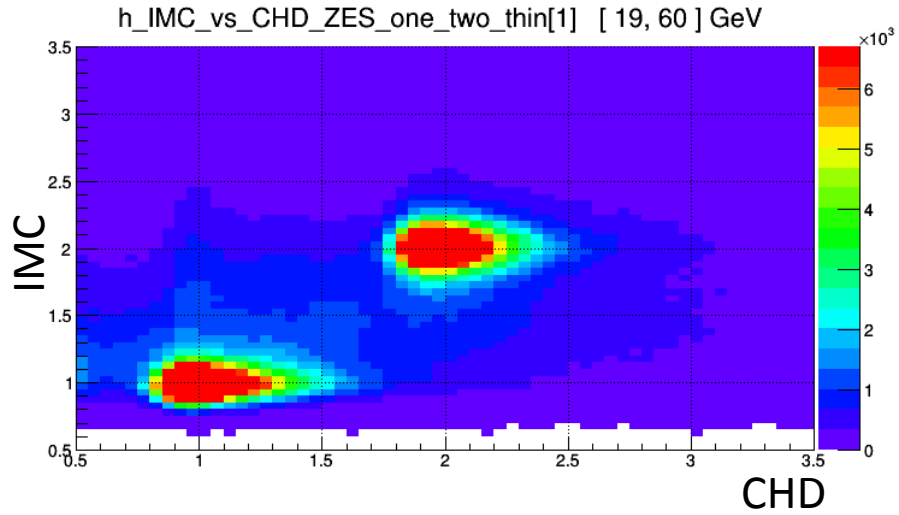
- A tight requirement (FITFLAG=3) results in an efficiency loss below 100 GeV (Cyan triangles).
- Above 1 TeV track and shower axis reconstruction efficiencies are close to 1.

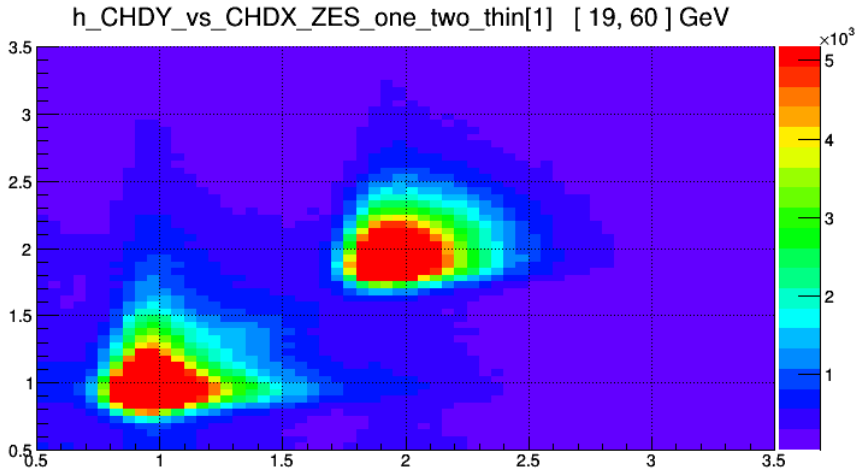


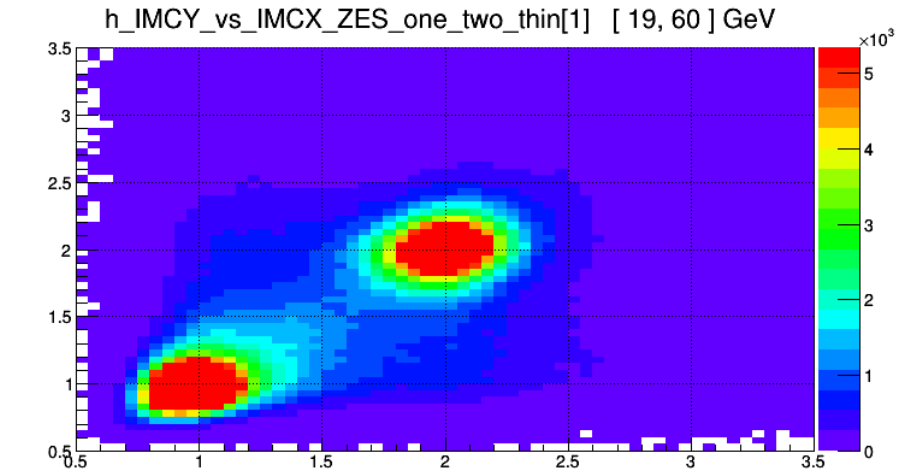
Charge assignment from CHD and IMC

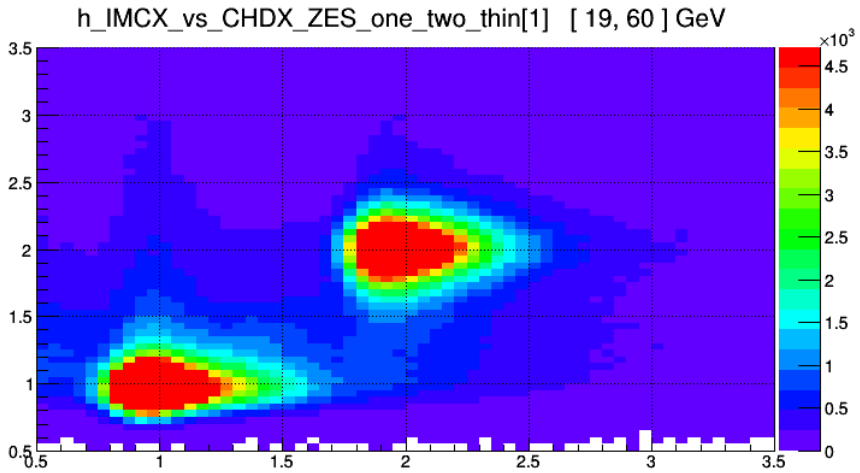
VIEW_X = (CHD_X, IMC_X)
VIEW_Y = (CHD_Y, IMC_Y)

4 charge measurements from track projections in 2 views.







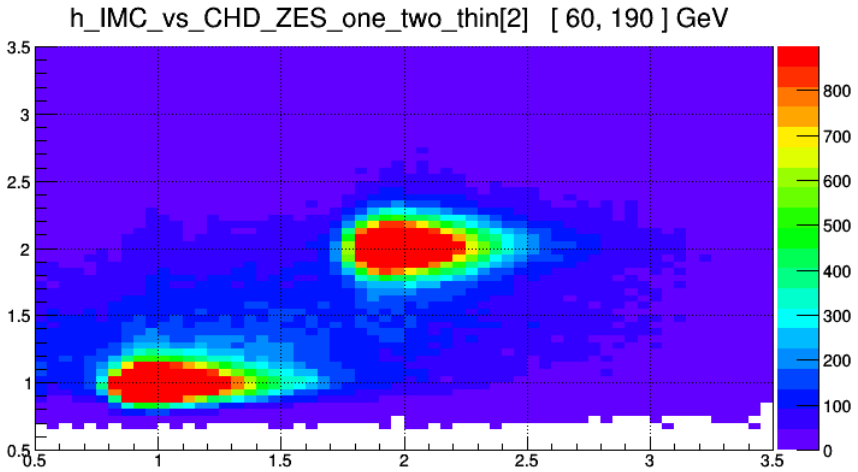


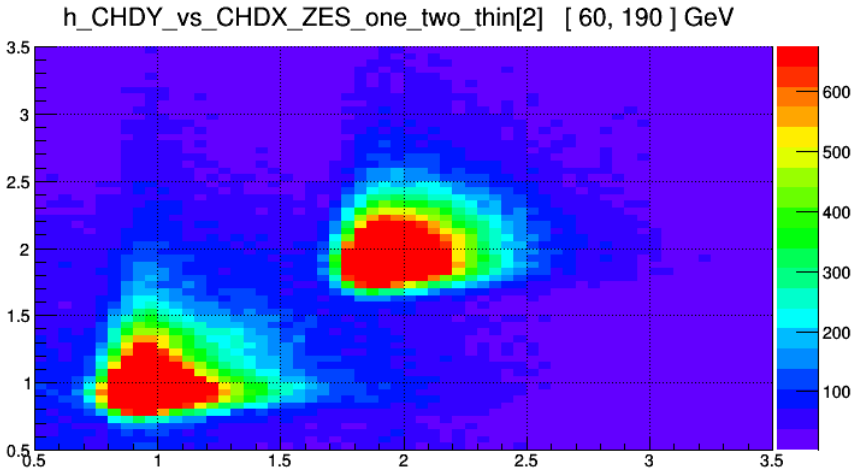
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 1

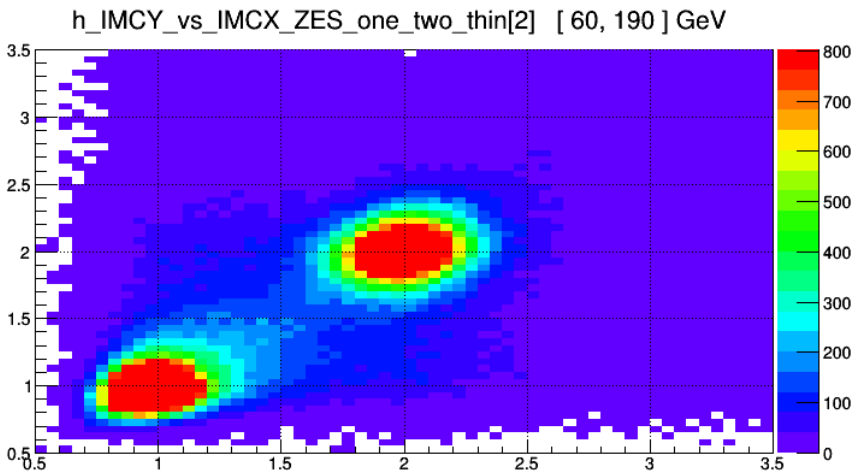
Top left: IMC charge vs CHD charge;
Bottom left: IMC-Y vs IMC-X

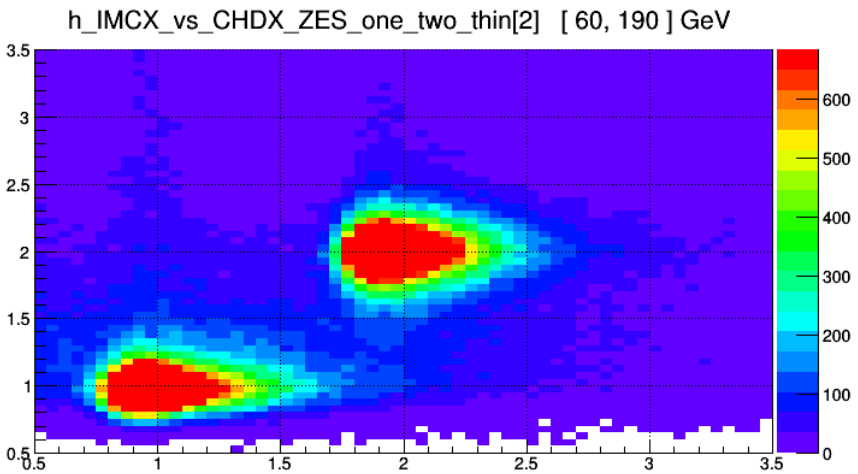
Top right: CHD-Y vs CHD-X
Bottom right: IMC-X vs CHD-X

Charge assignment from CHD and IMC



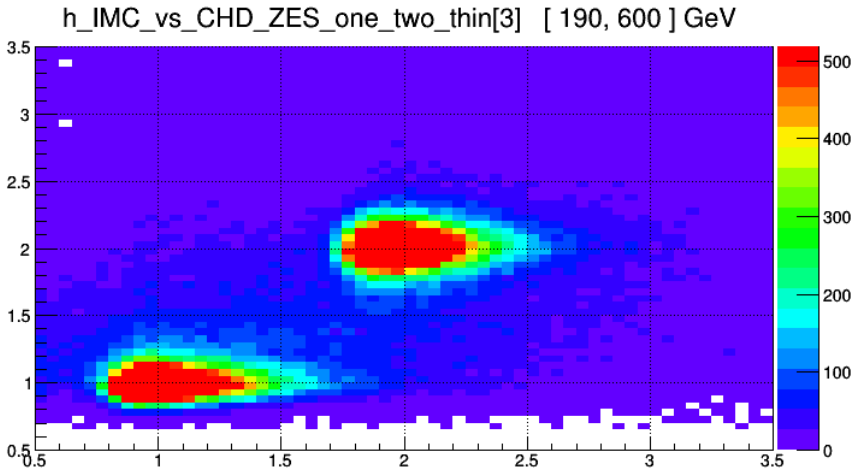


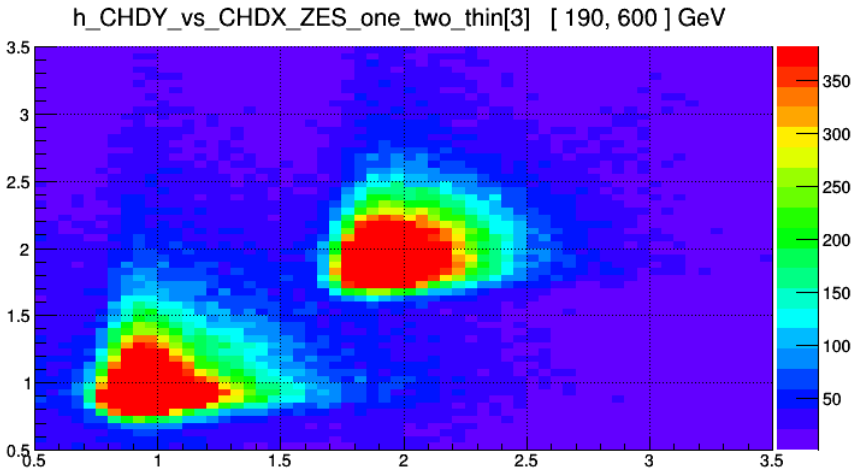


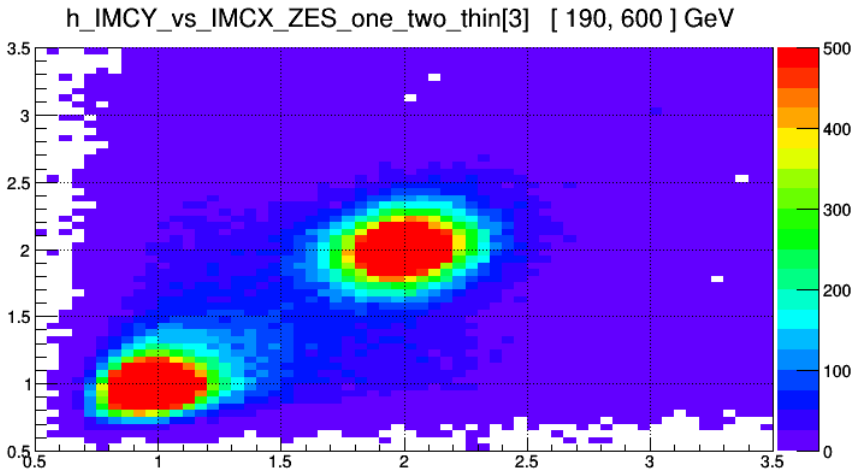


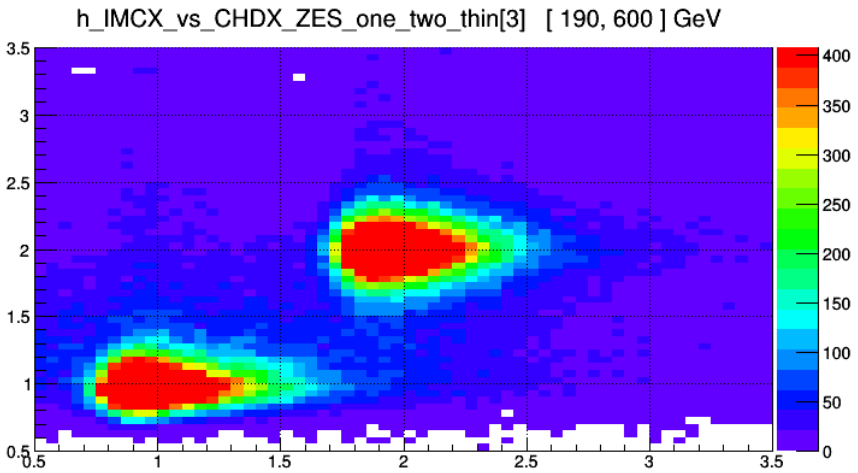
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 2

Charge assignment from CHD and IMC



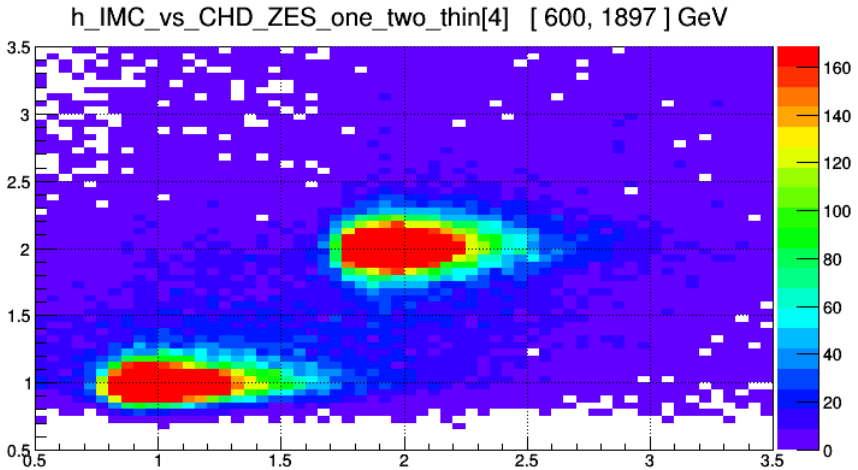


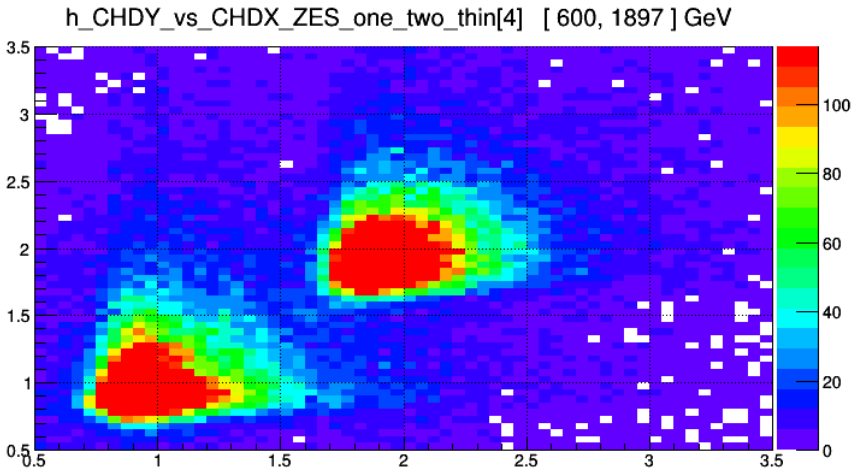


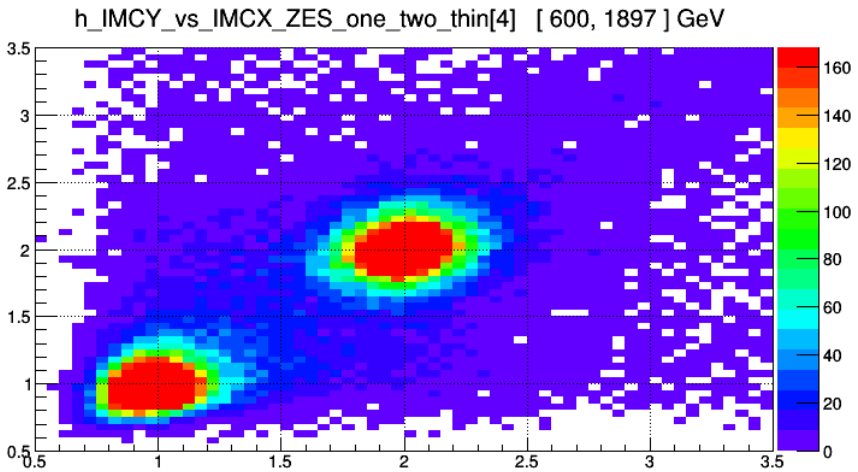


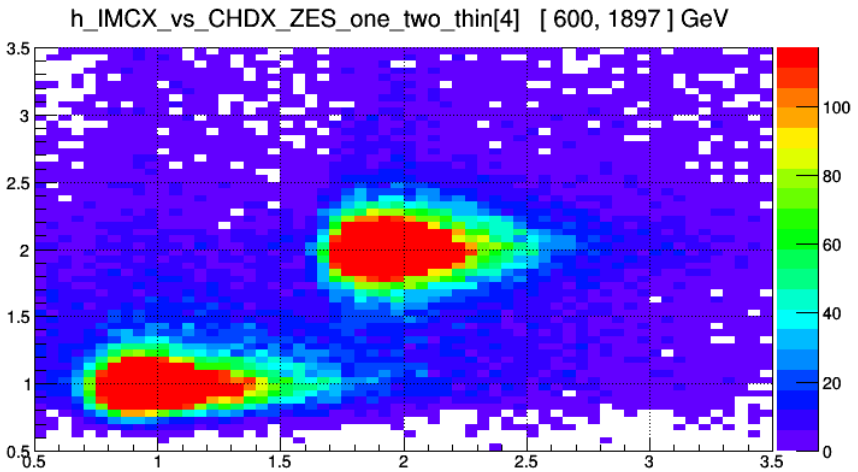
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 3

Charge assignment from CHD and IMC



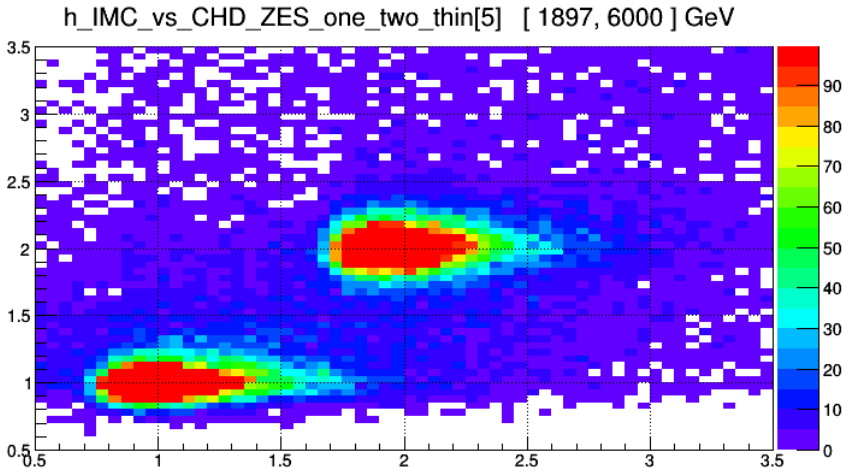


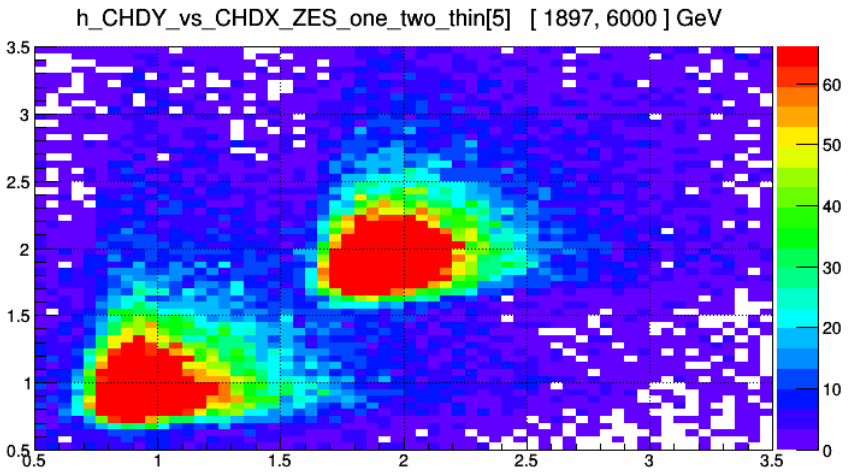


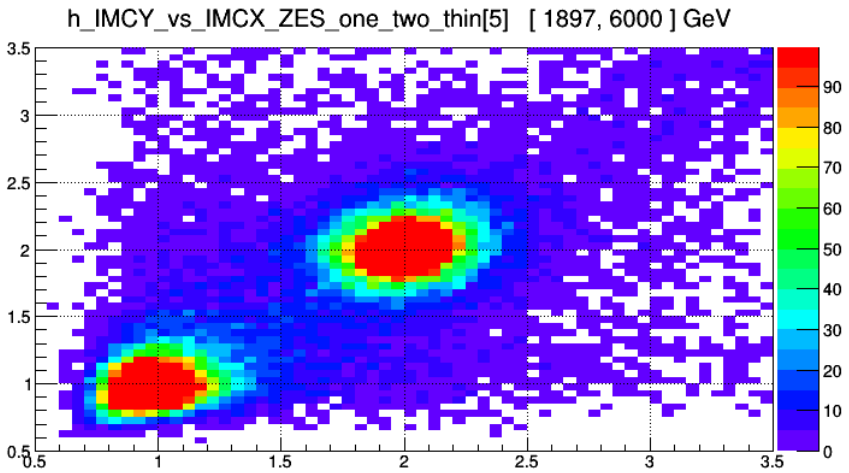


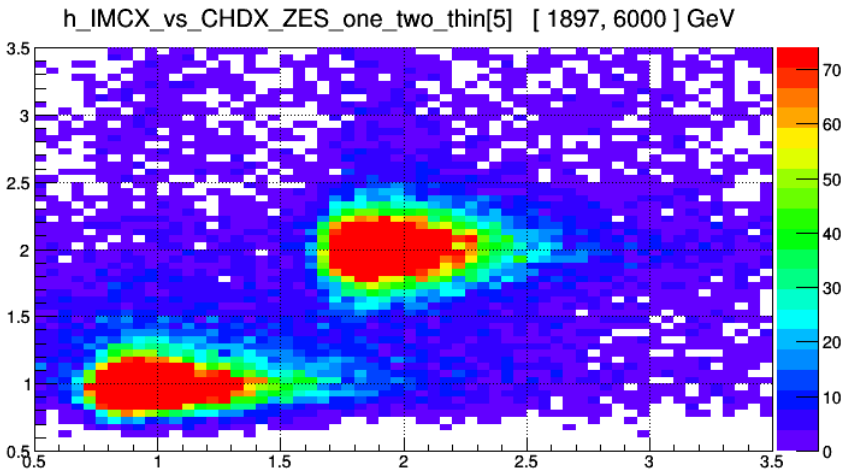
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 4

