Report on reconstruction performances

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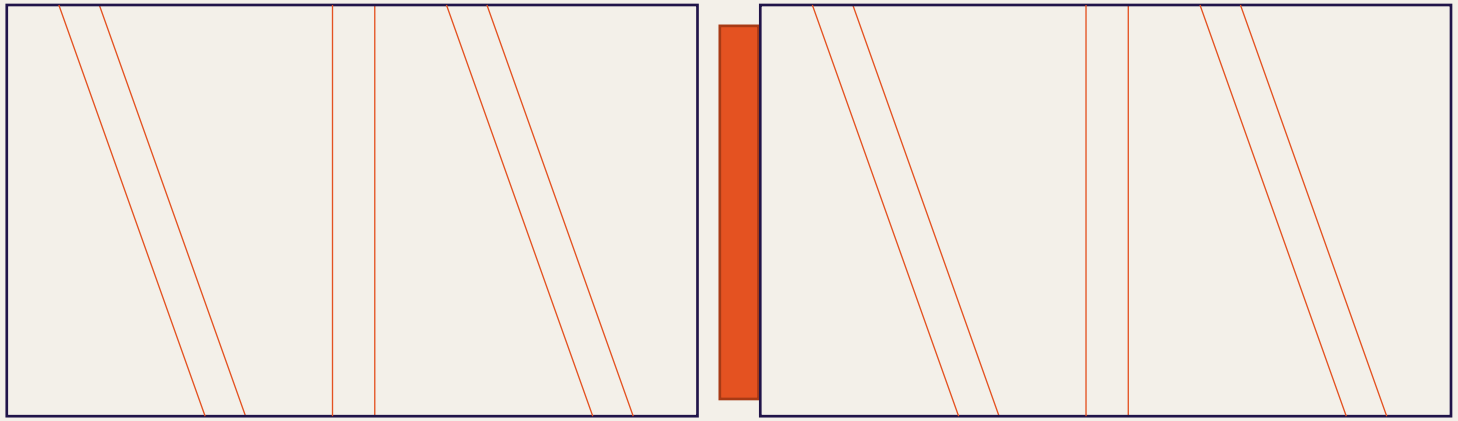
SETUP

1. FairSoft: **nov22** version
2. Fairmu: **WiP_ v0.10.0** branch (https://gitlab.cern.ch/mgoncerz/fairmuone/-/tree/WiP_v0.10.0) → In **master** branch, the MCS in not included in the evaluation of the uncertainty of the tracks points -just the intrinsic one ($\sim 10 - 20\ \mu m$). In this new branch, the contribution is introduced in the tracks from *kinematical vertex fit*.



Two stations, 6 modules each, with X and Y tilted

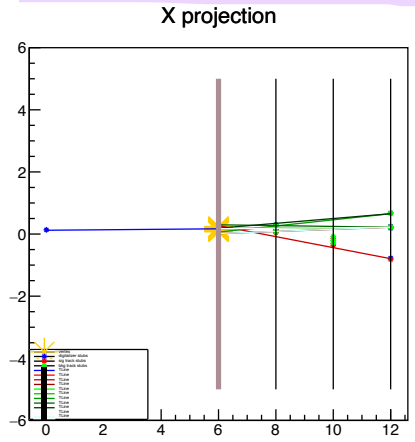
VERTEXING

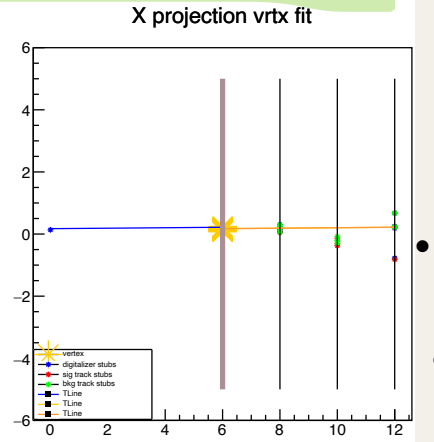
KINEMATICAL FIT VERTEXING

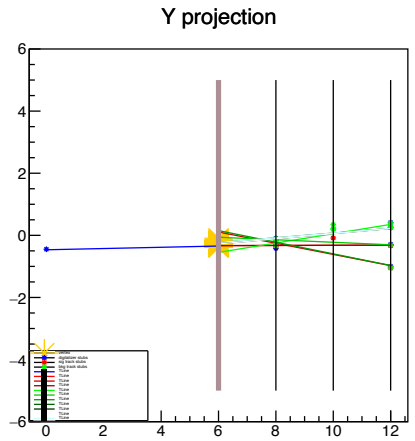
- **100% efficient** when elastic events is there
- **Able** to choose the **correct** elastic tracks when multiplicity is high (because of ghosts)
- Z fixed

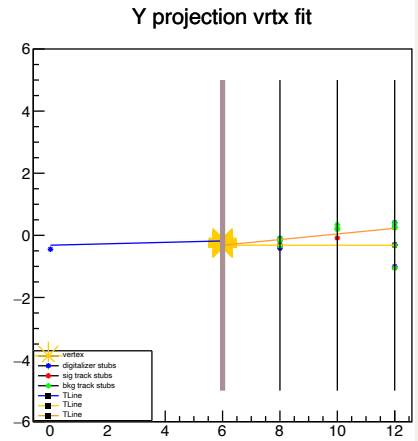
ADAPTIVE FIT VERTEXING

- Efficient in the ~ **80%** of the elastic events
- No incoming track information
- When number of tracks is high, **not able** to select **correct** tracks
- Z **not** fixed







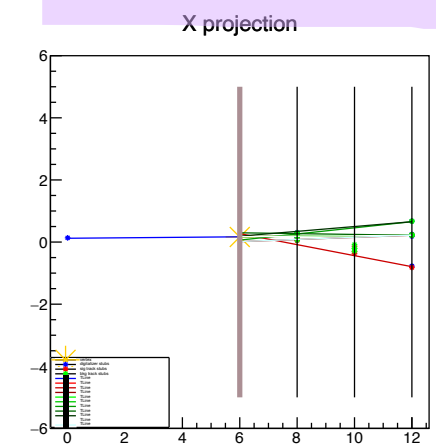