Charge assignment from CHD and IMC



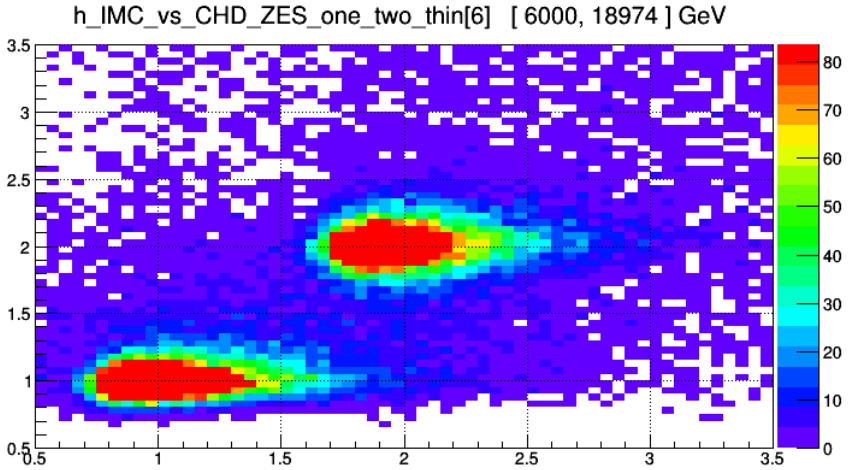


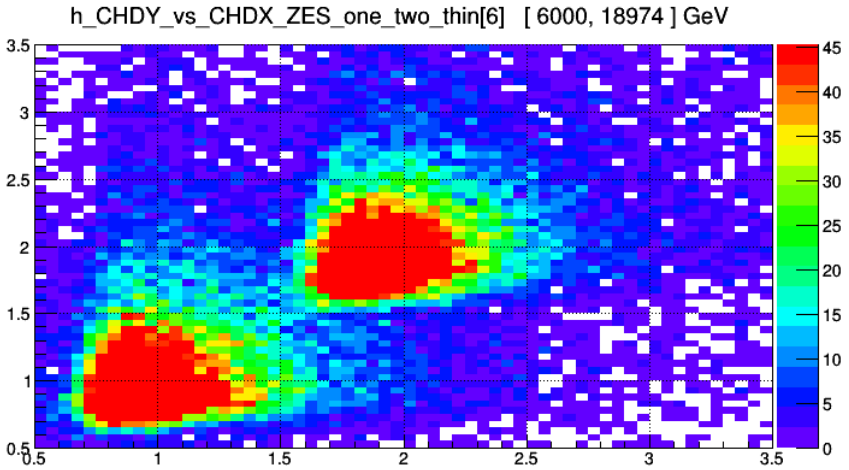


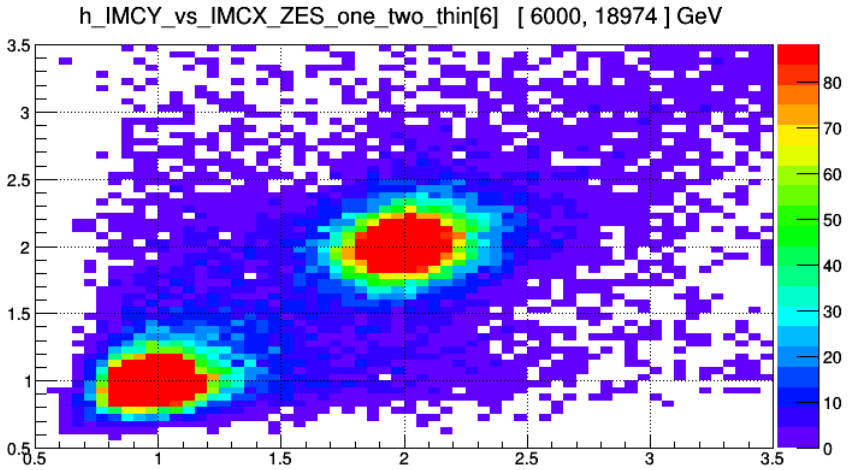


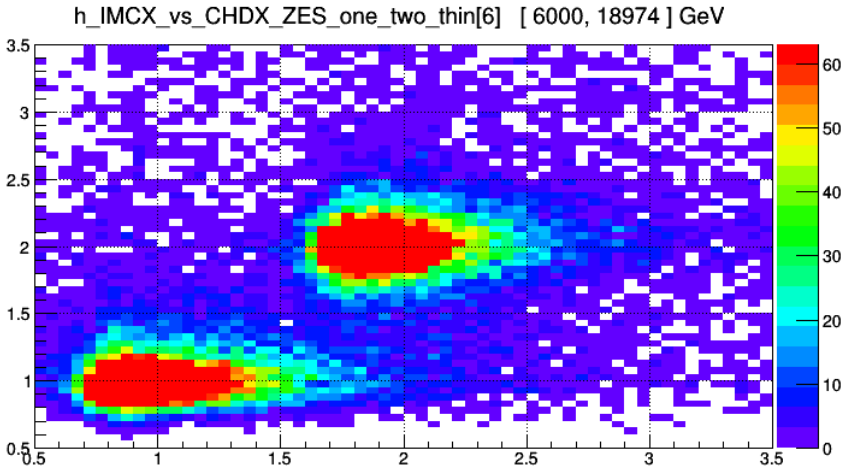
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 5

Charge assignment from CHD and IMC



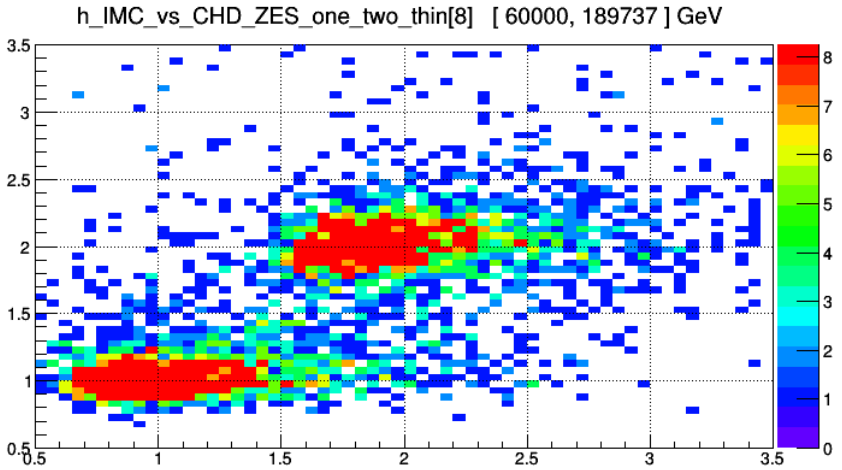


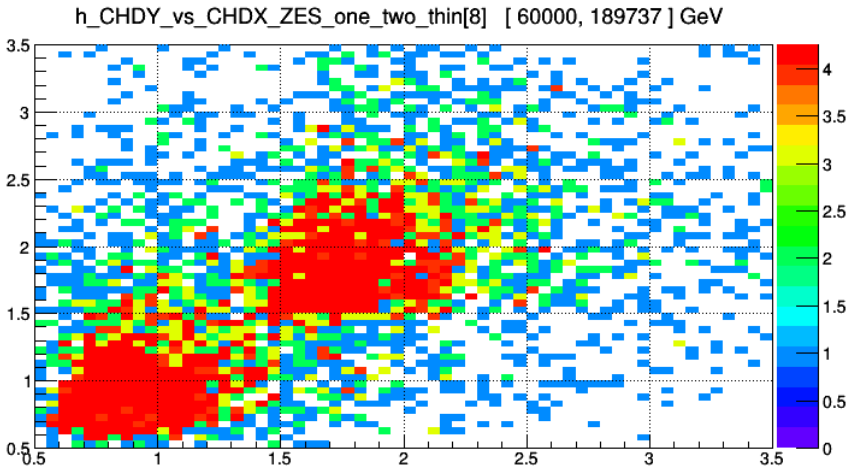


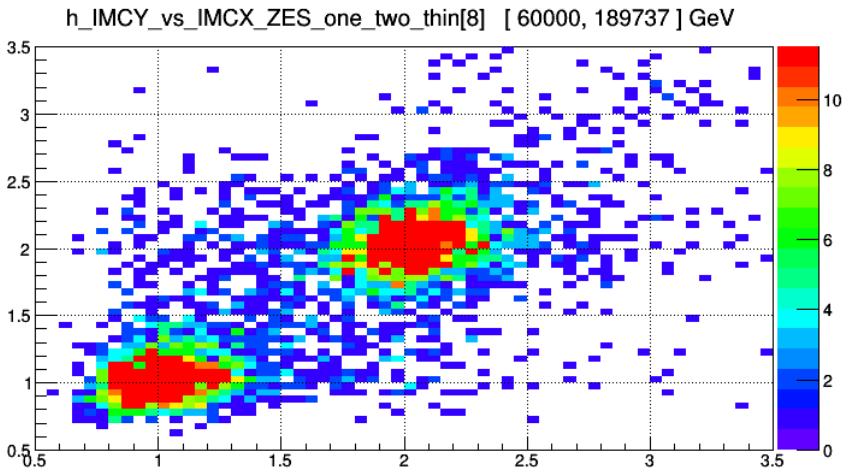


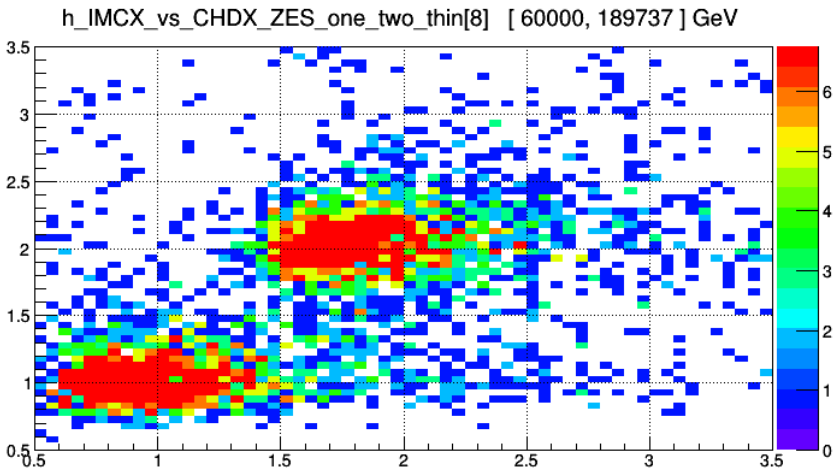
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 6

Charge assignment from CHD and IMC







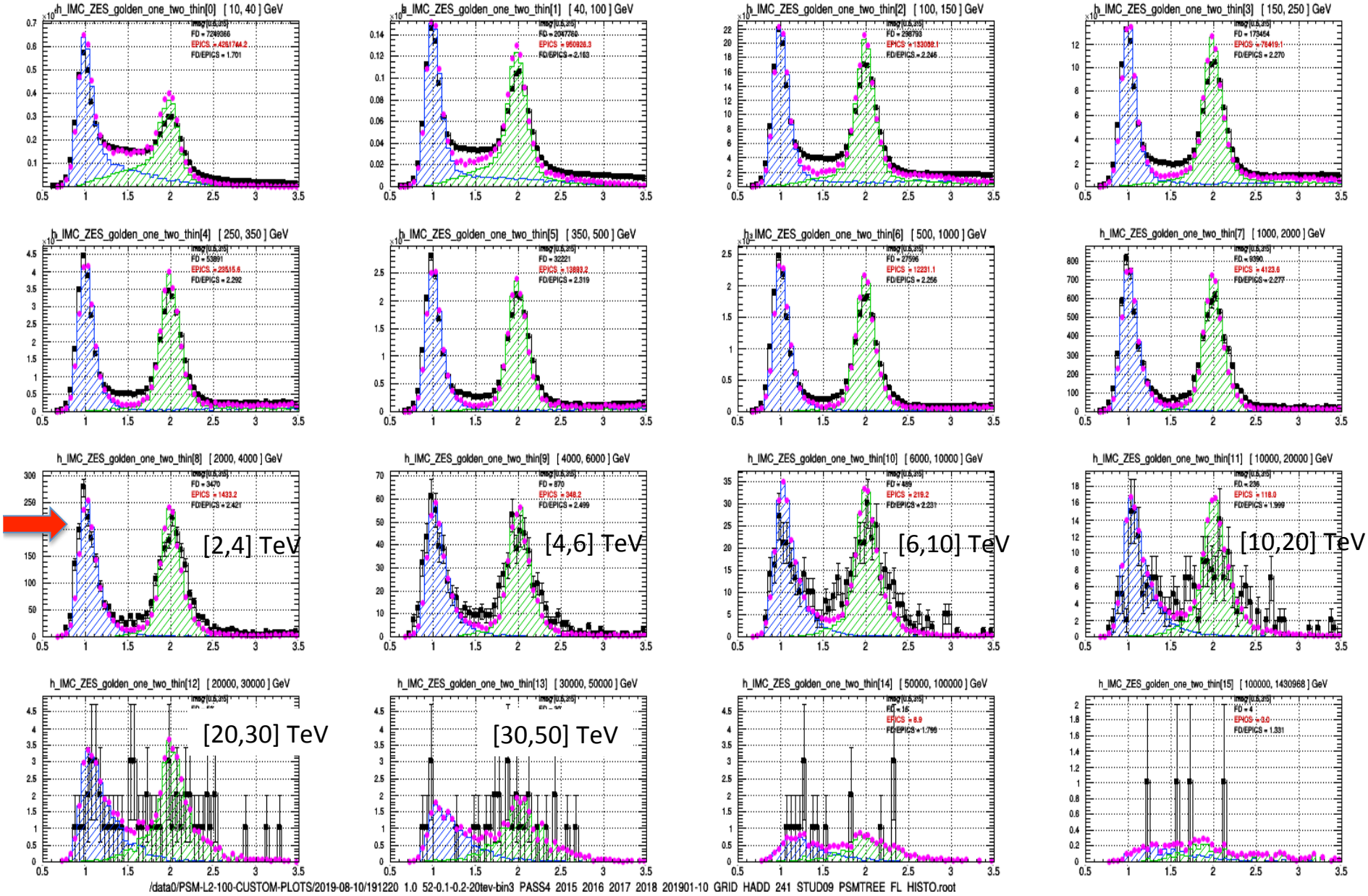


/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 8

PASS 4 ICLIB 1.1

IMC charge in energy slices (loose selection of p+He candidates

p = blue; He = green
MC sum = Magenta
EPICS

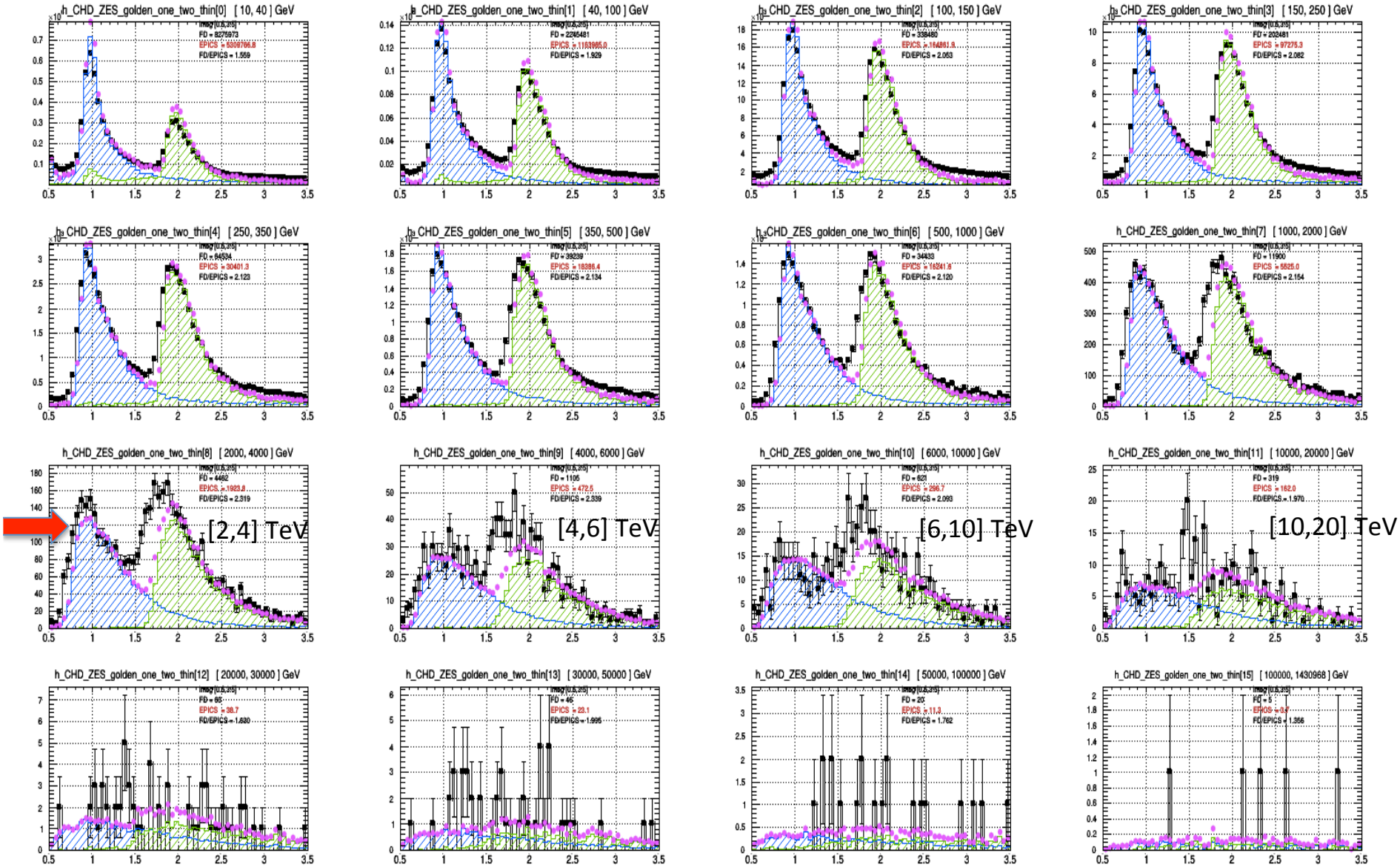


/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/191220 1.0 52-0.1-0.2-20tev-bin3 PASS4 2015 2016 2017 2018 201901-10 GRID HADD 241 STUD09 PSMTREE FL HISTO.root

PASS 4 ICLIB 1.1

CHD charge in energy slices (loose sel of p+helium candidates

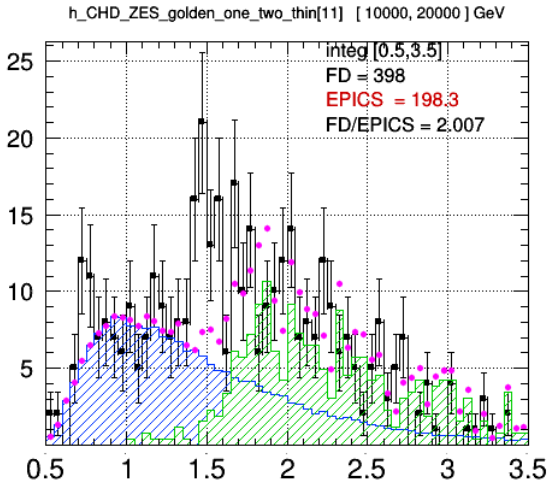
p = blue; He = green
MC sum = Magenta
EPICS

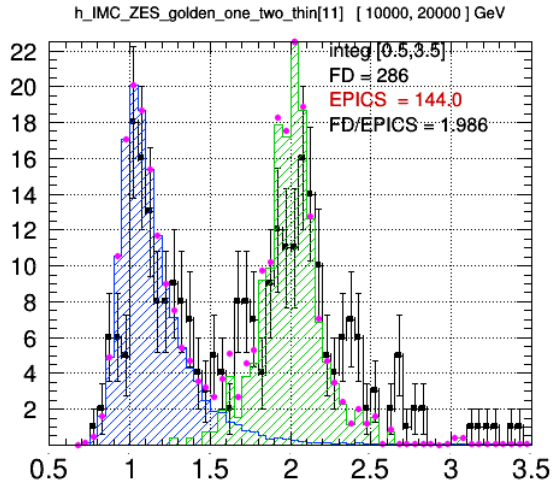


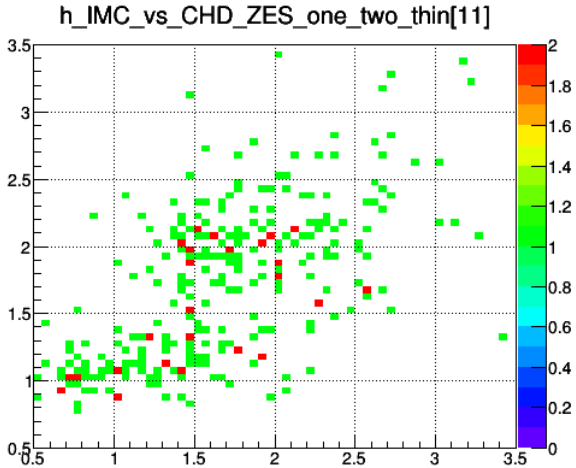
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/191220 1.0 52-0.1-0.2-20tev-bin3 PASS4 2015 2016 2017 2018 201901-10 GRID HADD 241 STUD09 PSMTREE FL HISTO.root

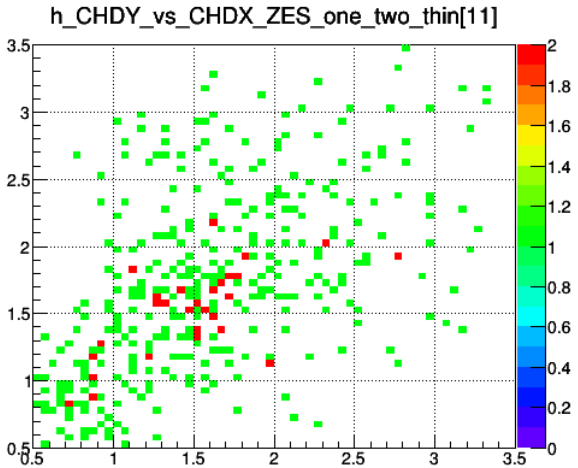
proton and helium charges at 10 TeV

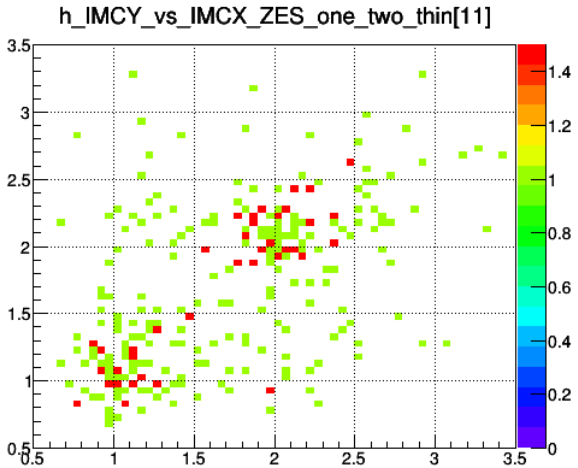
- Despite the low statistics IMC charges show p-He separation power and consistency with EPICS
- Separation with CHD only at TeV energies looks difficult.
- **use IMC only for p, He separation above 1 TeV.**

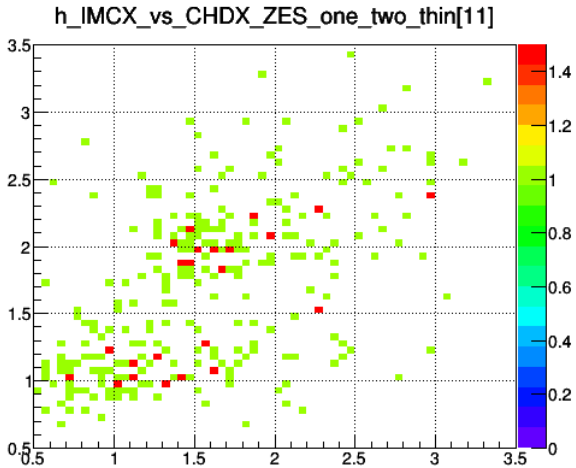












/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root 11

VIEW-ORIENTED CHARGE SELECTION

- **VIEW-ORIENTED Charge ONE (pre-) selection**

CHARGE_ONE_XZ IMC_XZ [0.5, 1.5] && CHD-X [0.5, **2.0**]
CHARGE_ONE_YZ IMC_YZ [0.5, 1.5] && CHD-Y [0.5, **2.0**]

A **charge_one candidate** is selected if it satisfies the |Z|=1 condition at least in one view:

CHARGE_ONE CHARGE_ONE_XZ || CHARGE_ONE_YZ

- **rejection of Z >= 2 nuclei background using the OPPOSITE VIEW**

CHARGE_ONE_XZ && CHD-Y > **1.8** && IMC-YZ > **1.8** => reject
CHARGE_ONE_YZ && CHD-X > **1.8** && IMC-XZ > **1.8** => reject

(*) cuts in RED have been enlarged in this analysis

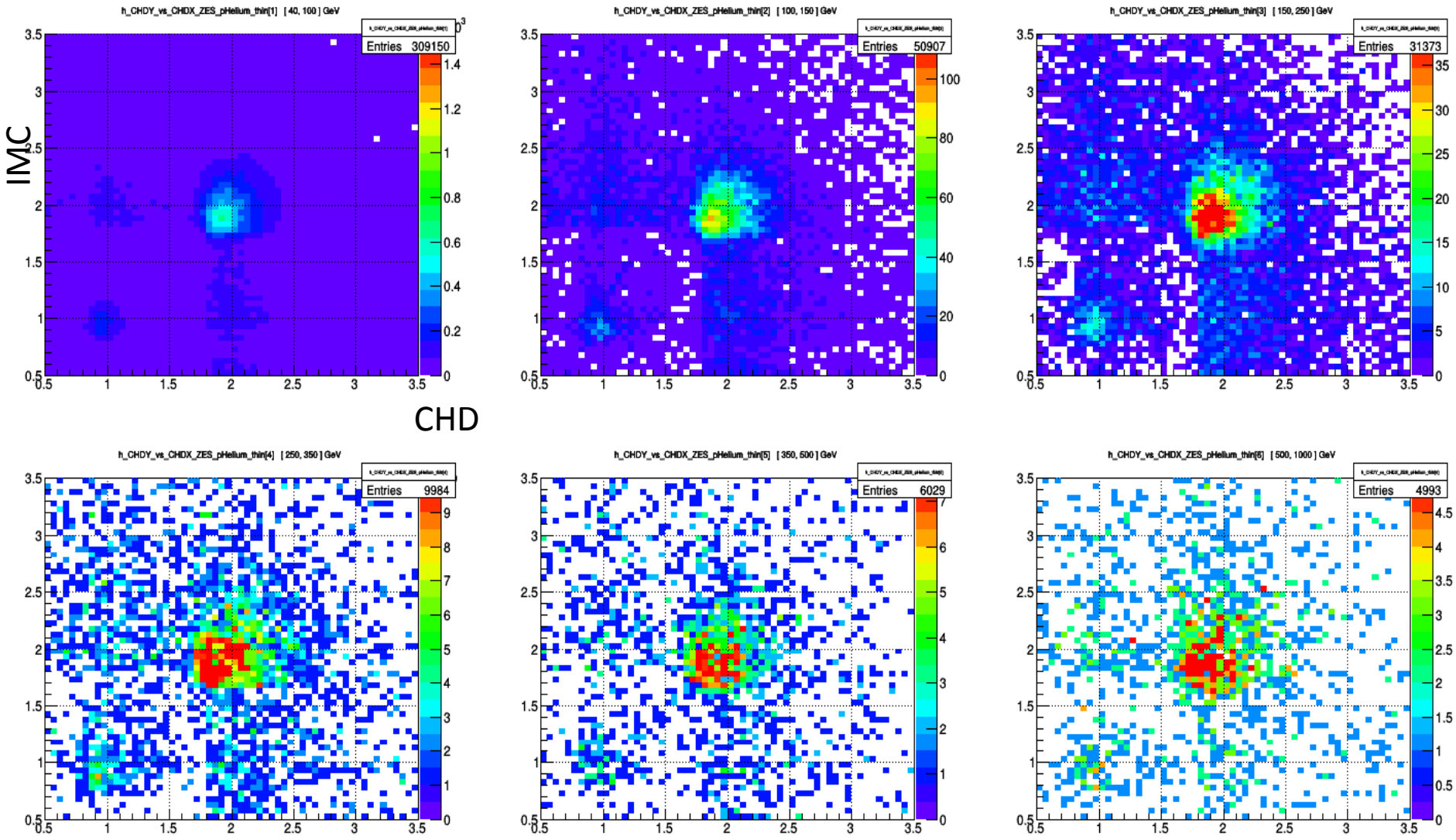
- **further rejection of Z >= 2 nuclei using COMBINED (CHD, IMC) charge**

CHD_Z > 1.5 && IMC_Z > 1.3 => reject

(CHD_Z = average of CHDX and CHDY; IMC_Z = average of IMC_X and IMC_Y)

Helium background contamination study

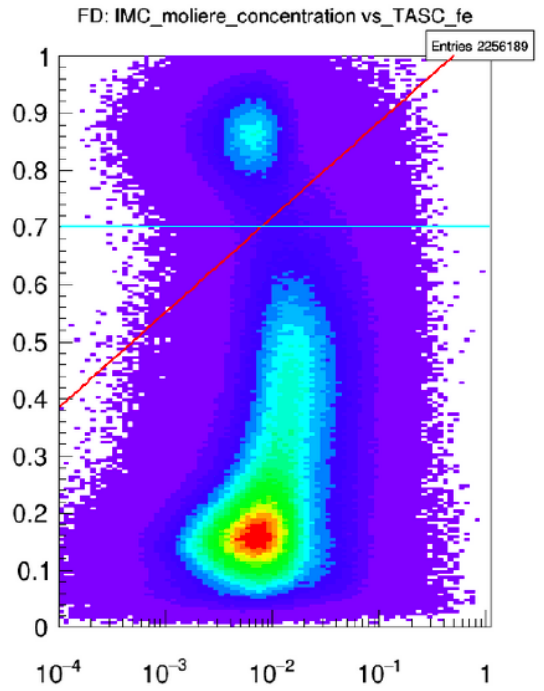
from FLIGHT data: rejected Helium 6 slices from 40 GeV to 1 TeV



/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/191220 1.0 52-0.1-0.2-20tev-bin3 PASS4 2015 2016 2017 2018 201901-10 GRID HADD 241 STUD09 PSMTREE FL HISTO.root

- Electron rejection:

IMC_concentration along track > 0.8 => reject as electron



- Off-acceptance tracks "standard" rejection cuts:

define: fEn = TASC layer(n) edep/ TASC_total_edep (n=0, 1, ...11)

① **if at least one TASC layer has fEn > 0.4 the event is rejected**

define: fEn_max_fraction =max{fEn, n=0,11} / TASC_total_edep

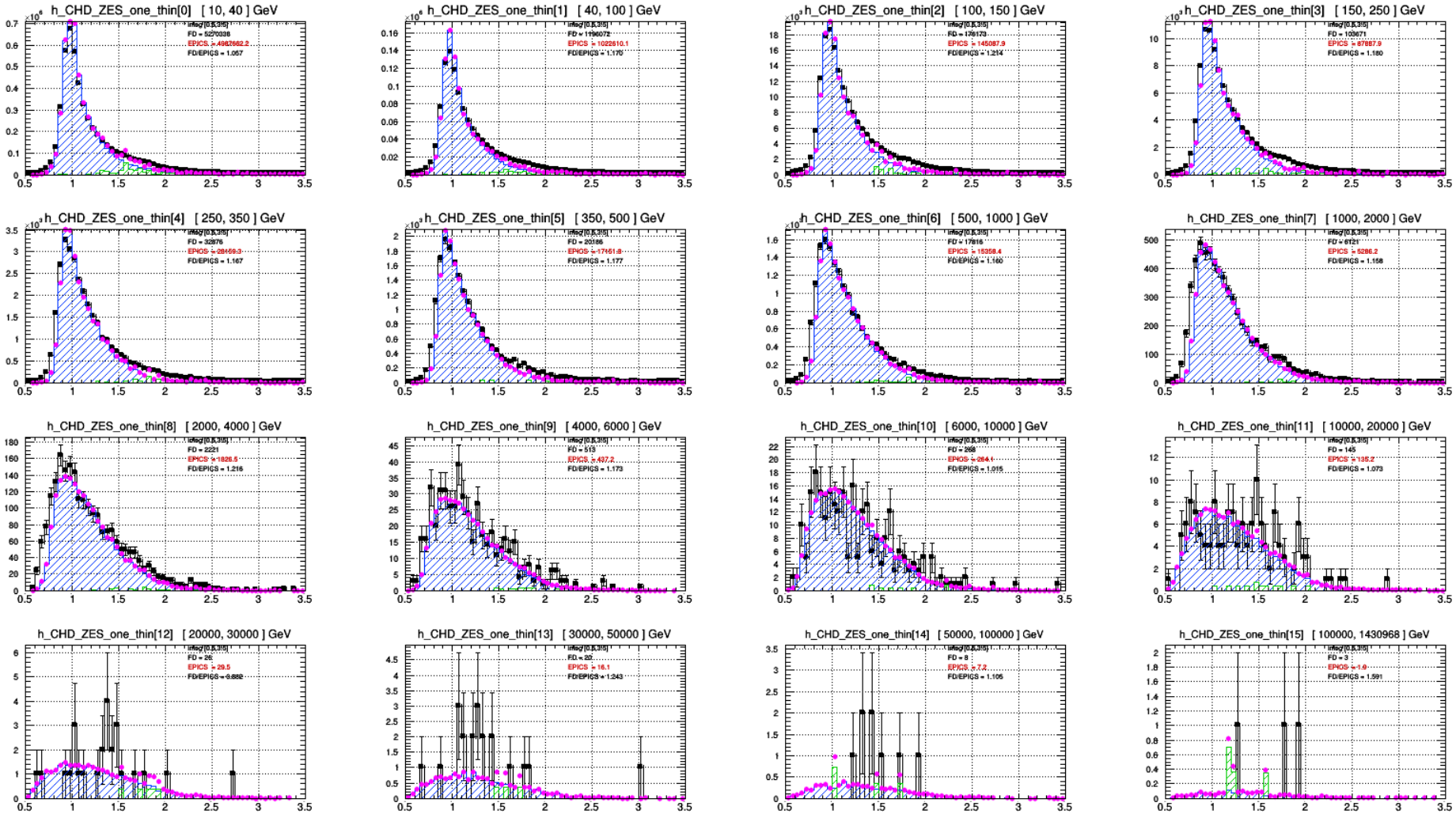
② **if fEn_max_fraction > cut(*) the event is rejected**

(*) energy dependent from 0.3 to 0.2 at high energy

Final sample of proton candidates:

Black = FD
Blue = EPICS
Green = helium bkg

charge distribution in deposited energy slices

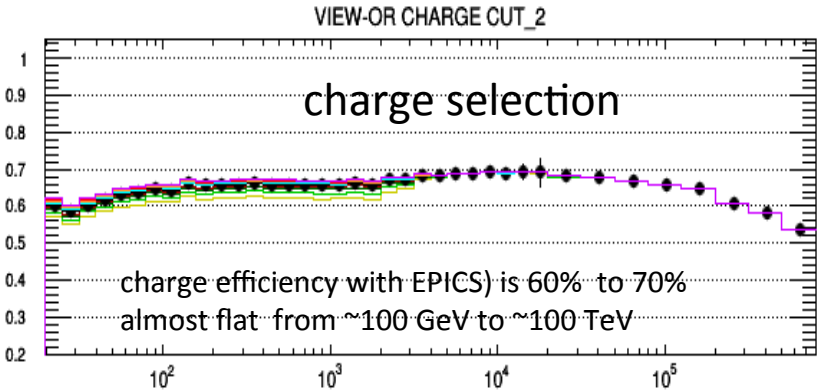


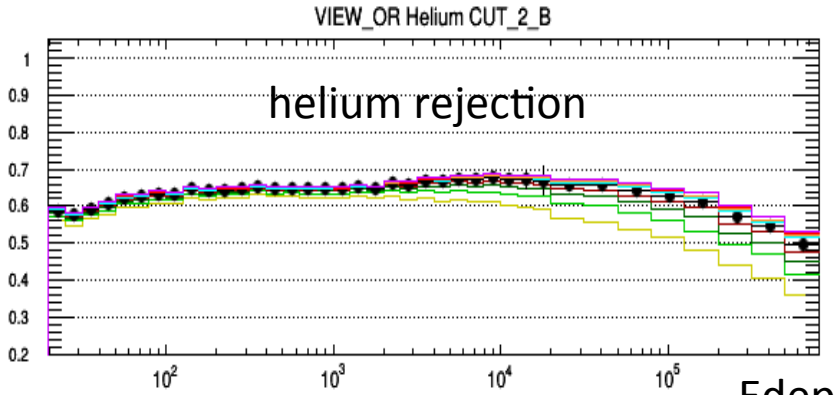
/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200130 1.0 52-0.1-0.2-20tev-bin3 PASS4 201511-12 2016 2017 2018 201901-10 GRID HADD 259 ACC A1 PSMTREE FL HISTO.root

RELATIVE efficiencies (normalized to previous cut) vs Edep

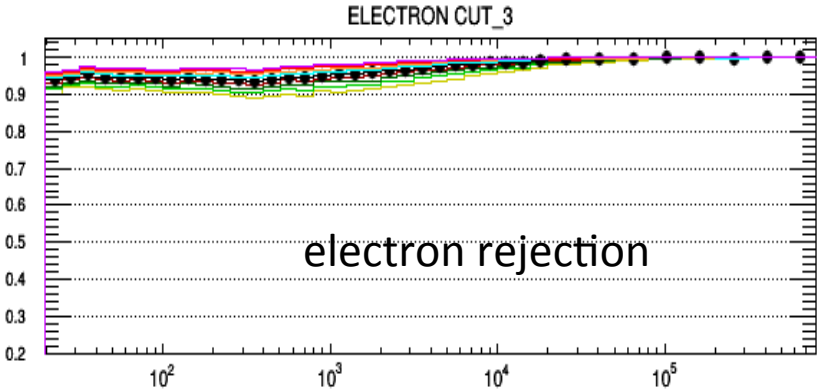
- study the stability of the efficiency when cuts are varied

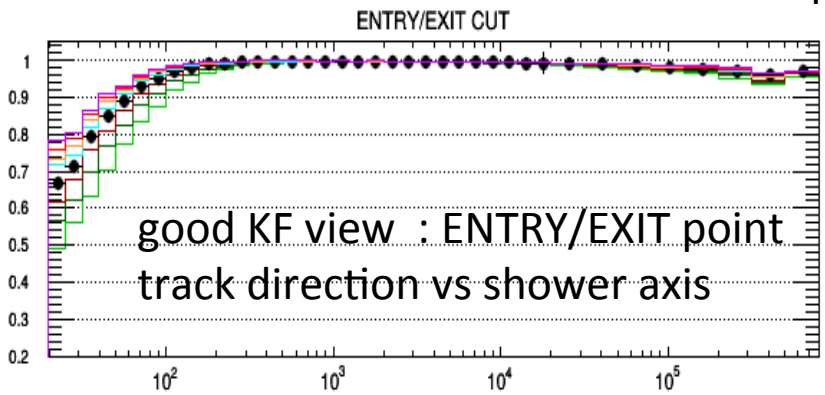
(each curve is obtained by varying **one cut** while leaving the others unchanged)

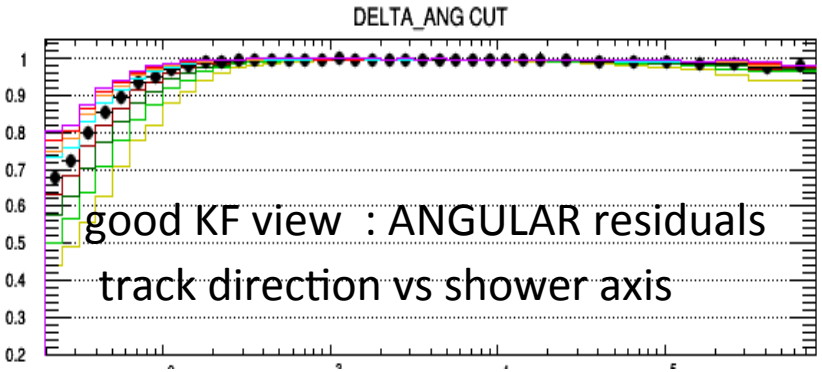


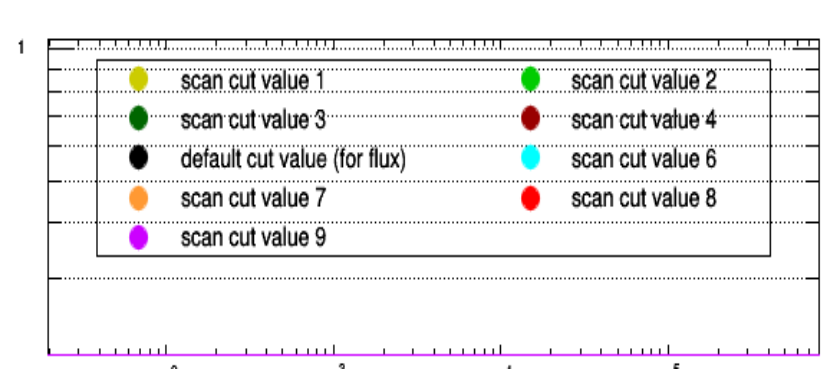


Edep





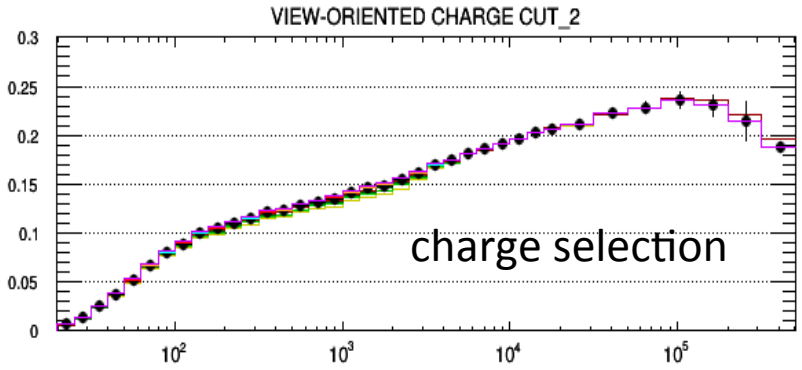


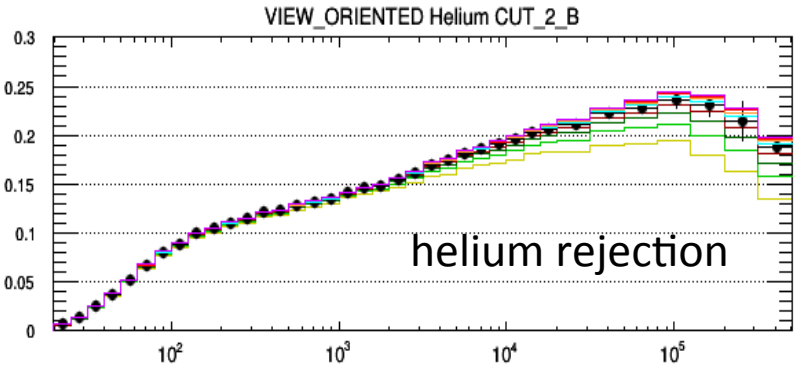


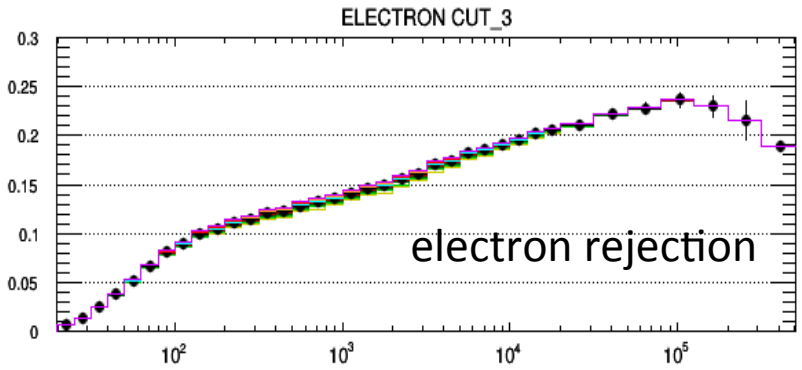
ABSOLUTE efficiency vs Edep

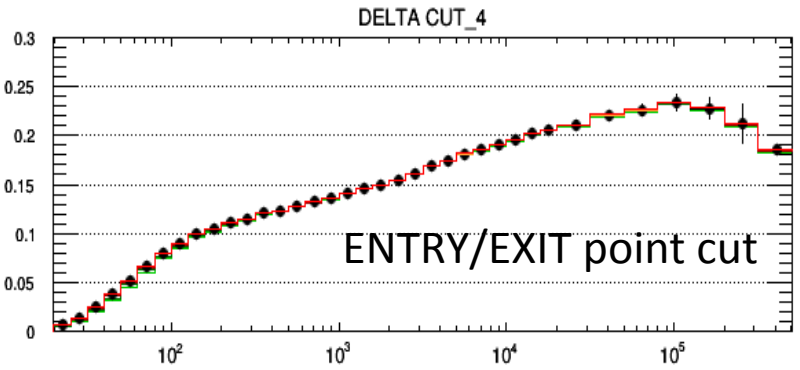
- study the stability of the efficiency when cuts are varied

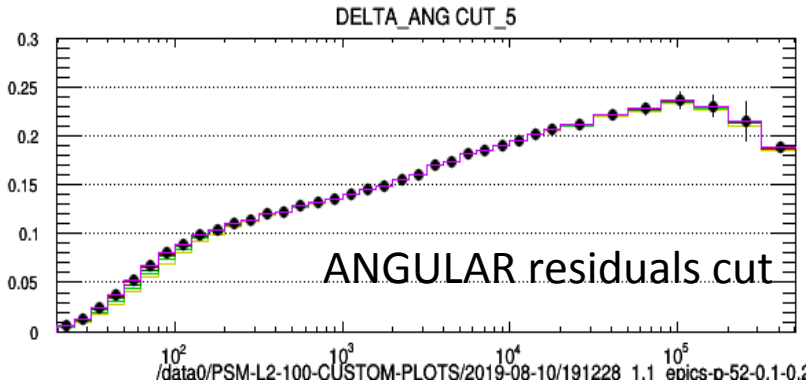
(each curve is obtained by varying **one cut** while leaving the others unchanged)

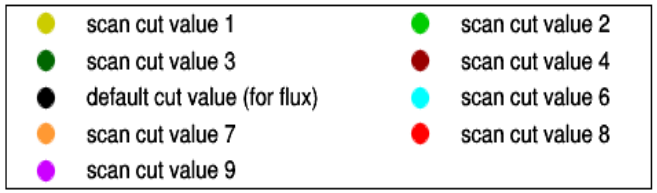










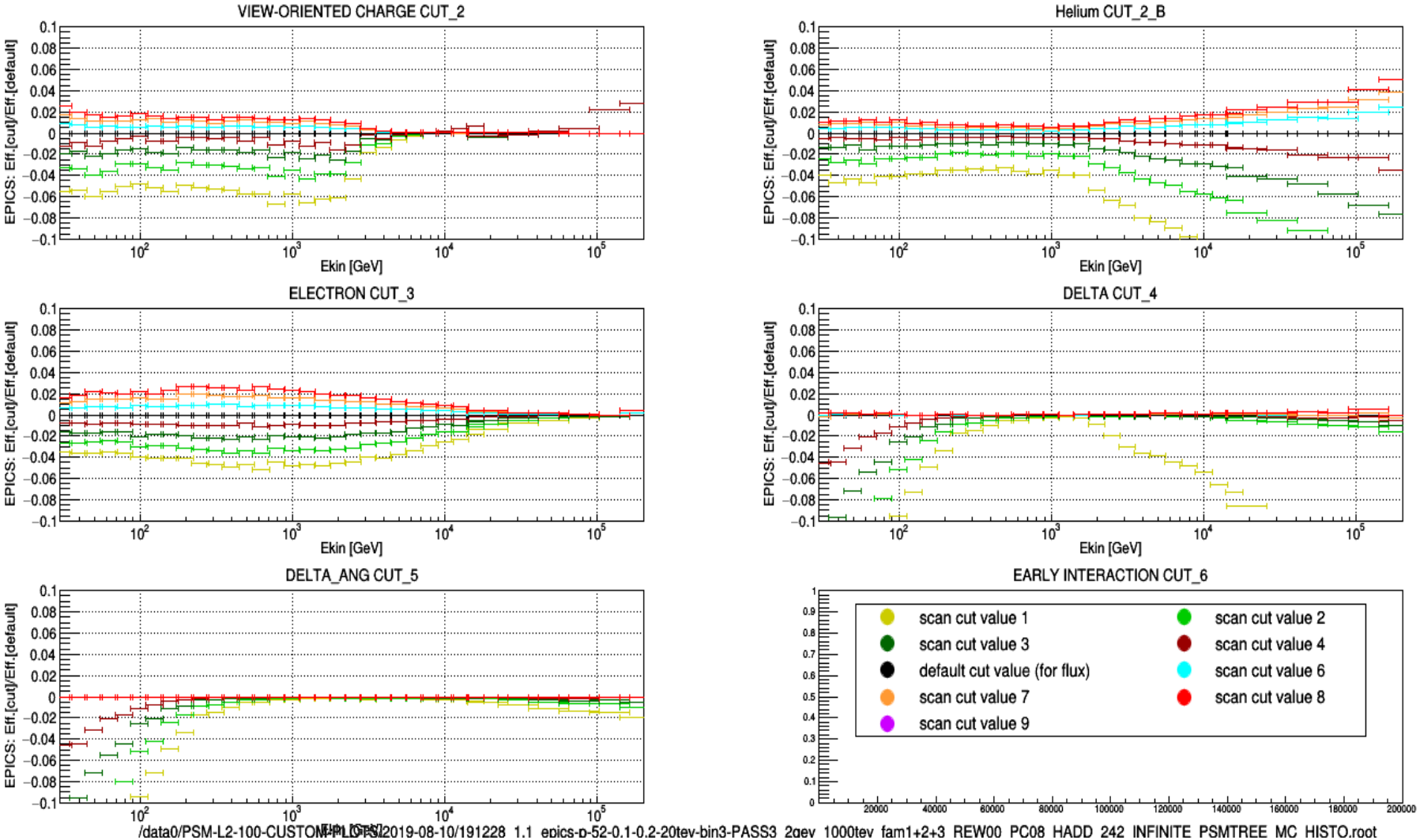


/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/191228_1.1_epics-p-52-0.1-0.2-20tev-bin3-PASS3_2gev_1000tev_fam1+2+3_REW00_PC08_HADD_242_INFINITE_PSMTREE_MC_HISTO.root

Fractional variation of ABSOLUTE efficiency (residuals vs reference efficiency)

study the stability of the absolute efficiency when cuts are varied

(each curve is obtained by varying **one cut** while leaving the others unchanged)



Subtraction of residual Helium background contamination

The percentage of residual He contaminants is estimated bin-by-bin from the MC using two different methods:

Method 1: from Helium MC get the ratio $R = Np^{fake} / N_{He}^{MC}$ where

Np^{fake} = number of He passing the proton selection
N_{He}^{MC} = number of He passing the He selection

From FLIGHT data (FD): take the number of He candidates N_{He}^{FD} and the number of proton N_p^{FD} using the He and p selections, respectively.

Then the FD proton sample N_p after subtraction of He contaminants is

$$N_p = N_p^{FD} - R\, N_{He}^{FD}$$

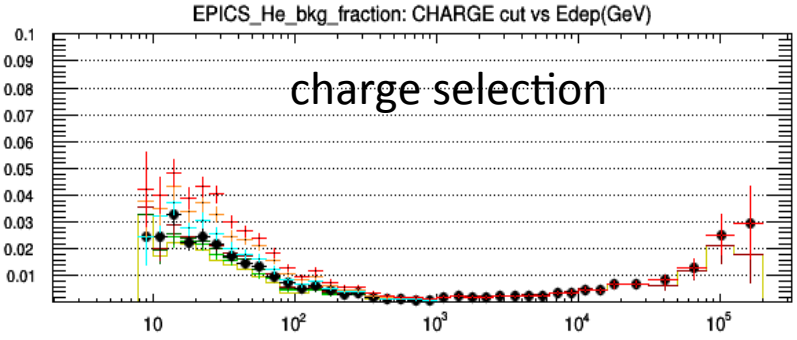
Method 2: scale the number of contaminants Np^{fake} from He MC to the number expected in FD using the relative normalization of FD livetime to number of MC events.

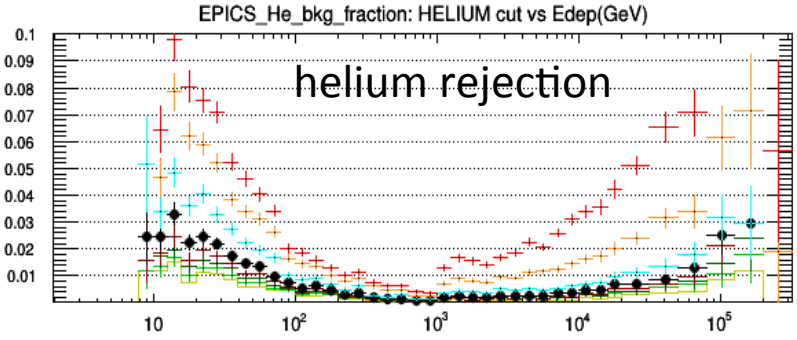
Fraction of Helium background contamination (EPICS) method 1

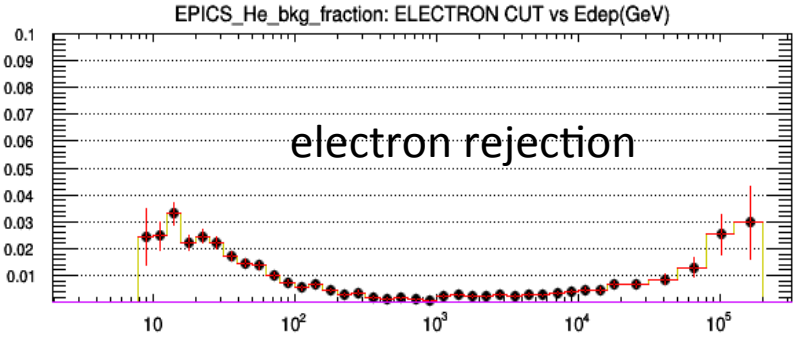
Vary selection cuts and study the residual Helium contamination R as a function of deposited energy Edep in TASC

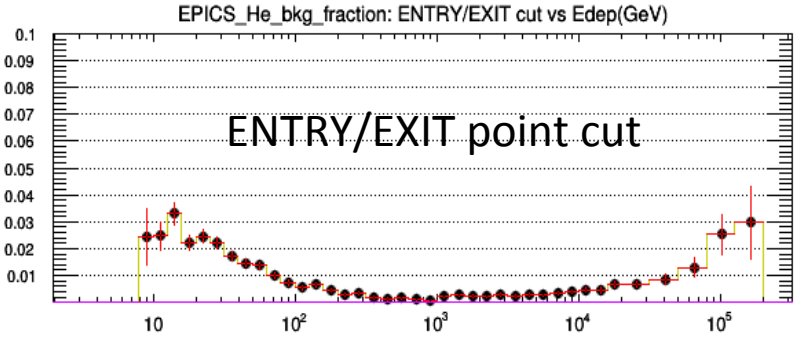
The relevant cuts are CHARGE (top left) and He rejection cut (top right)

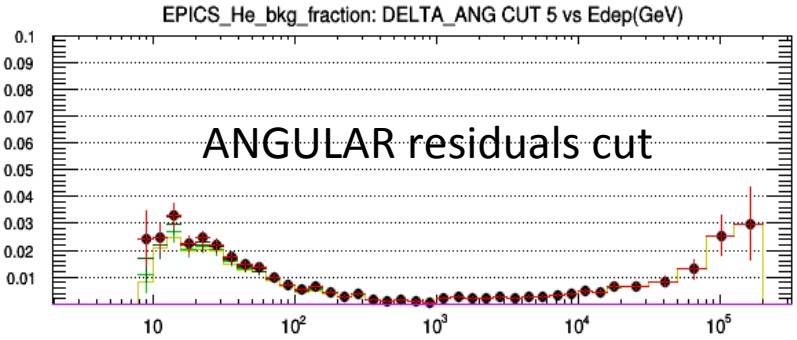
Final cuts: **filled black circles**

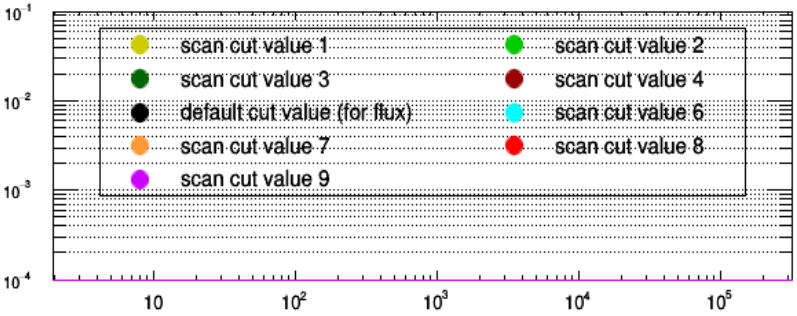








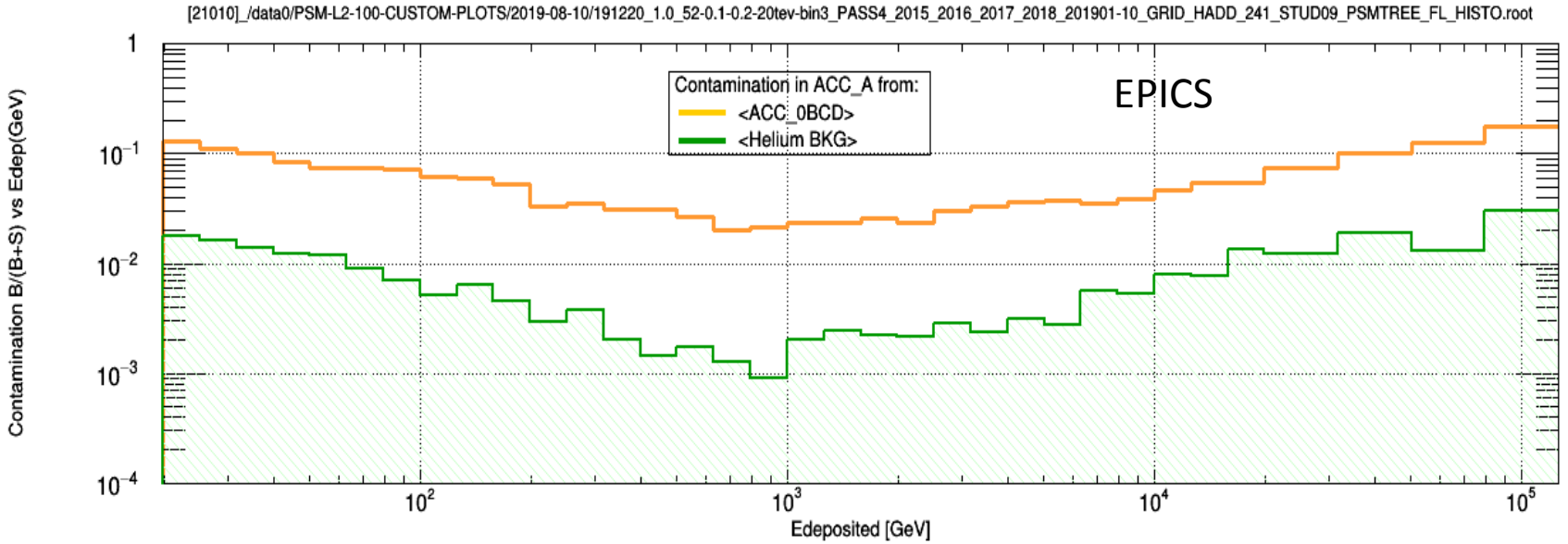


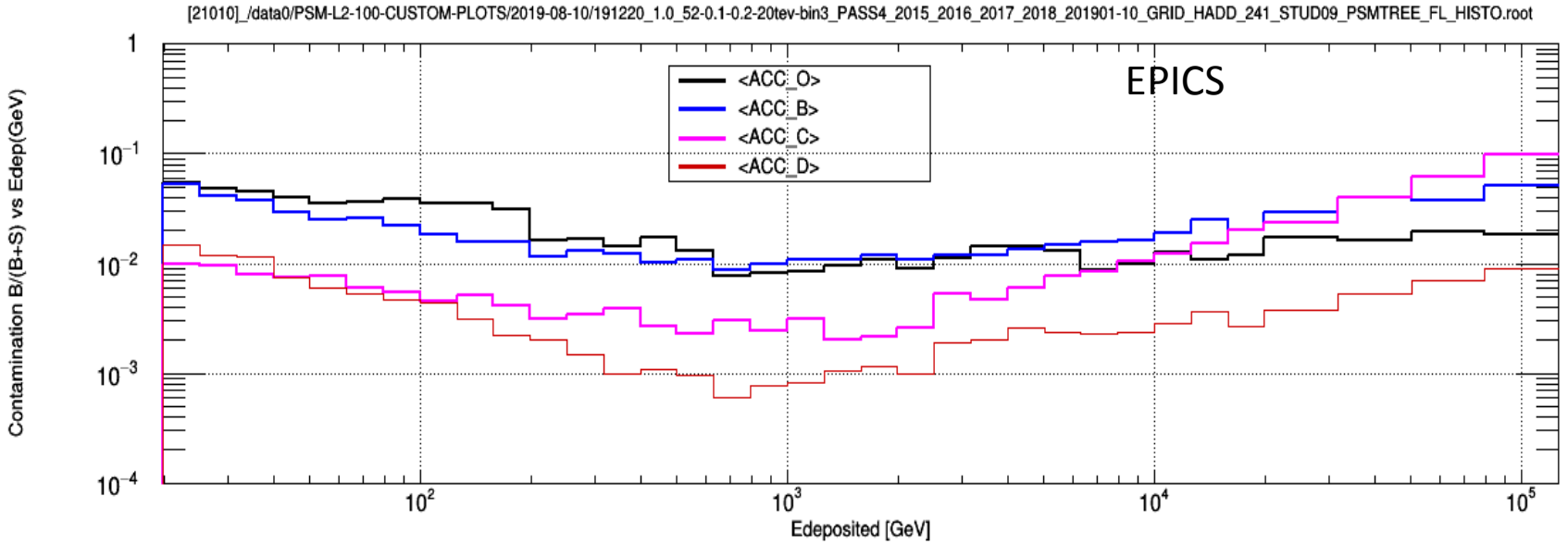


Contamination of events erroneously reconstructed in acceptance A1

(RECO_A) while coming from different true acceptances: ZERO, A1, B1, C D

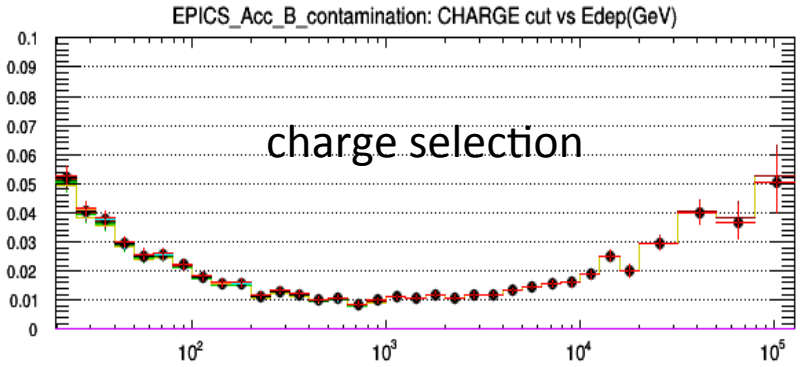
Dominant contrubutions are from acceptance ZERO and B1.

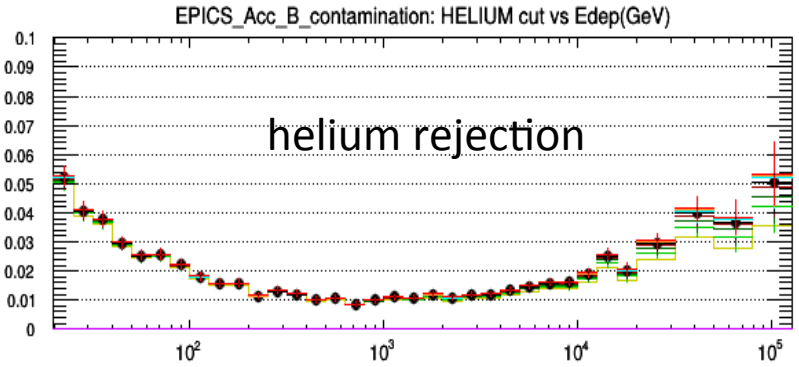


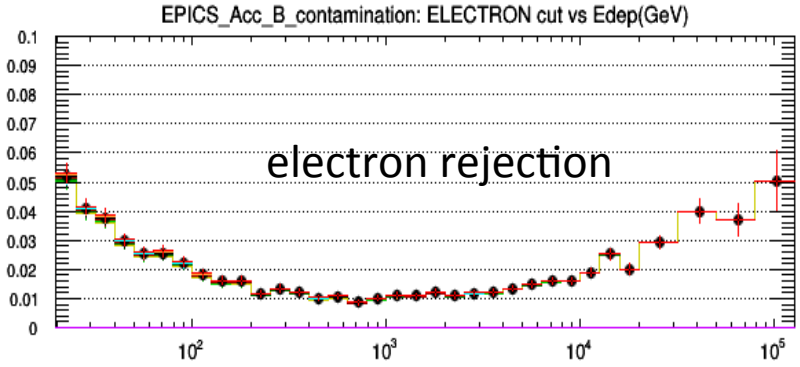


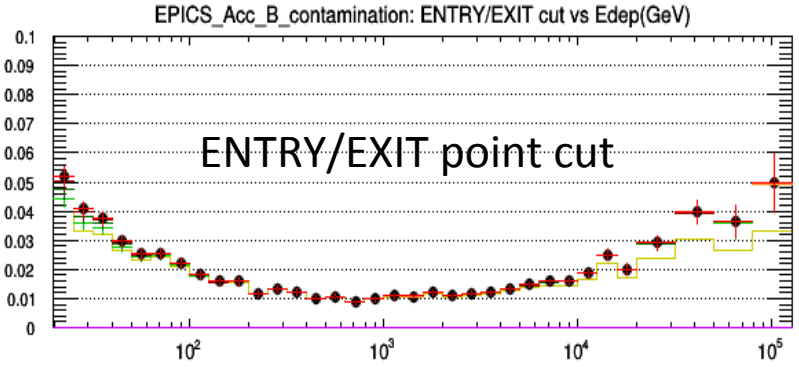
Background contamination from Acceptance-B1 (EPICS)

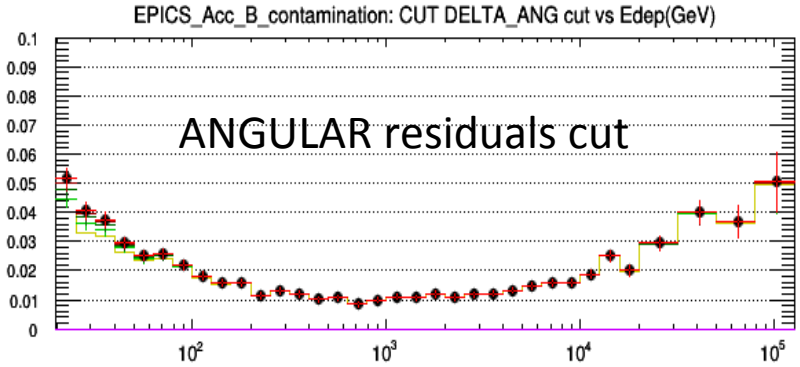
Vary selection cuts and study the contamination as a function of Edep in TASC

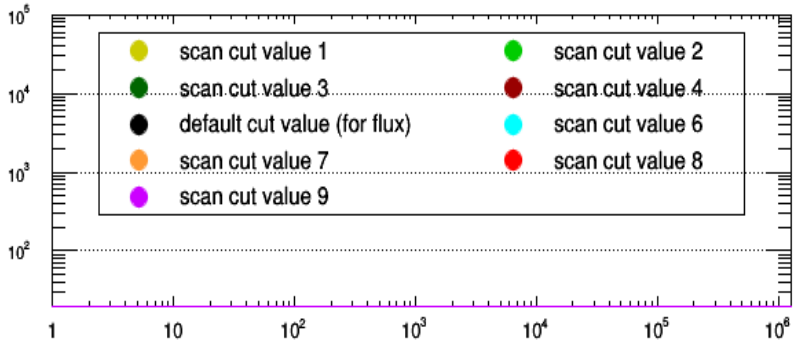






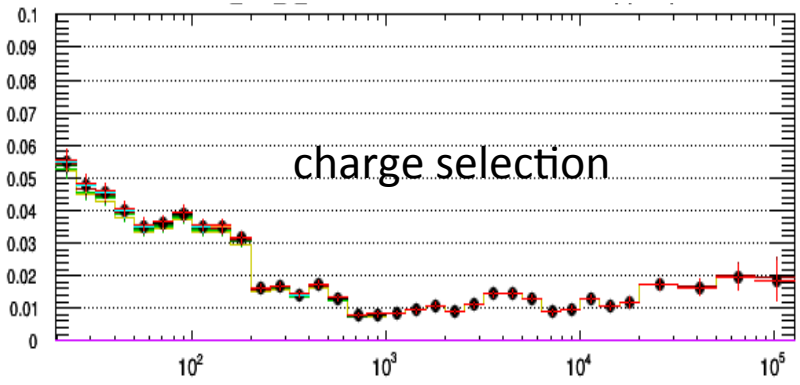


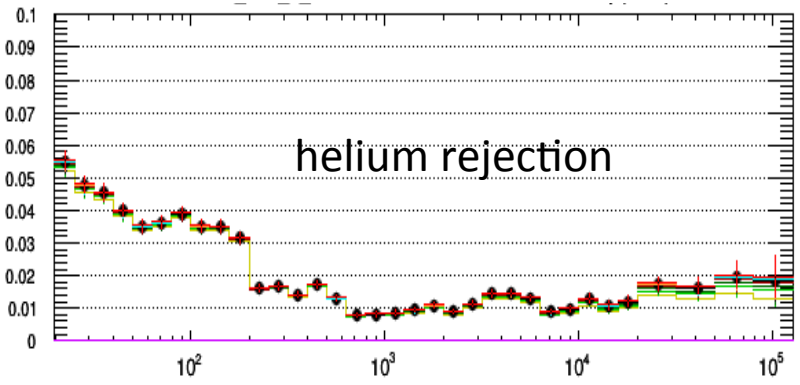


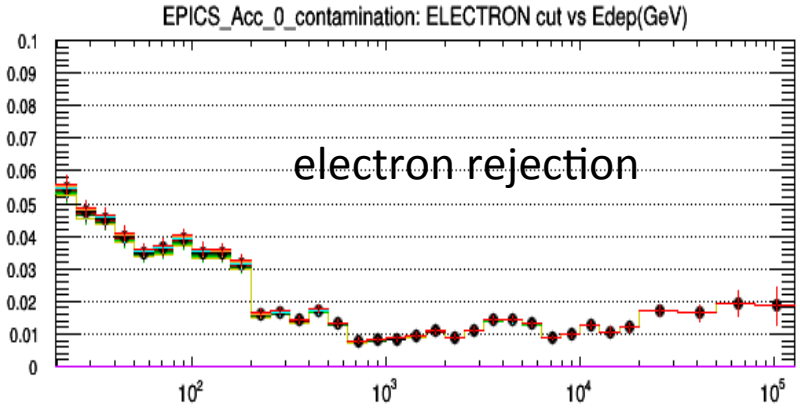


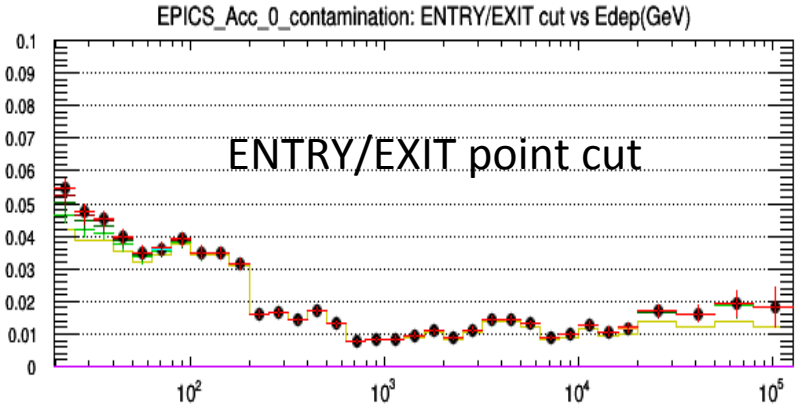
Background contamination from Acceptance-0 (EPICS)

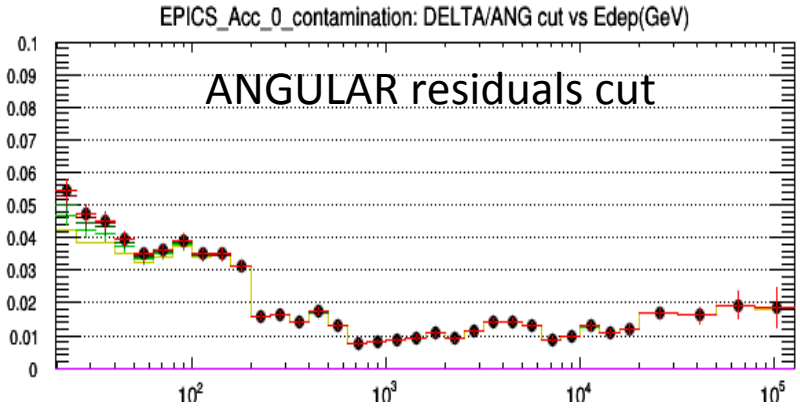
Vary the selection cut value and study the contamination as a function of Edep in TASC

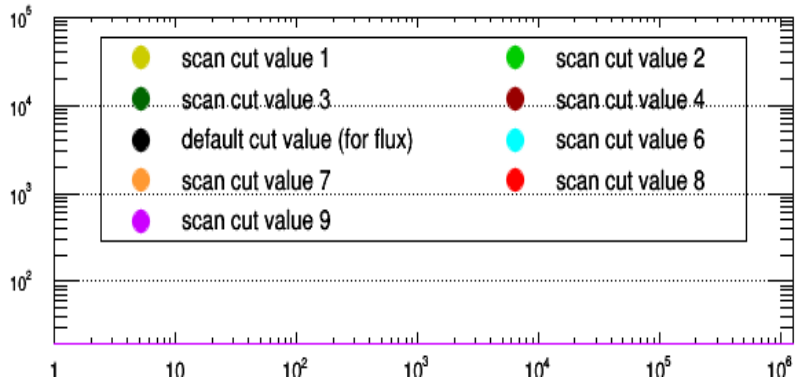






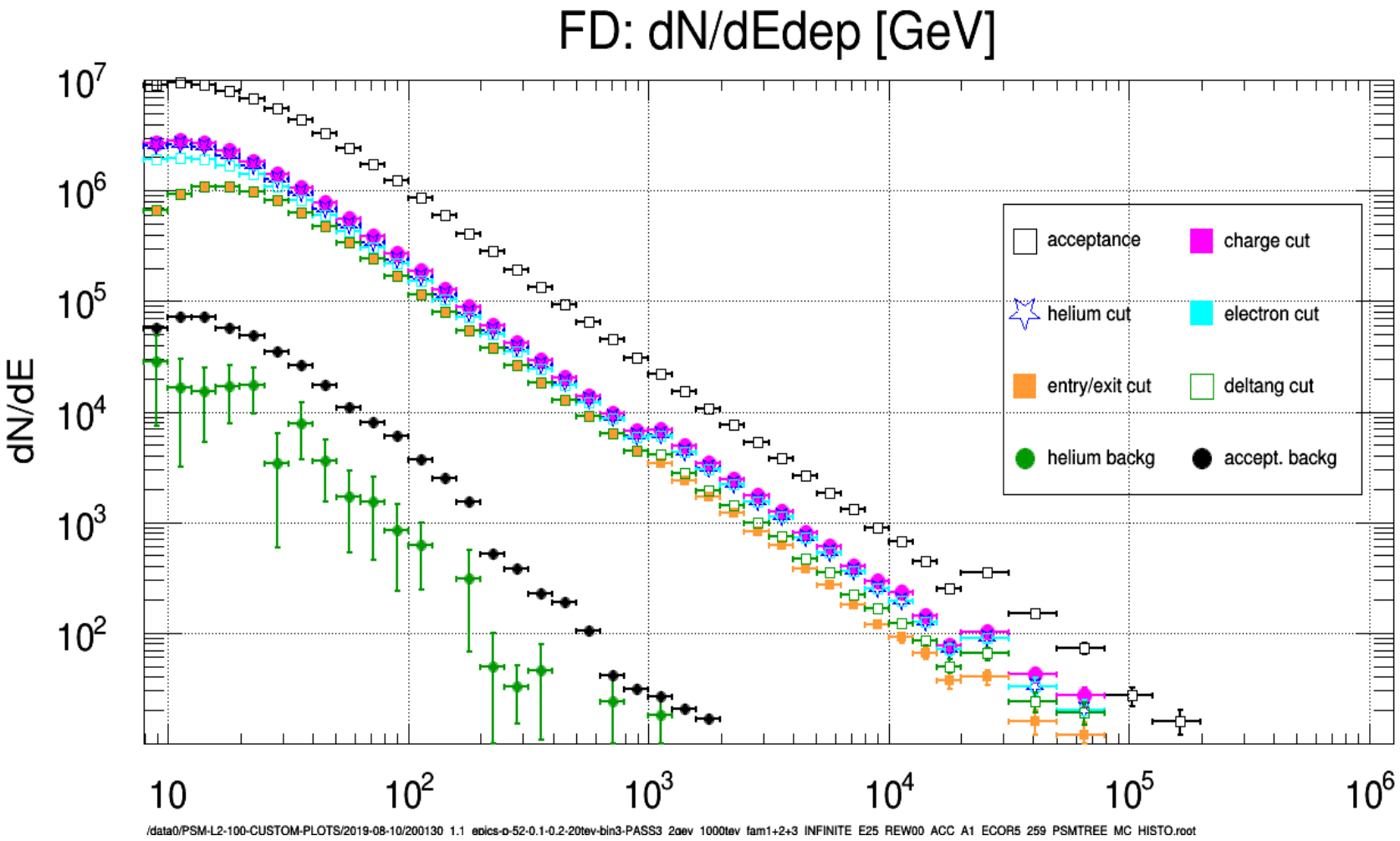






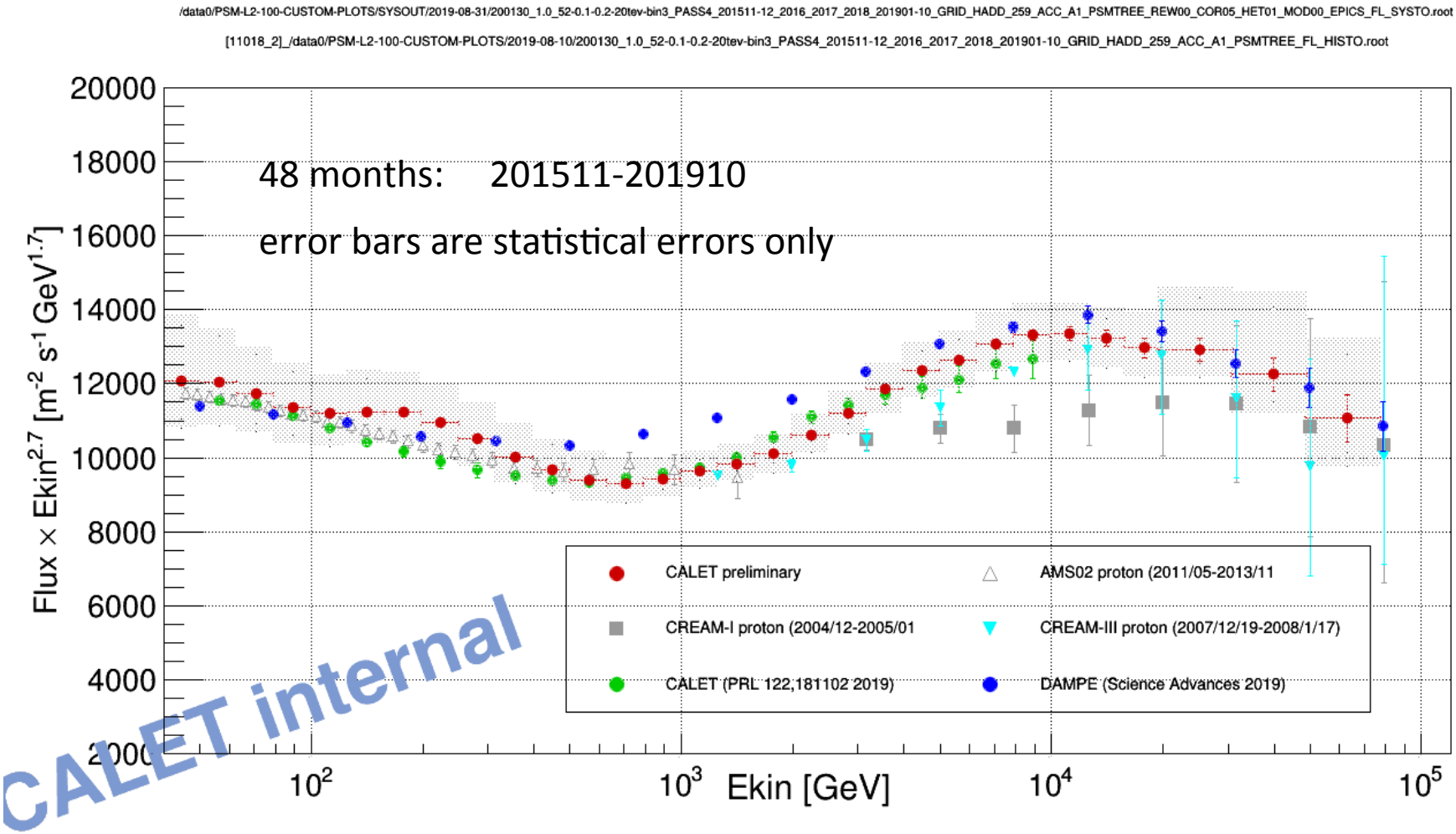
Proton candidates

- 48 months: 201511-201910 (201510 is excluded)
- selected proton candidates after each cut
- background events to be subtracted (black and green)



after: background subtraction, energy unfolding, efficiency corrections,
energy and trigger corrections (next slides), livetime normalization

Preliminary proton flux in acceptance A1



Study of systematic uncertainties

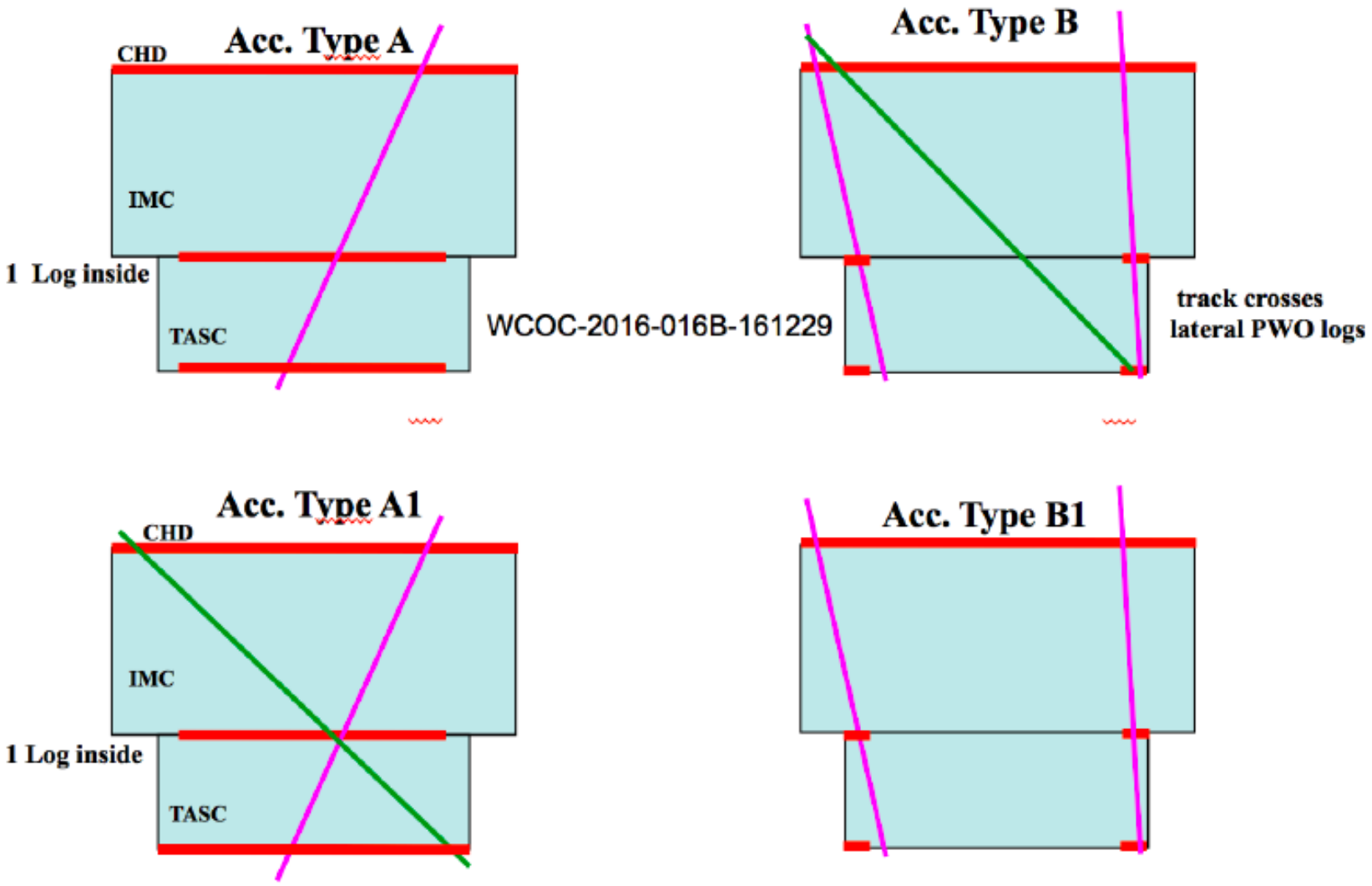
Study of expected sources of systematic error including:

1. Acceptance
2. Selection cuts
3. Subtraction of Helium background
4. Subtraction of events erroneously reconstructed in acceptance A1
5. Systematics from event re-weighting in MonteCarlo
6. Systematics from unfolding procedure
7. Systematics from energy dependent corrections: energy scale and trigger efficiency
8. Systematics from MonteCarlo modeling EPICS/FLUKA

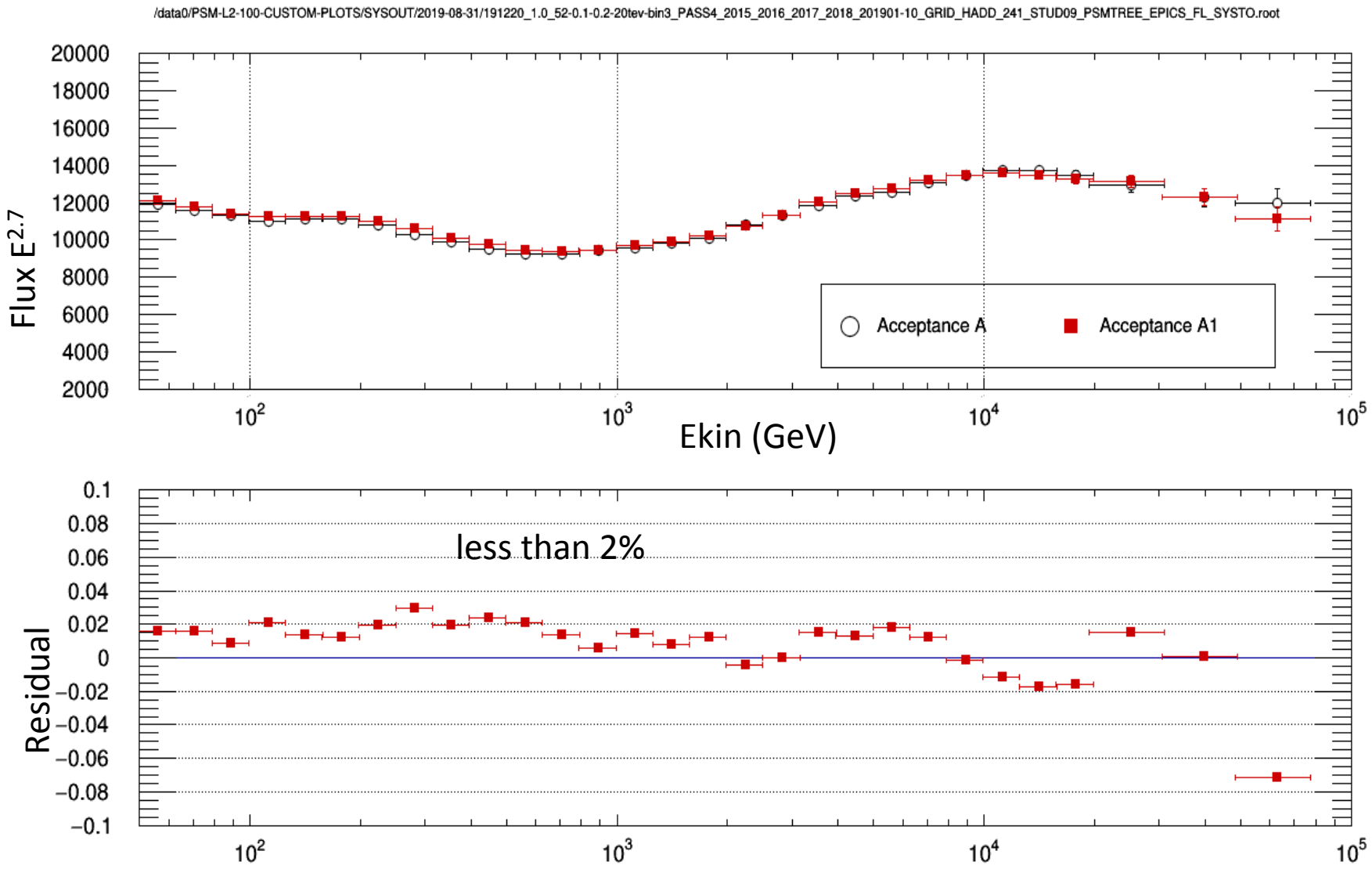
...

Definition of acceptance A1

increase in GF from Acceptance A -> A1 = 419 -> 510 cm^2 sr (~21.7%)



① Systematic error from increase of Acceptance A -> A1

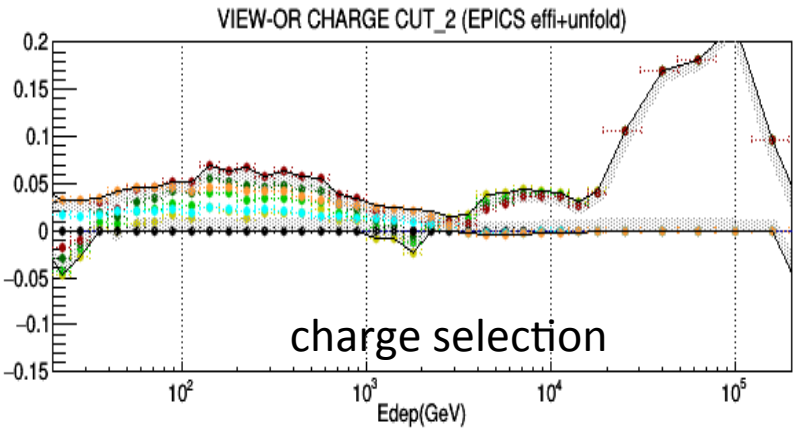


② Systematics from selection cuts

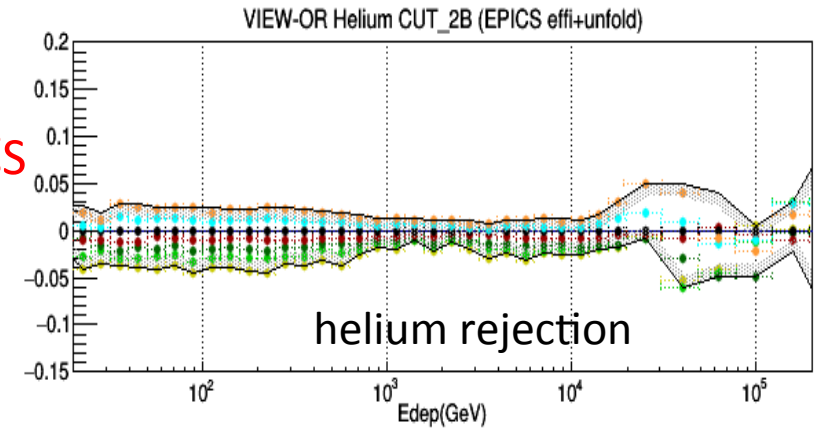
- Change one cut value at the time (leaving all other cuts unchanged) and see how much the flux changes with respect to the reference flux.

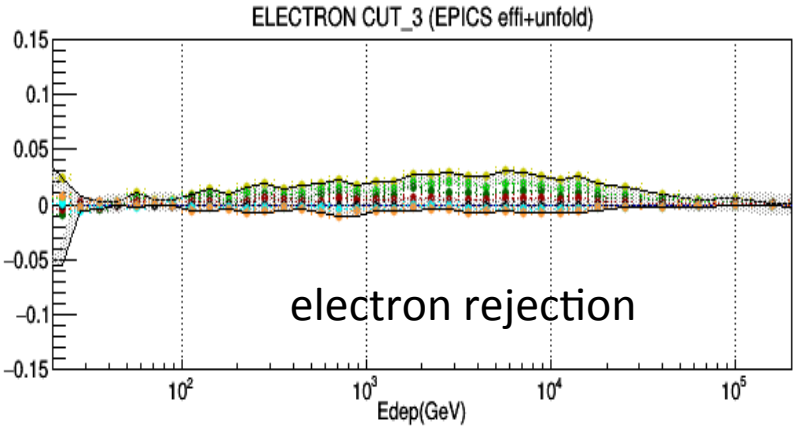
Plot this fractional variation (R_{flux} = $F/F_{referencd}$ -1) as a function of Ekin.

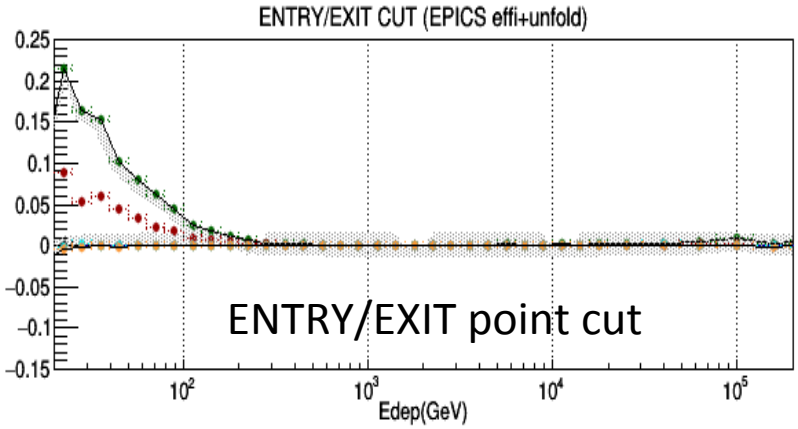
Flux residuals R_{flux} as a function of cuts. The GRAY band is contribution to systematic error

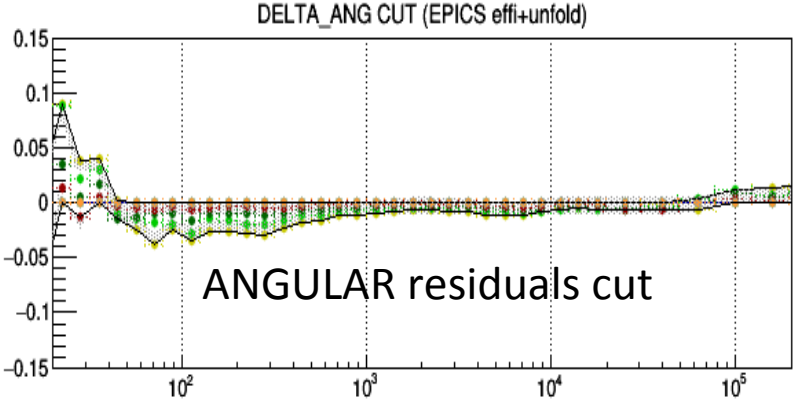


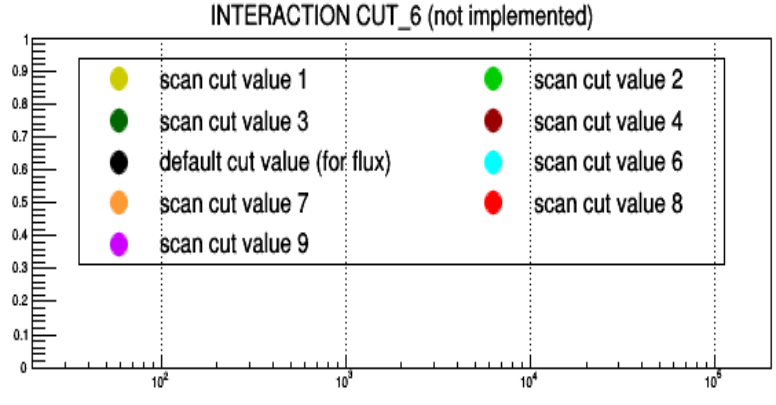
EPICs



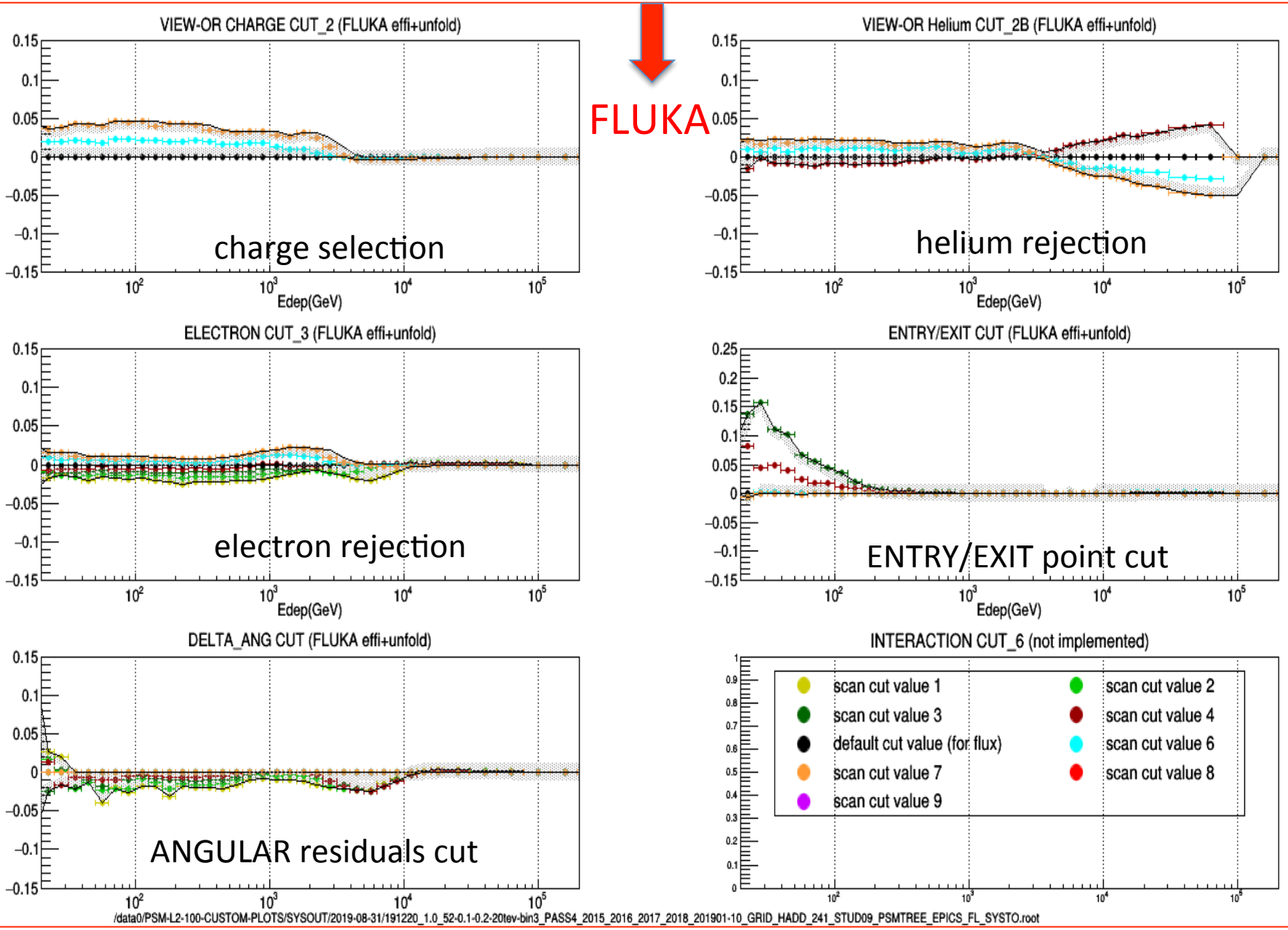






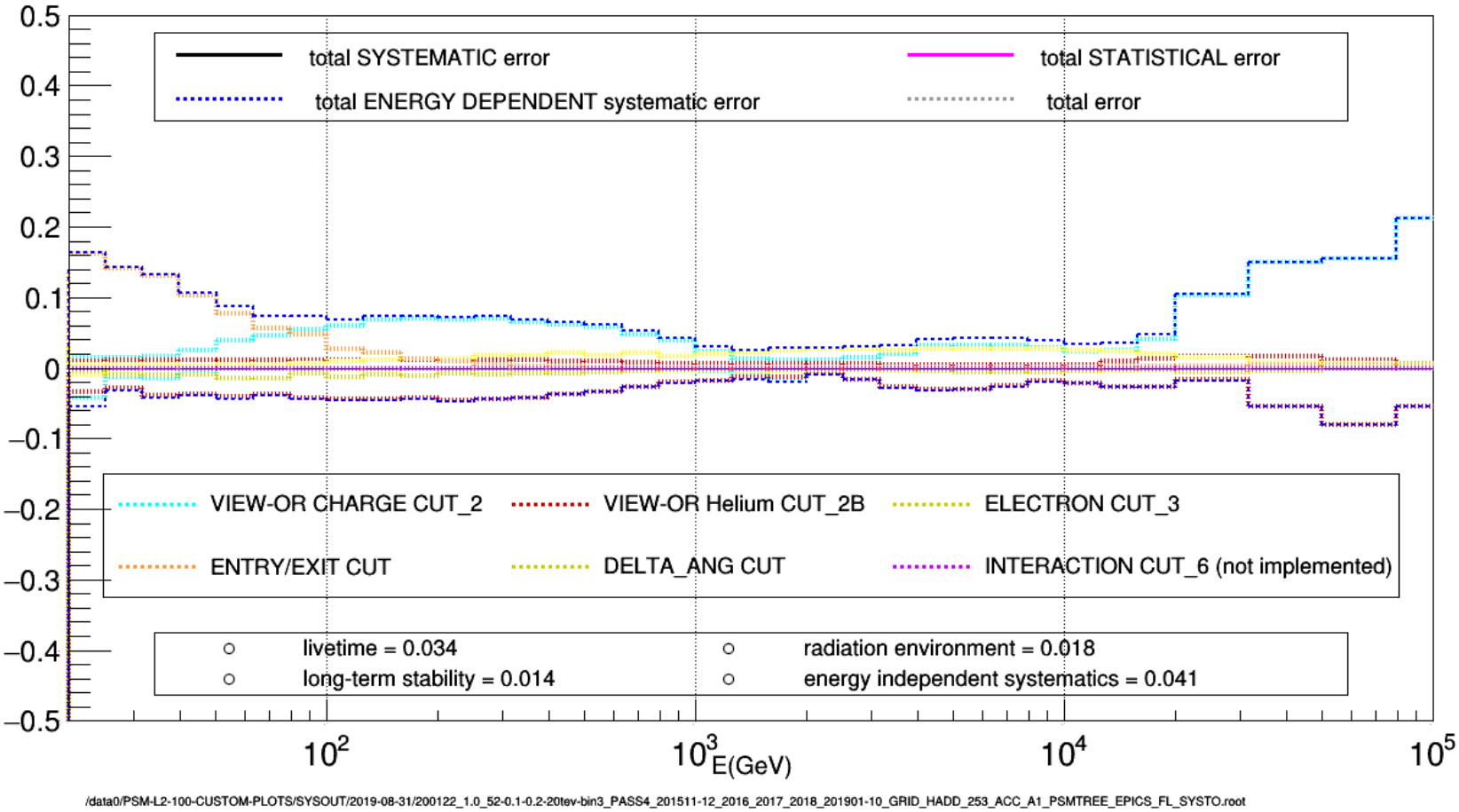


Flux residuals R_{flux} as a function of cuts. The GRAY band is contribution to systematic error



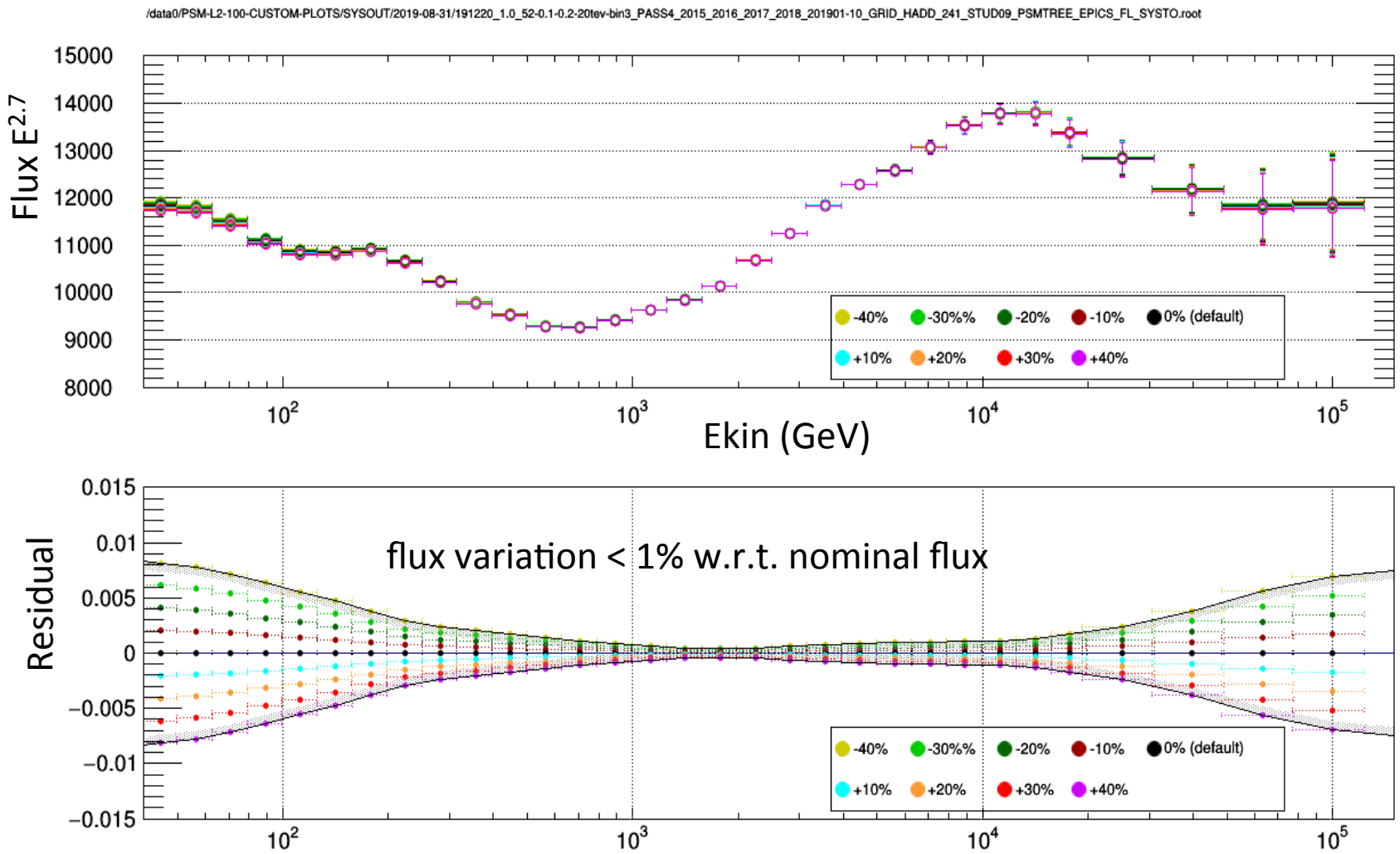
② Energy dependent systematics from selection cuts (summary)

- vary the selection cuts (10 values each) and determine the upper and lower bound
- each colored line in the plot below correponds to a given cut scan



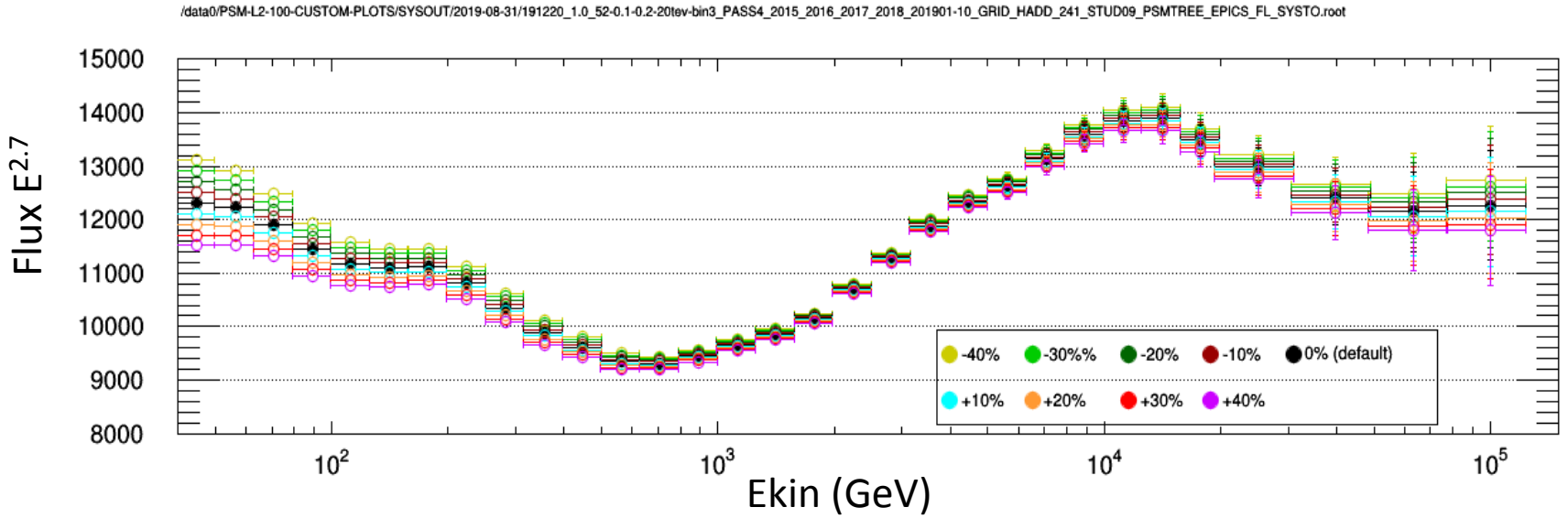
③ Systematic error from *helium background* subtraction

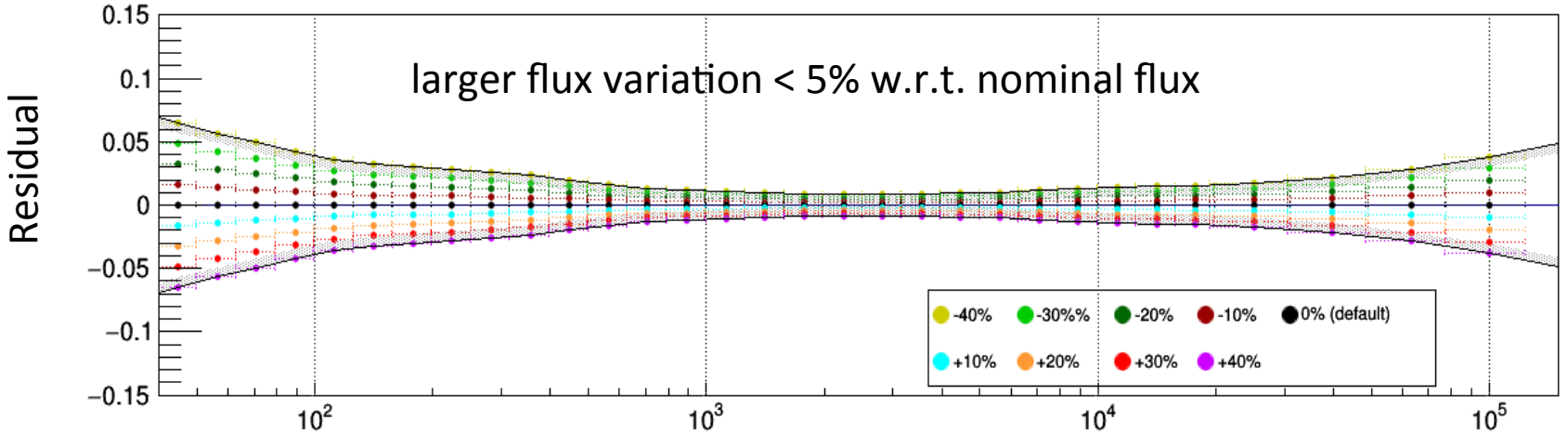
- vary the helium backg percentage from -40% to +40% in dN/dEdep before unfolding



④ Systematics from subtraction of *acceptance-misidentified events*

subtract events incorrecly reconstructed in acceptance-A while coming from 0.B,C,D
- vary the backg percentage from -40% to +40%

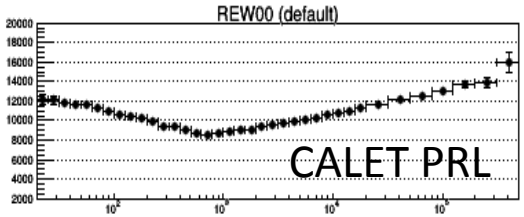


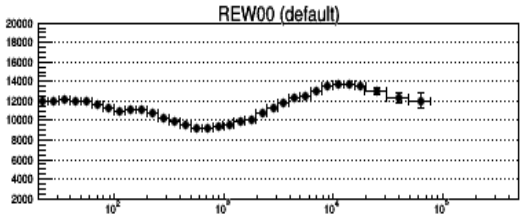


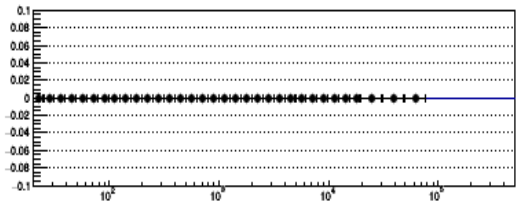
please note the different vertical scale -15%, + 15%

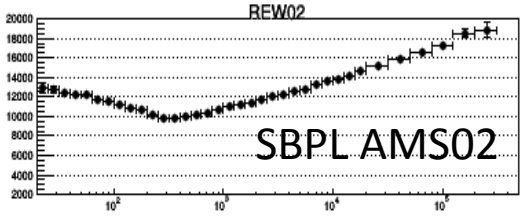
⑤ Study systematics from reweighting

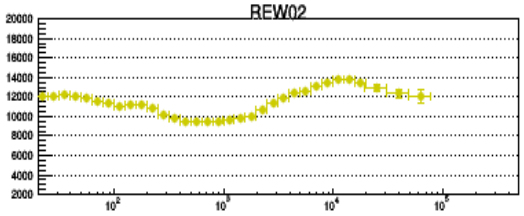
Change reweighting profile in EPICS (1st column), Flux (2nd), Flux residual (3rd)

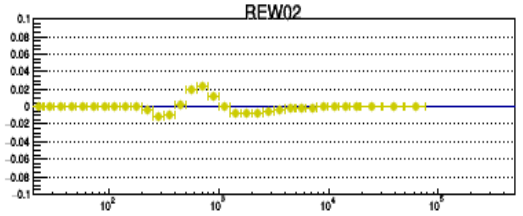


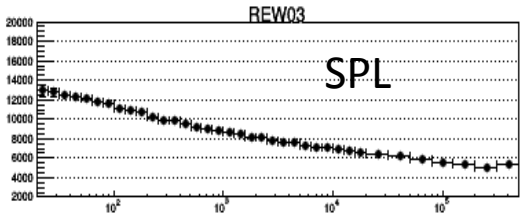


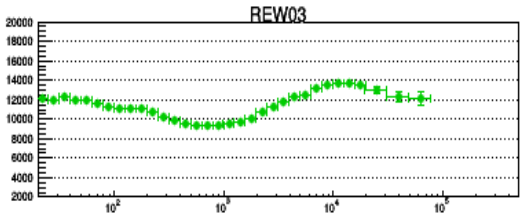


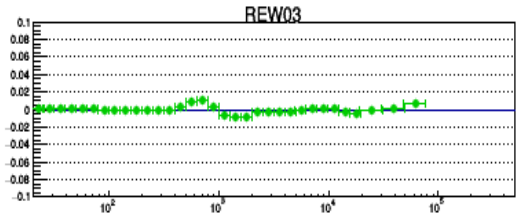


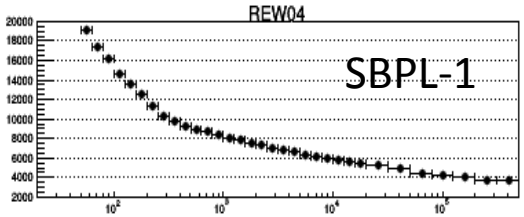


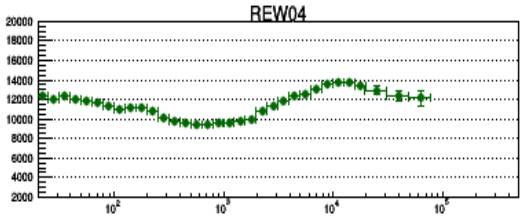


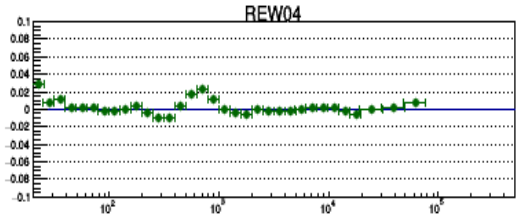


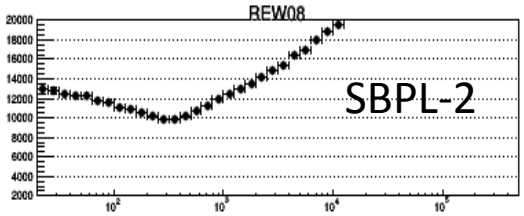


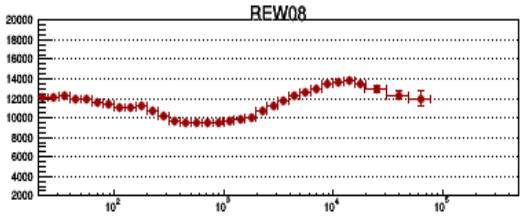


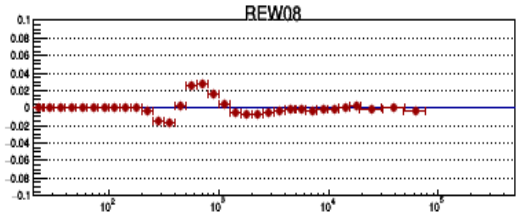






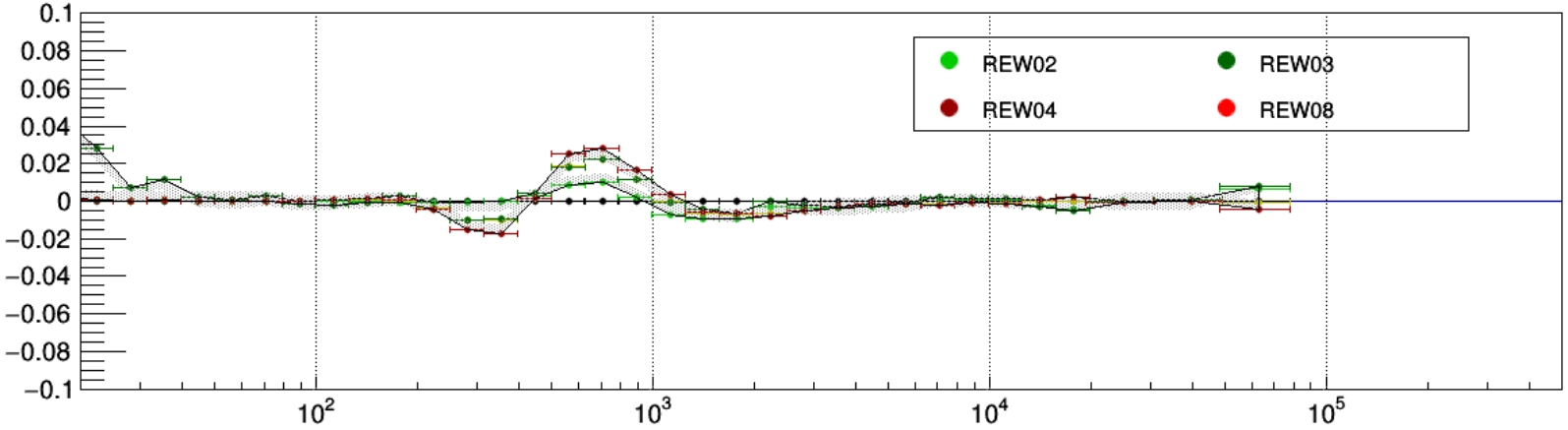






⑥ Unfolding procedure in EPICS and FLUKA

Contribution to the systematic error when changing the prior in **Bayesian unfolding** (REWxx is the reweighting profile)



The flux variation is generally small even using flux reweighting profiles covering a much larger parameter space than present measurements. Here are a few examples of reweighting profiles:

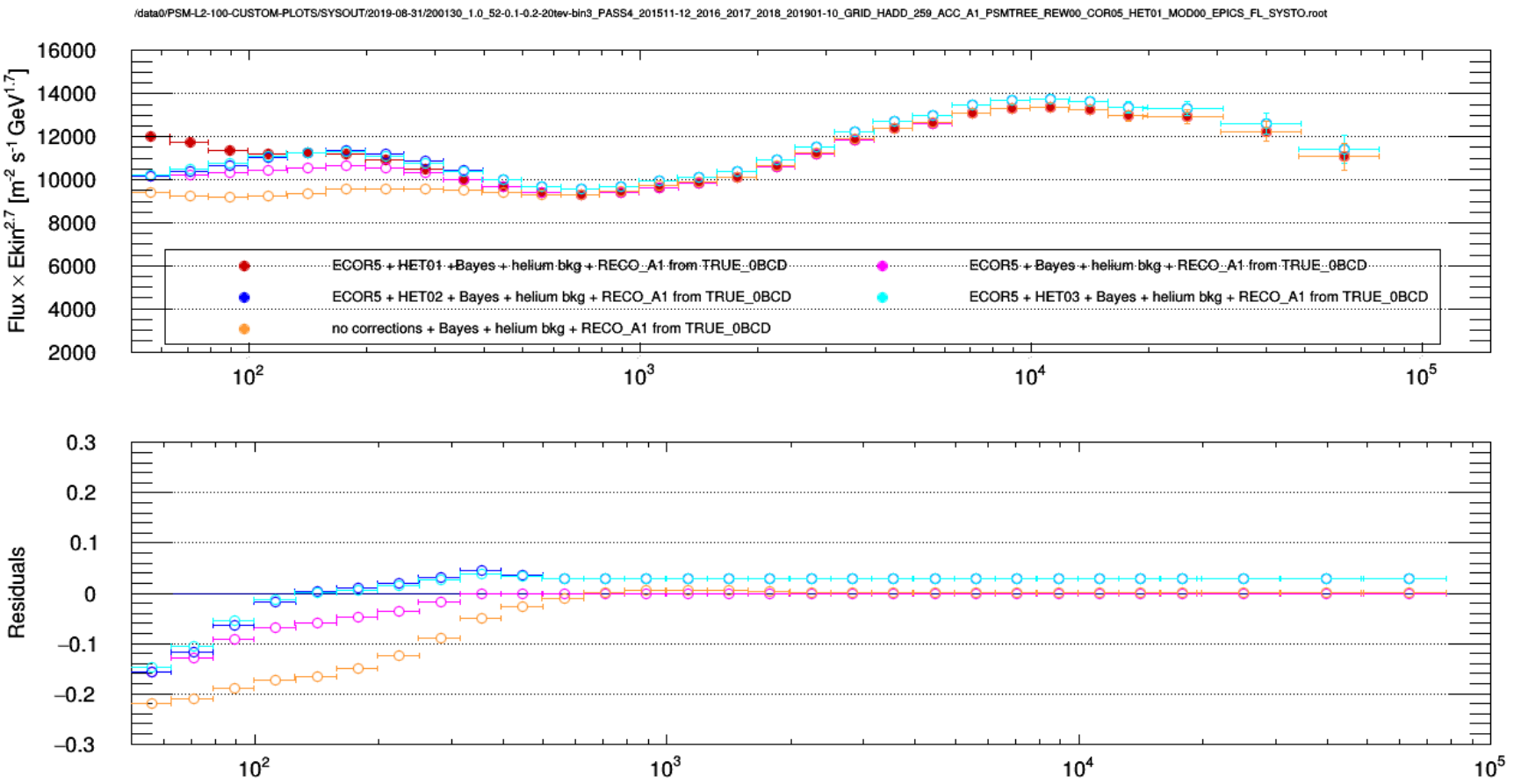
REW00: CALET profile from proton PRL paper
REW02: AMS02 single-broken power law (SBPL)
REW03: single power law (SPL)
REW04: SBPL-1 lower breakpoint and enhanced softening
REW08: SBPL-2 enhanced hardening

- Also small are the effects (not shown here) on the flux when changing the number of iterations (default = 2) in the Bayesian unfolding or using SVD procedure.

⑦ Flux stability when applying energy dependent corrections

- energy scale correction
- trigger efficiency correction

Variation of the flux above 1 TeV is small (<3%) while at lower energy the flux shape is sensitive to the trigger efficiency correction and energy scale correction.



⑧ Study of systematics from MonteCarlo modeling

In order to quantify the flux dependence from MC we first study:

1. High Energy trigger confirmation efficiency in EPICS/FLUKA
2. selection efficiencies in EPICS/FLUKA
3. background contamination in EPICS/FLUKA
4. unfolding matrices in EPICS/FLUKA

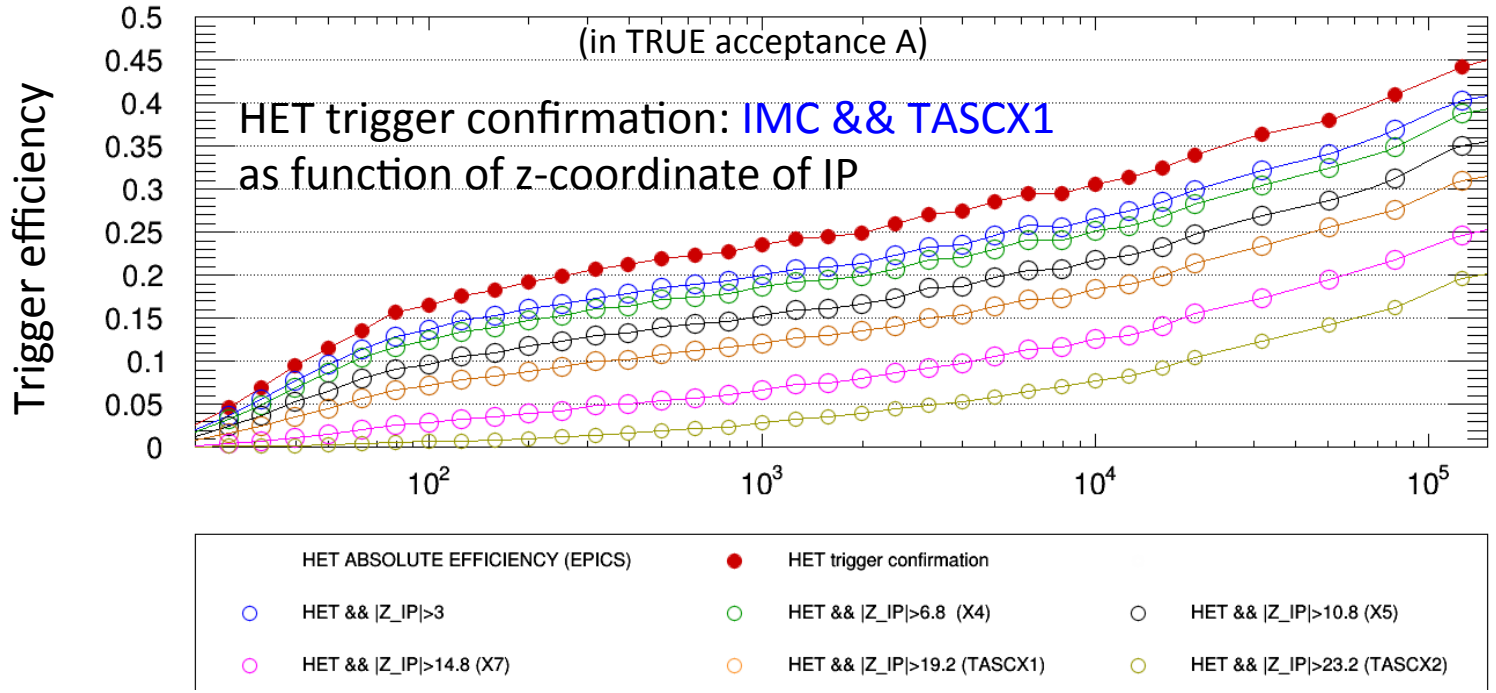
Study offline trigger confirmation as a function of IP position along z

default offline HET trigger confirmation requires:

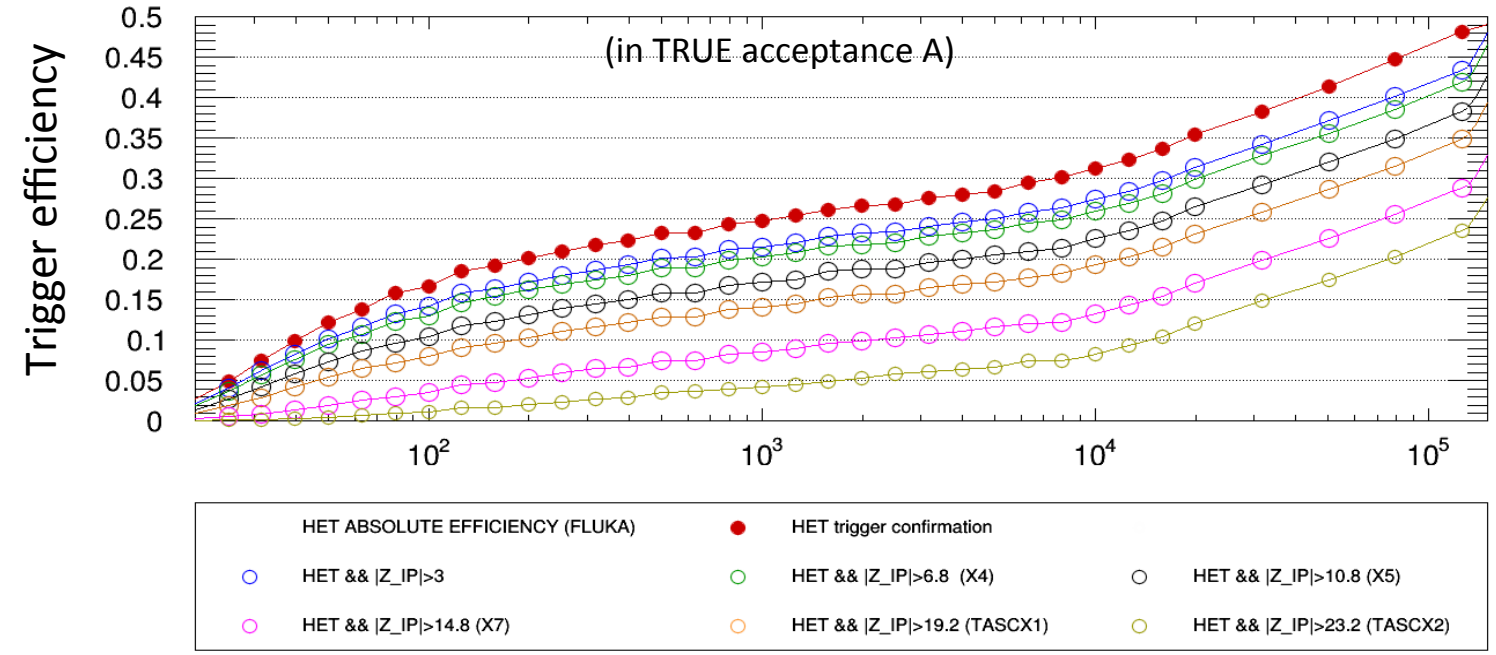
- ❑ trigger thresholds in 4 last IMC layers (50 mip) && TASCX1 (100 mip)

also studied:

- ○ triggering with last 4 IMC layers only
- ○ triggering with TASCX1 only


(in TRUE acceptance A)
HET trigger confirmation: IMC && TASCX1
as function of z-coordinate of IP
Trigger efficiency
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10^2
10^3
10^4
10^5
HET ABSOLUTE EFFICIENCY (EPICS)
HET trigger confirmation
HET && |Z_IP|>3
HET && |Z_IP|>6.8 (X4)
HET && |Z_IP|>10.8 (X5)
HET && |Z_IP|>14.8 (X7)
HET && |Z_IP|>19.2 (TASCX1)
HET && |Z_IP|>23.2 (TASCX2)

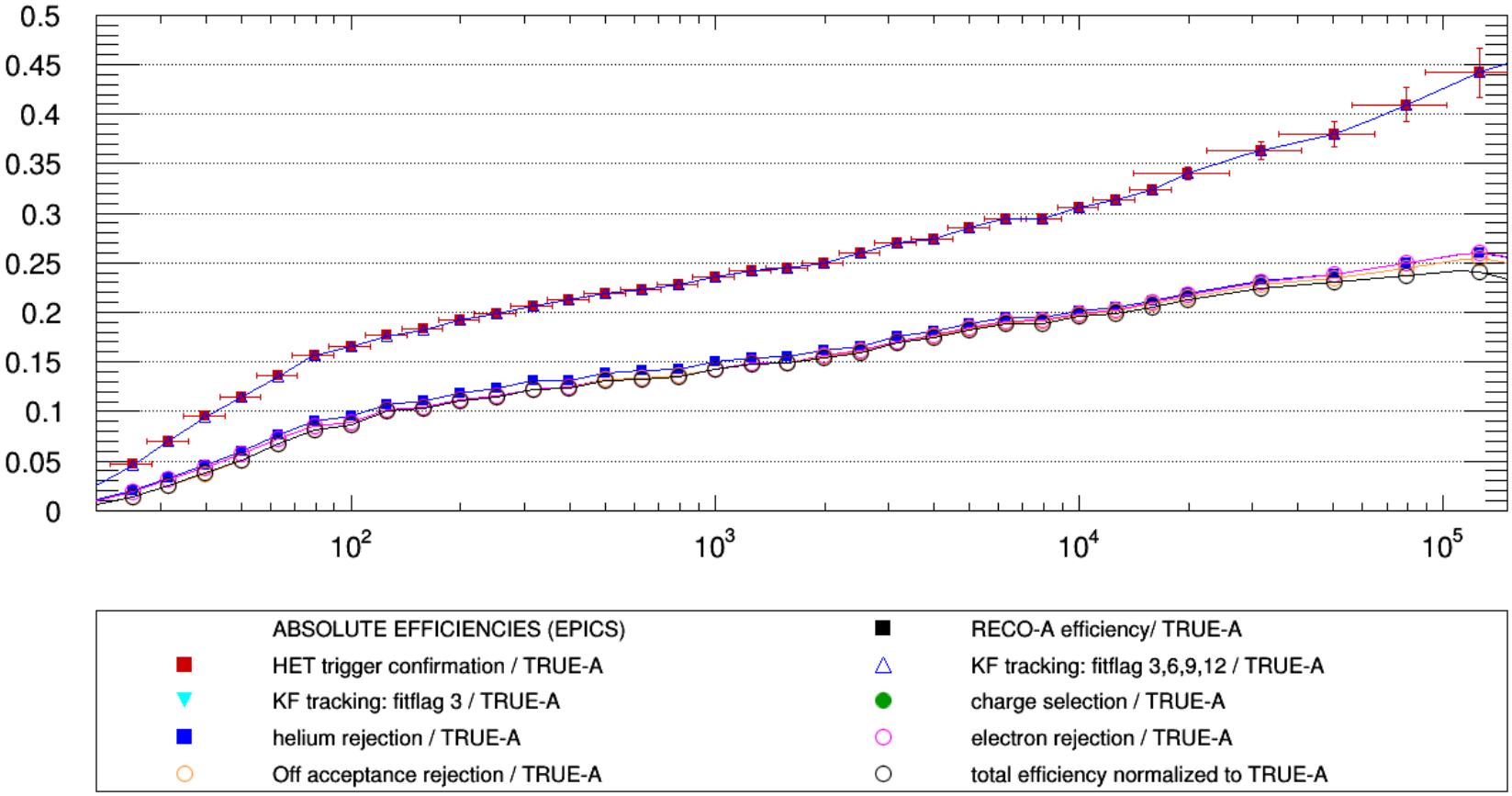
EPICS


(in TRUE acceptance A)
Trigger efficiency
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10^2
10^3
10^4
10^5
HET ABSOLUTE EFFICIENCY (FLUKA)
HET trigger confirmation
HET && |Z_IP|>3
HET && |Z_IP|>6.8 (X4)
HET && |Z_IP|>10.8 (X5)
HET && |Z_IP|>14.8 (X7)
HET && |Z_IP|>19.2 (TASCX1)
HET && |Z_IP|>23.2 (TASCX2)

FLUKA

Absolute efficiencies in EPICS

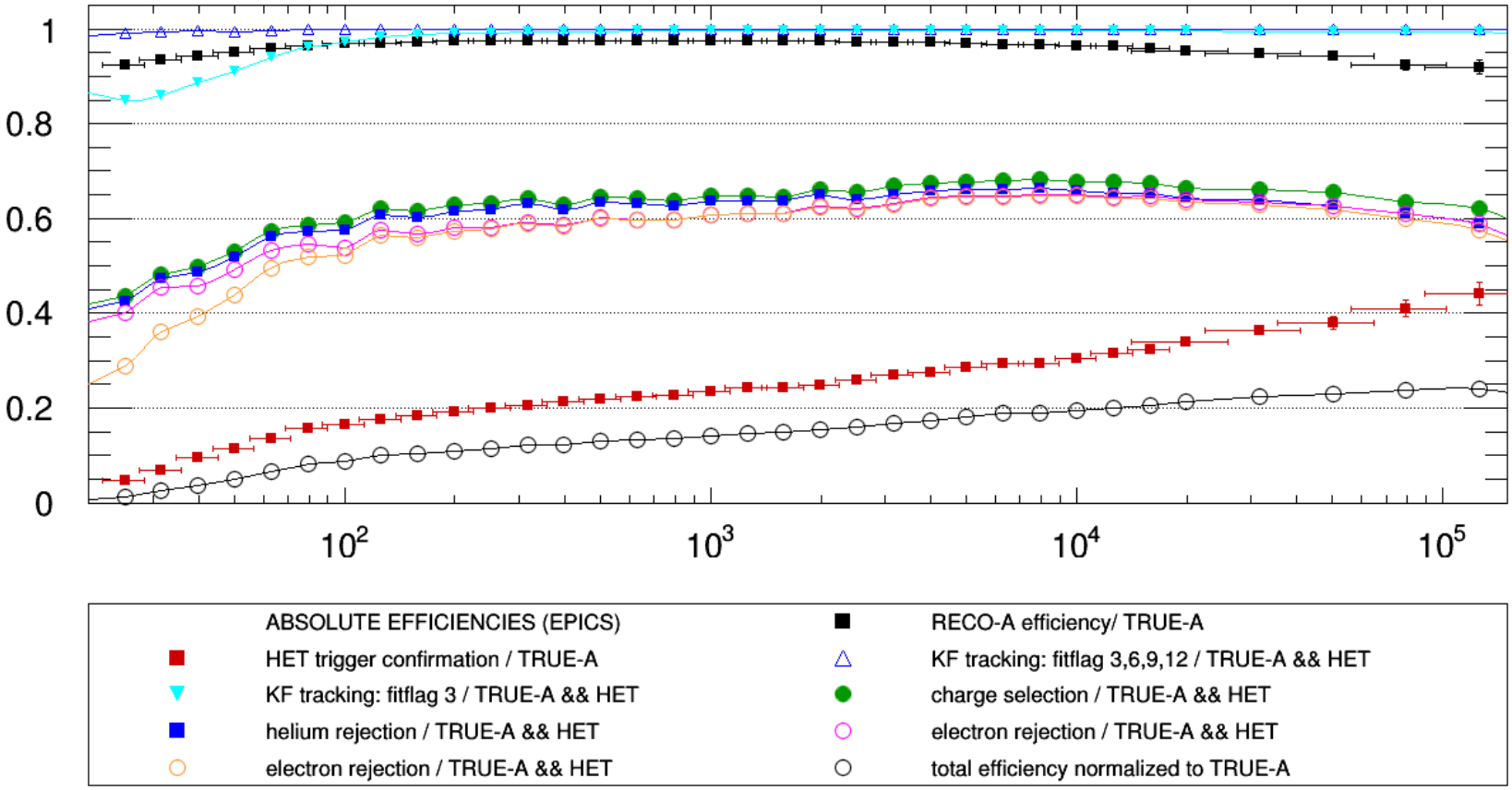
normalized to Acceptance-A1 (see legenda)



Absolute efficiencies are small and dominated by trigger efficiency, therefore
it is useful to use a relative normalization for some efficiencies as done in the next slides

Selection efficiencies in EPICS

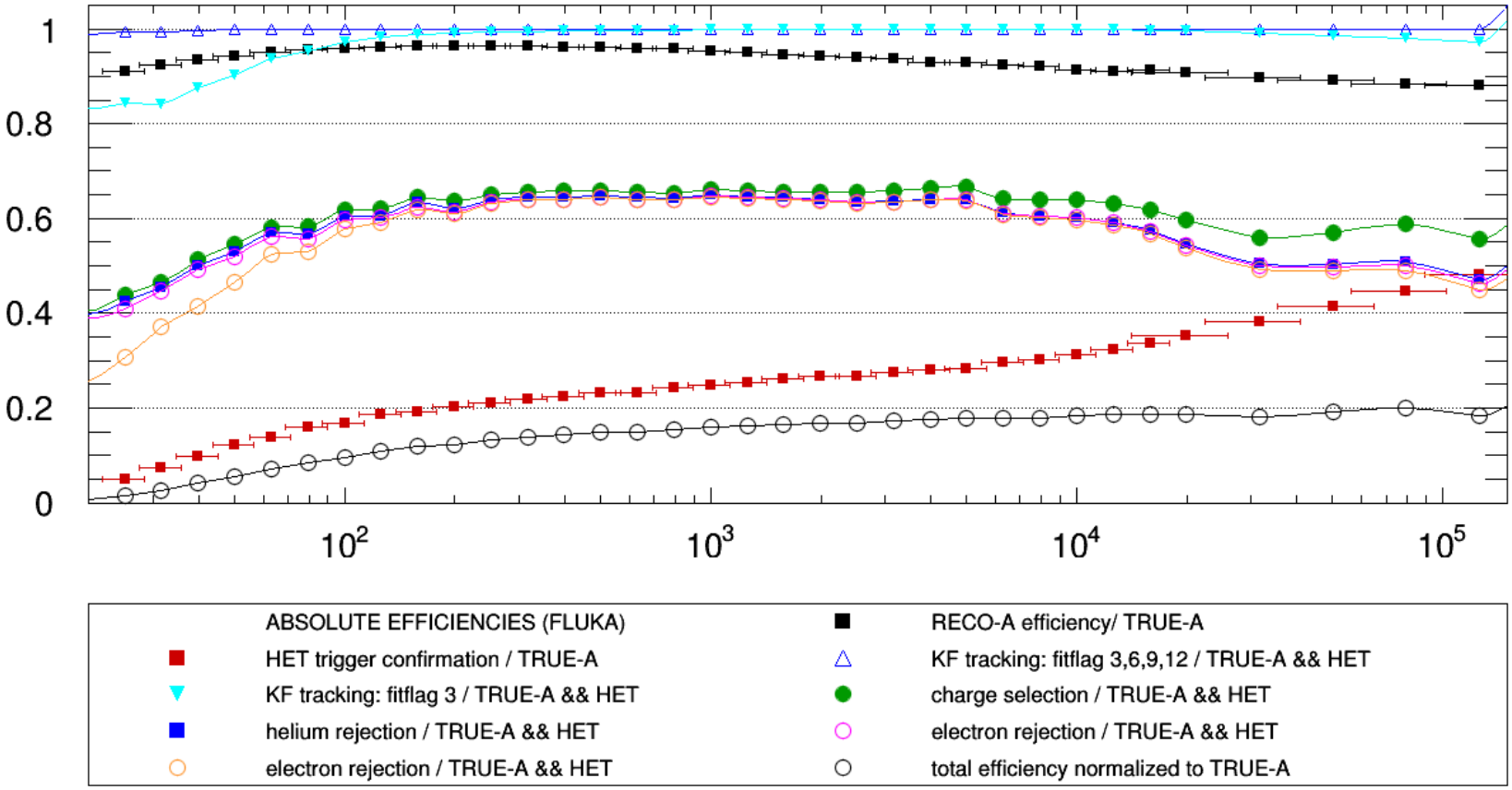
normalized to Acceptance-A or to Acceptance && HET trigger (see legenda)



/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200120_1.1_epics-p-52-0.1-0.2-20tev-bin3-2gev_1000tev_3_INFINITE_E25_REW00_ACC_A_PC08_252_PSMTREE_MC_HISTO.root

Selection efficiencies in FLUKA

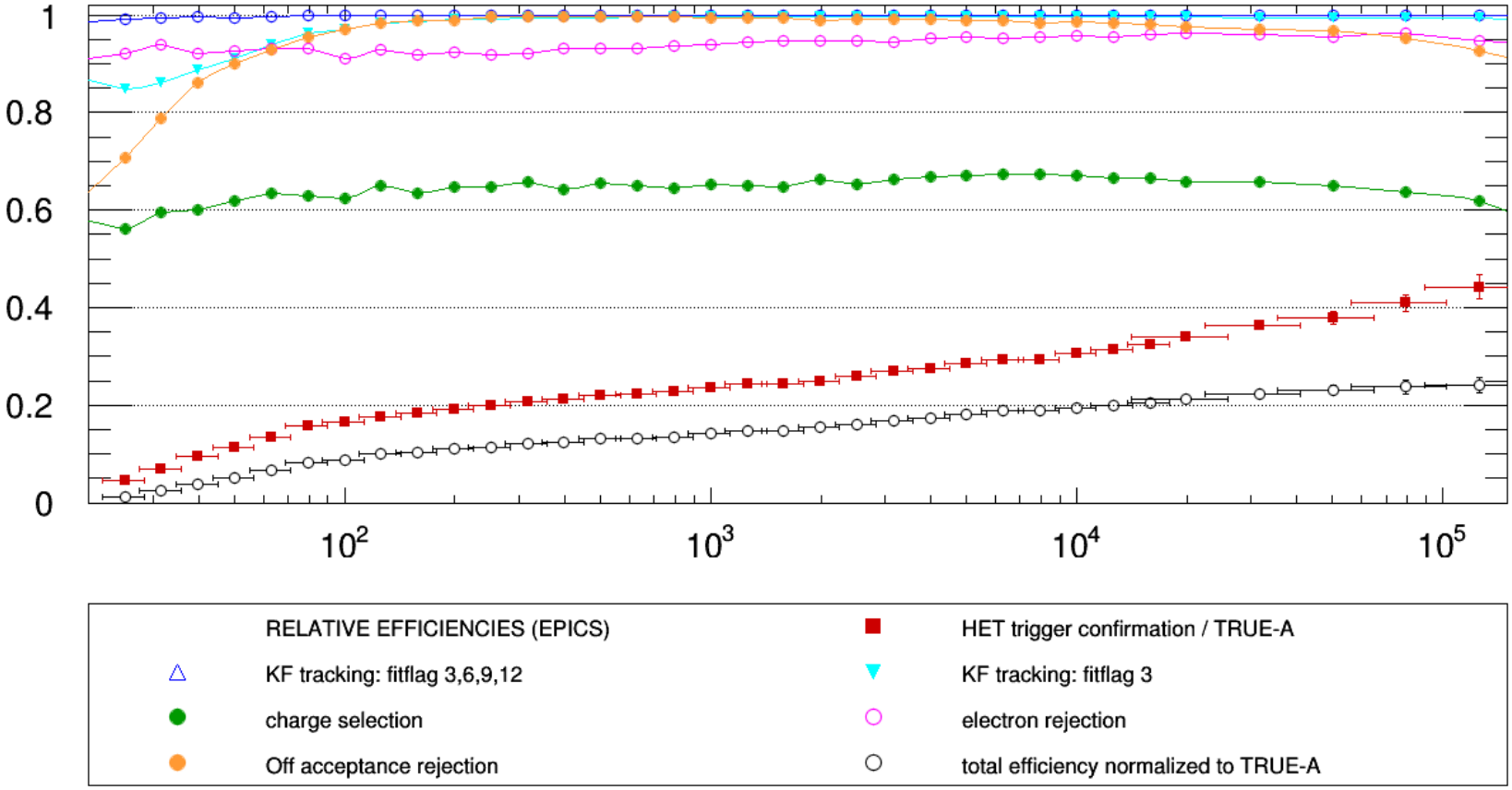
normalized to Acceptance-A or to Acceptance && HET trigger (see legenda)



/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200120_1.1_fluka-p-52-0.1-0.2-20tev-bin3-6gev_237.5tev_1_REW00_PC08_252_INFINITE_REW00_ACC_A_PSMTREE_MC_HISTO.root

Relative efficiencies in EPICS

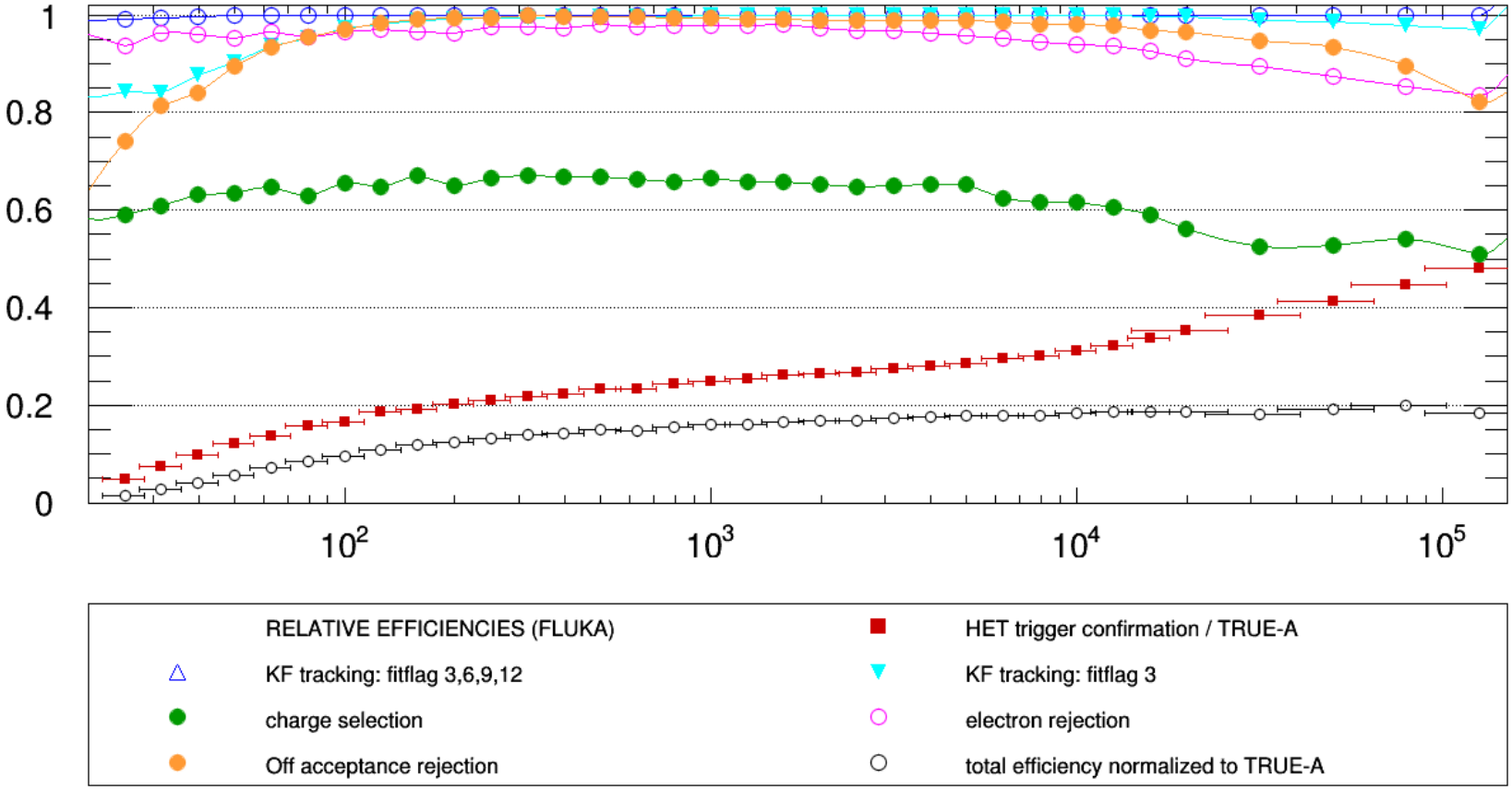
normalized to previous cut (see legenda)



/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200120_1.1_epics-p-52-0.1-0.2-20tev-bin3-2gev_1000tev_3_INFINITE_E25_REW00_ACC_A_PC08_252_PSMTREE_MC_HISTO.root

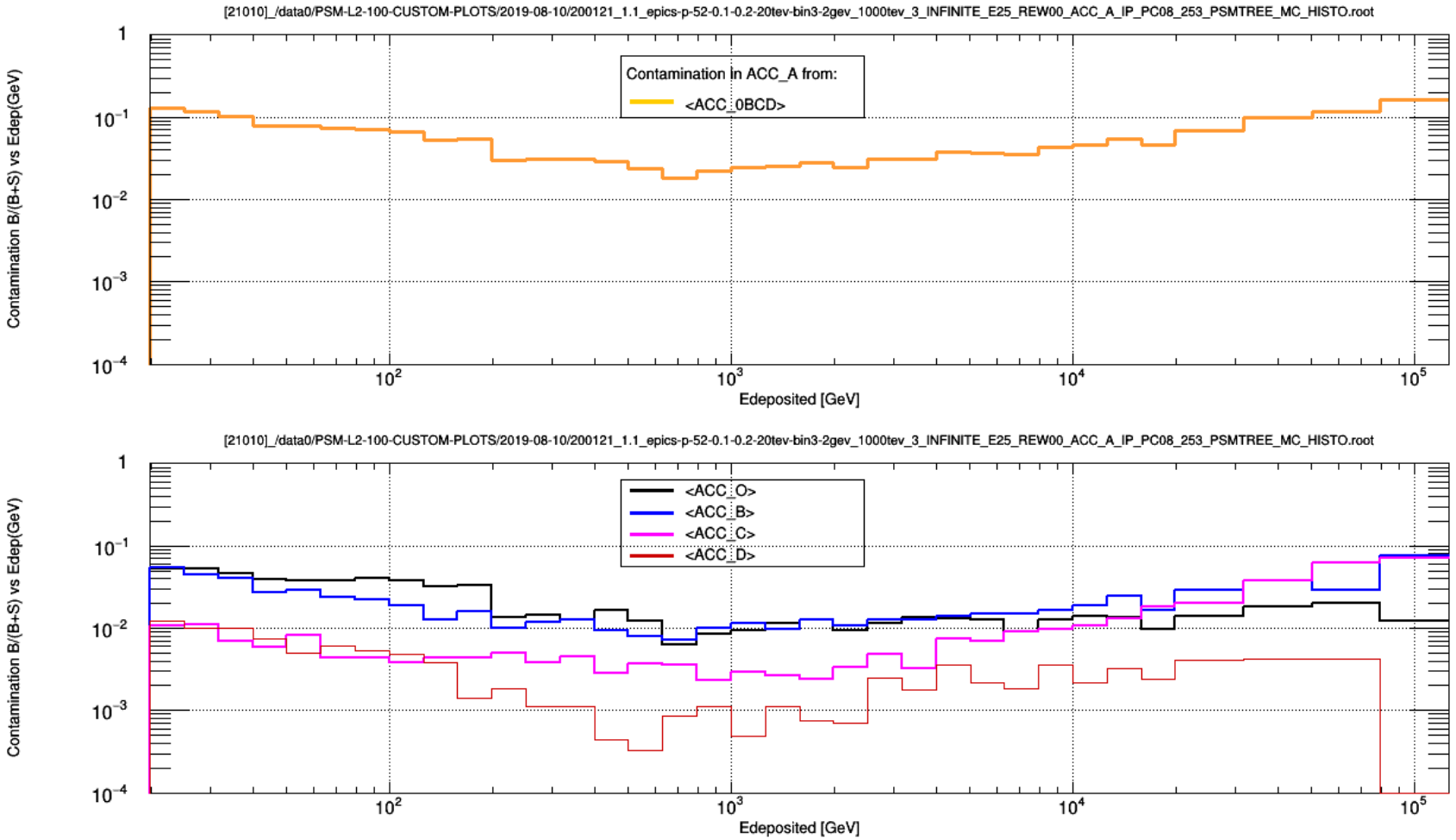
Relative efficiencies in FLUKA

normalized to previous cut (see legenda)

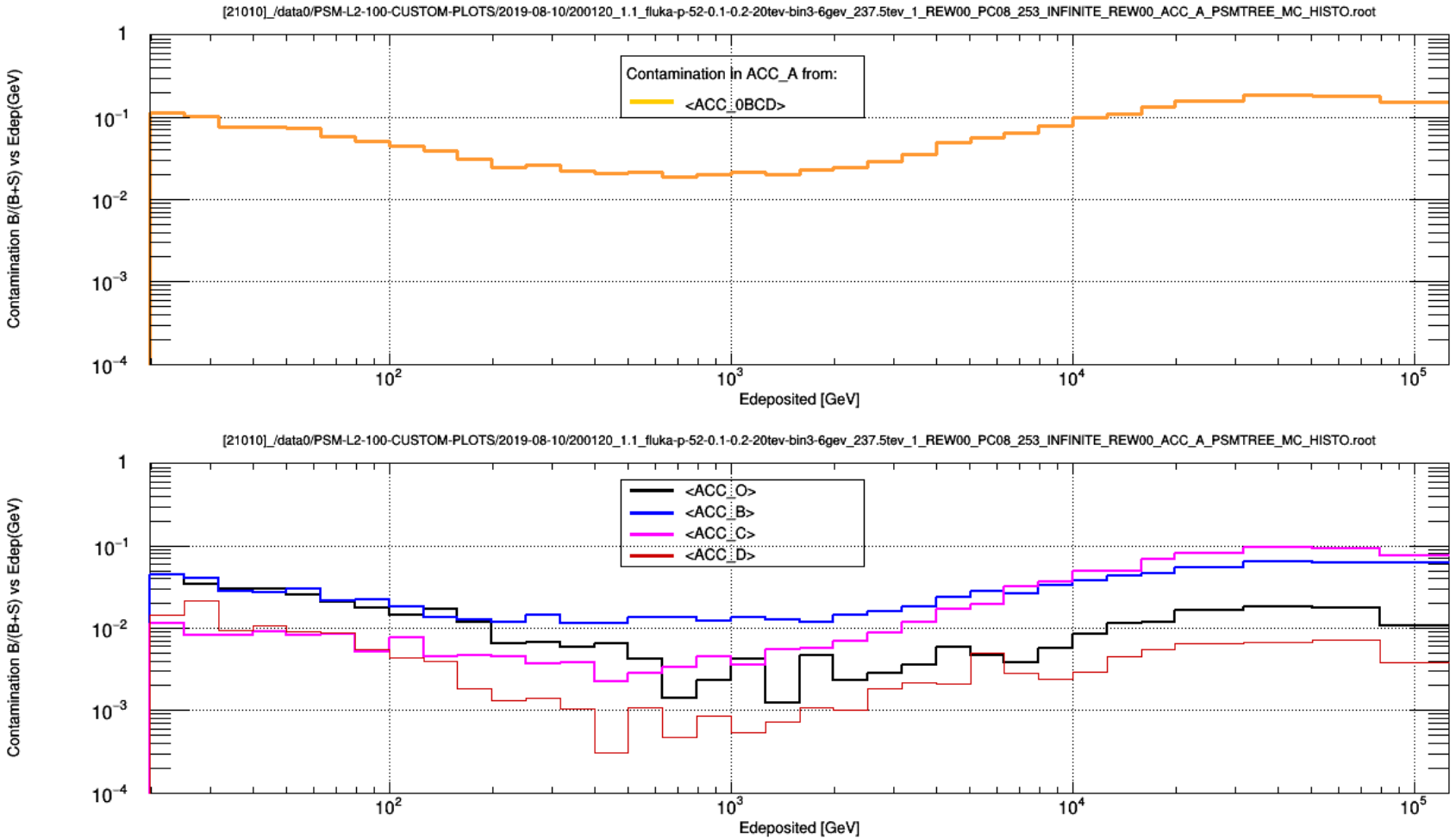


/data0/PSM-L2-100-CUSTOM-PLOTS/2019-08-10/200120_1.1_fluka-p-52-0.1-0.2-20tev-bin3-6gev_237.5tev_1_REW00_PC08_253_INFINITE_REW00_ACC_A_PSMTREE_MC_HISTO.root

Acceptance-A contamination background in EPICS



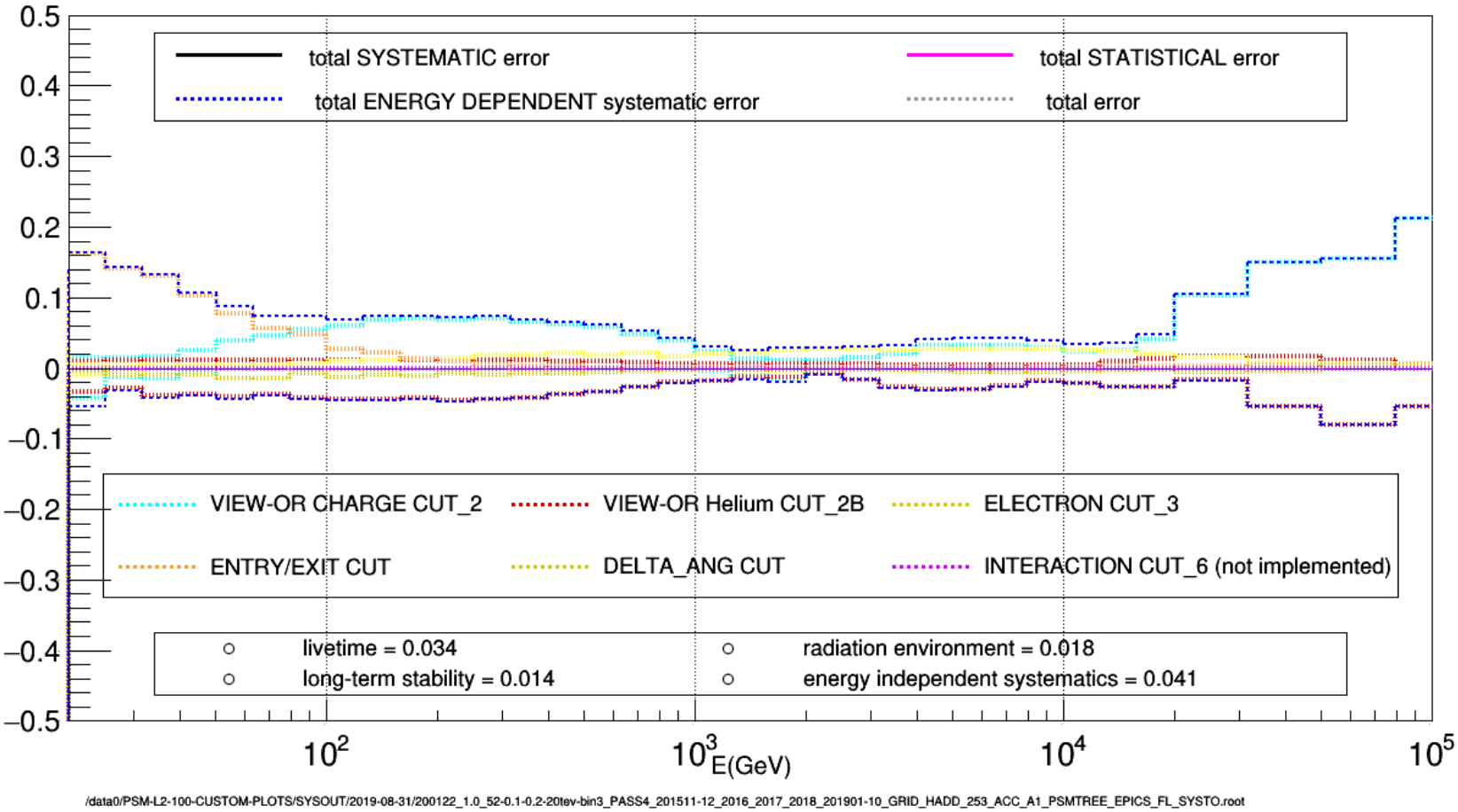
Acceptance-A contamination background in FLUKA



Summary of systematic uncertainties (preliminary)

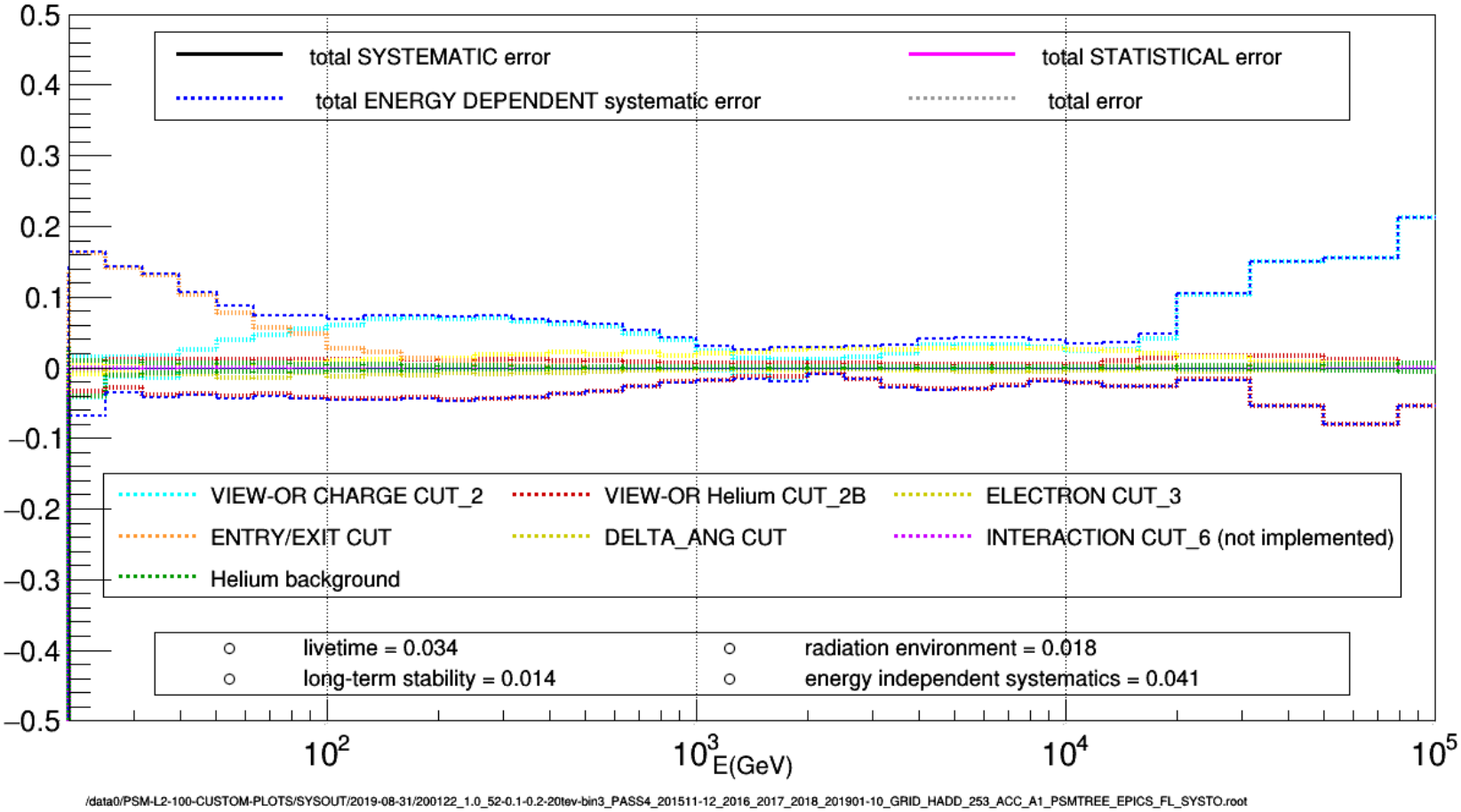
❑ from selection cuts

- vary the selection cuts (10 values each) and determine the upper and lower bounds
- each colored line in the plot below correponds to a given cut scan



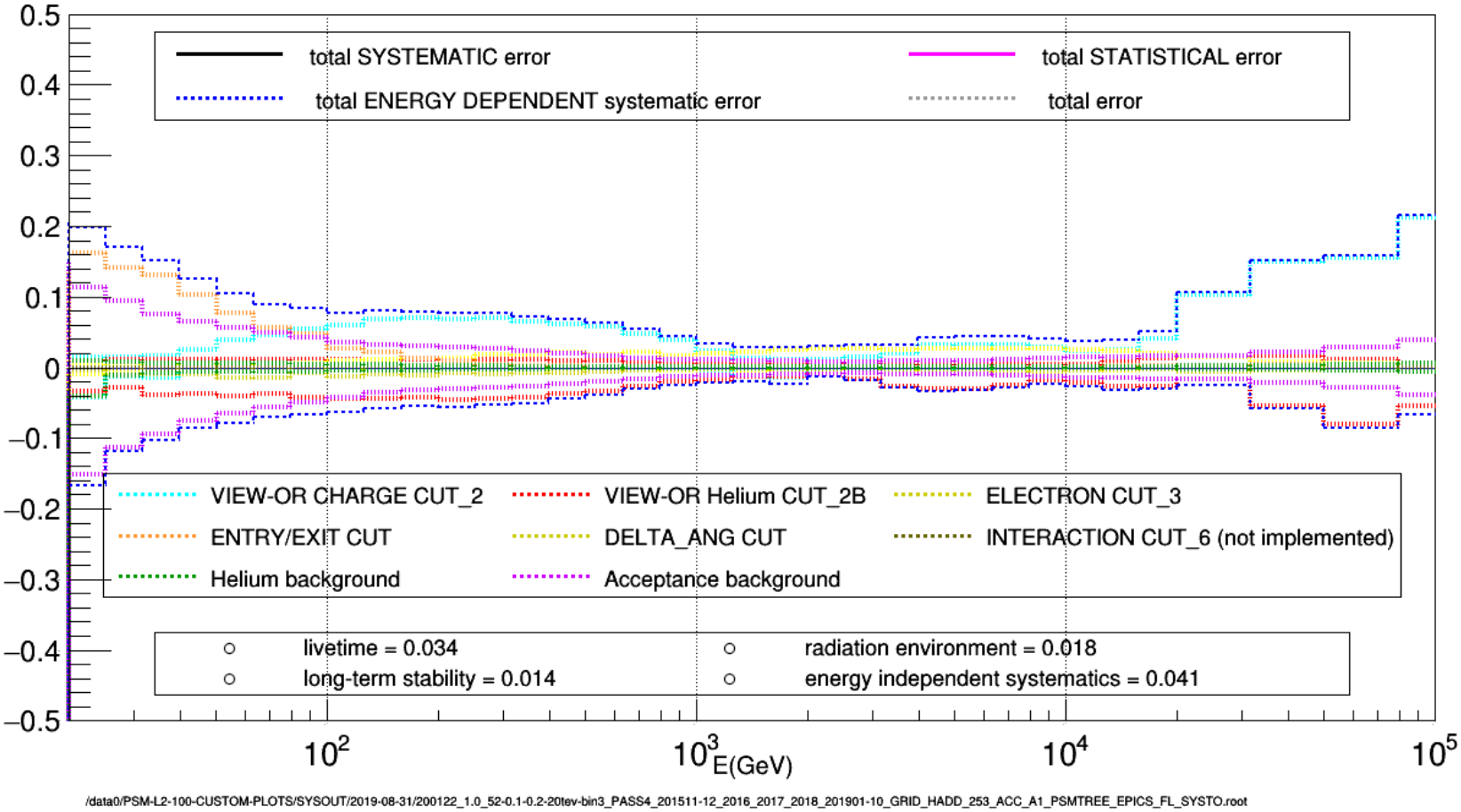
Energy dependent systematic uncertainties

- Add uncertainty on Helium subtraction (Green)



Energy dependent systematic uncertainties

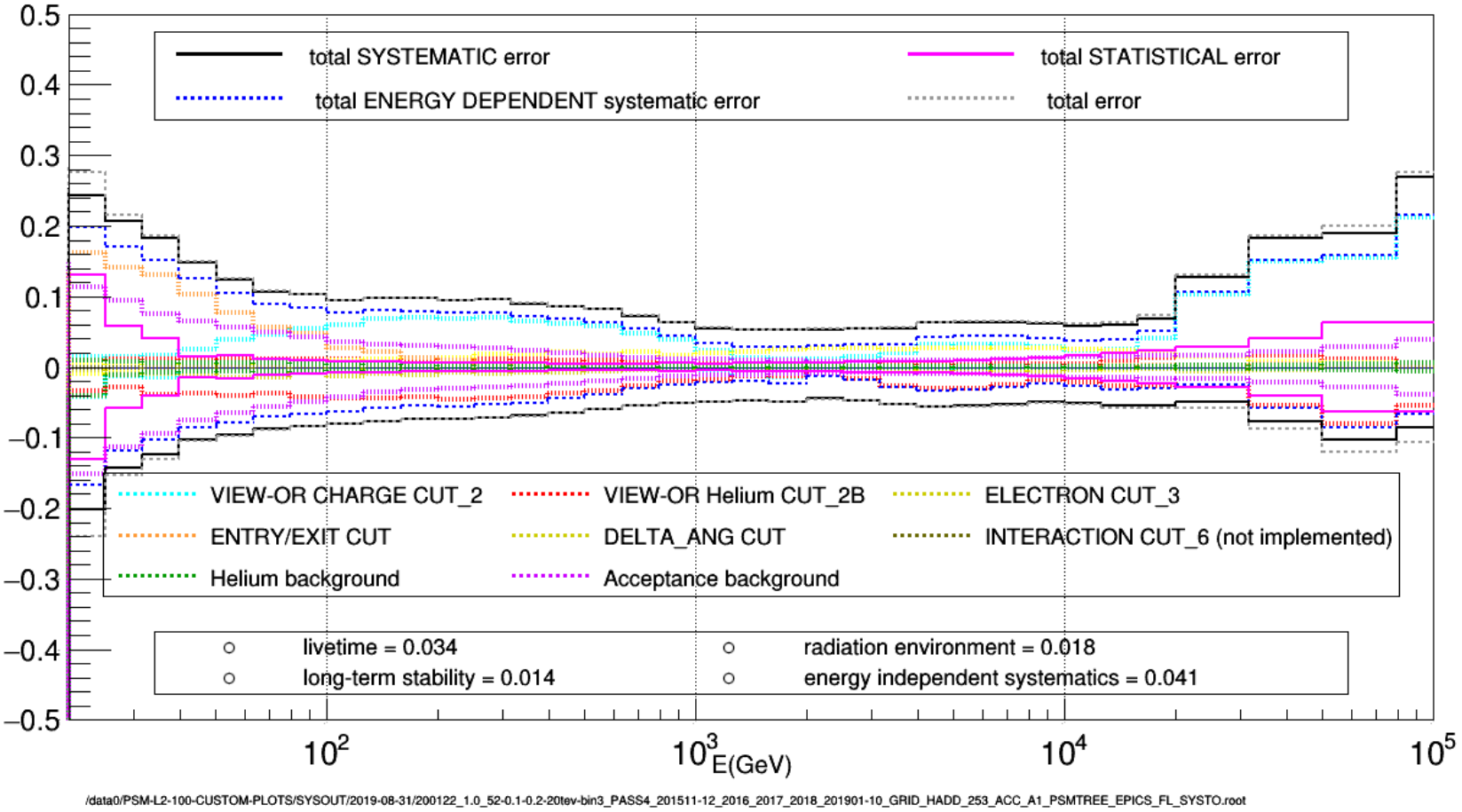
- Add uncertainty on Helium subtraction (Green) + misidentified Acceptance (Violet)



- Add uncertainty on Helium subtraction (Green) + misidentified Acceptance (Violet)
- Add energy independent systematic + statistical error

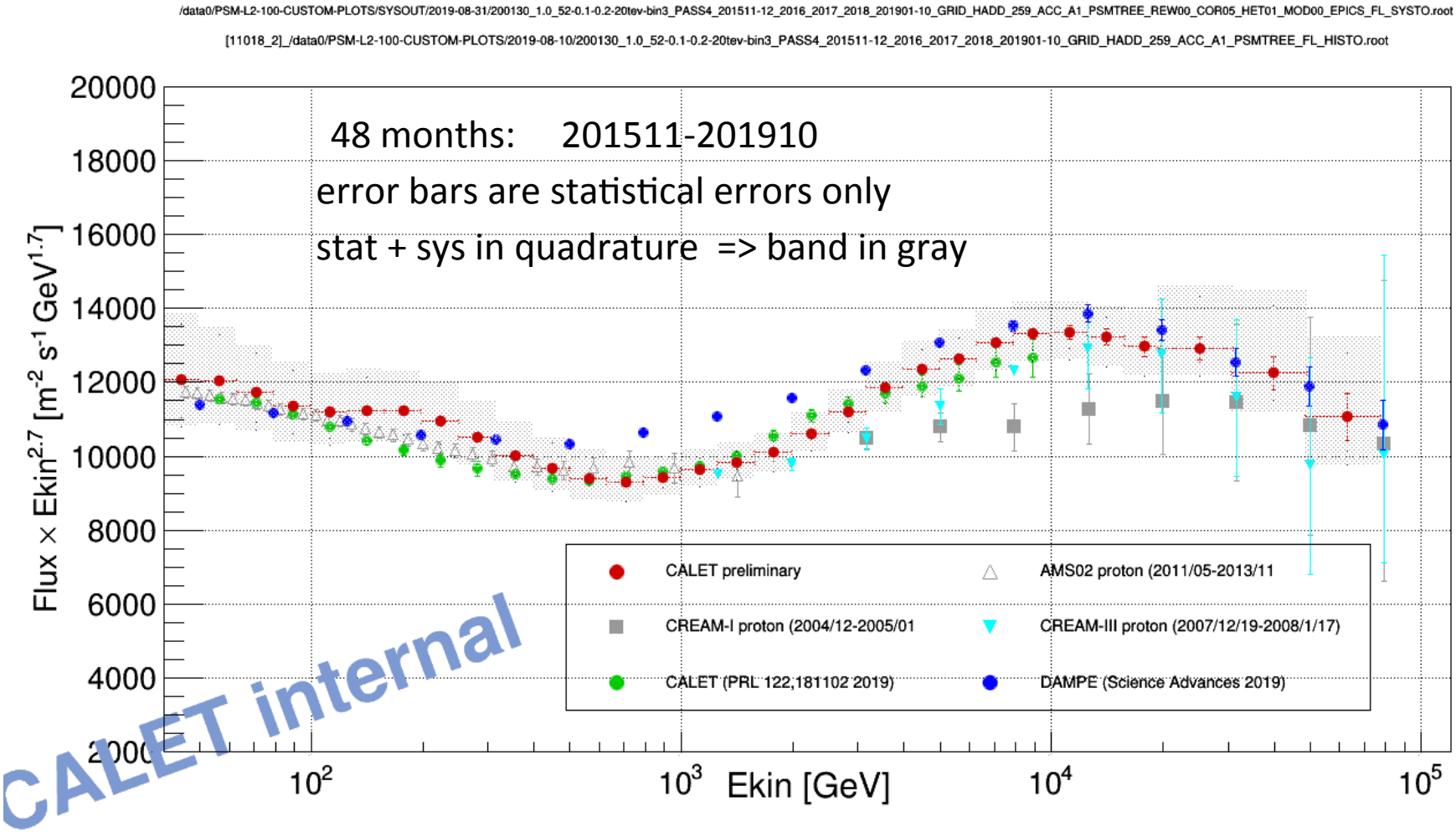
Summary of systematic error contributions (as a function of Ekin) **evaluated using EPICS** :

- energy dependent (cuts, background subtraction, etc...)
- energy independent: livetime, long-term stability, radiation environment (from PRL paper)



Preliminary proton flux

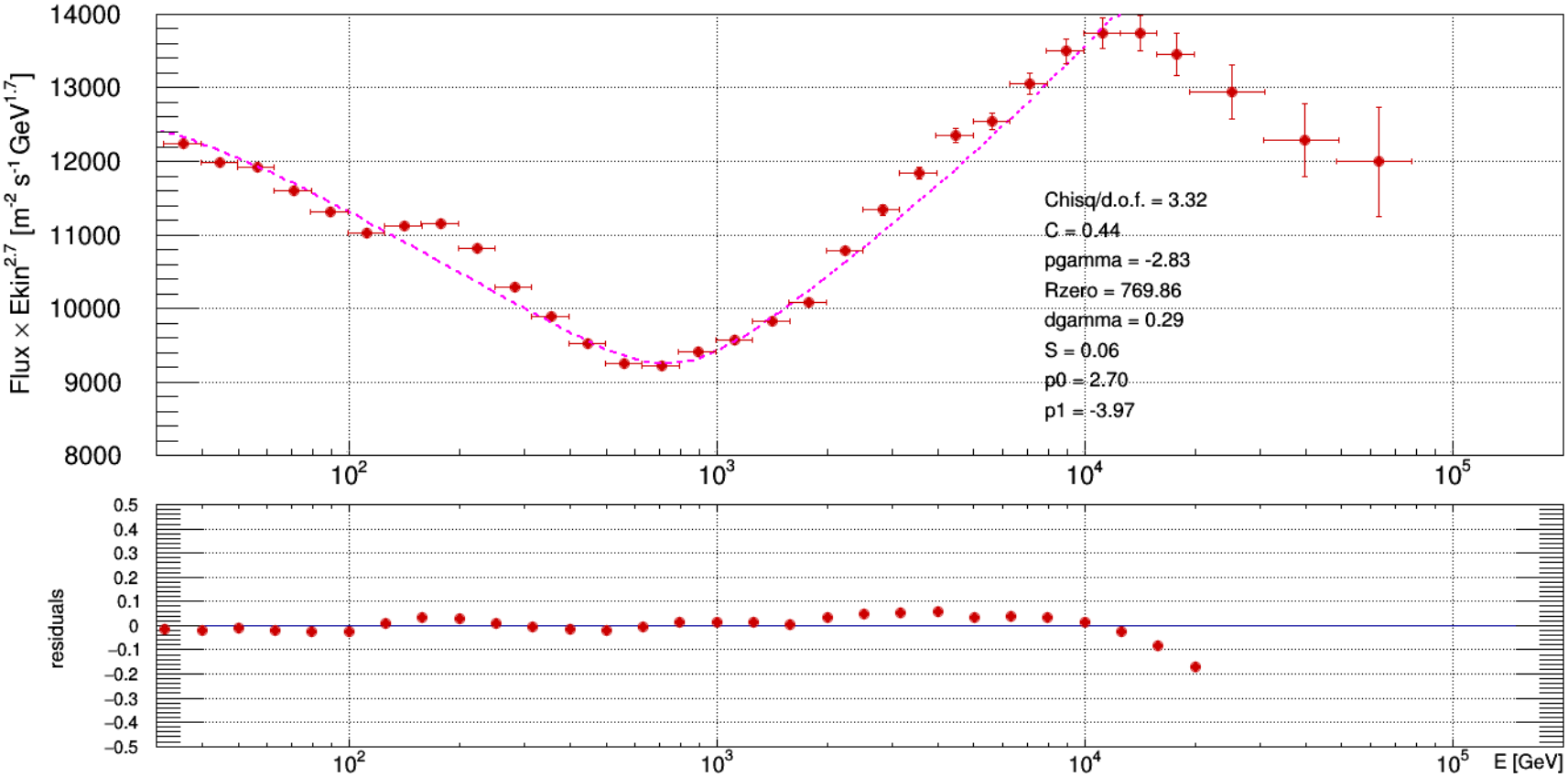
2020-02-03



Fit with a Single Broken Power Law (SBPL)

5 parameter fit (AMS02 parametrization) +
+ 2 extra params for the low energy region below 20 GeV (not shown)

- fit up to 10 TeV consistent with CALET PRL paper



Conclusions from the present analysis

- the proton flux is consistent with the PRL result up to 10 TeV
- above 10 TeV a flux reduction is suggested by the present analysis
- work is **in progress** to improve the assessment of the systematic uncertainties including:

  - quantitative total systematic uncertainty with FLUKA
  - additional studies on systematics from energy scale correction
  - additional studies on systematics from trigger efficiency correction
  - systematics related to energy leakage

  et al.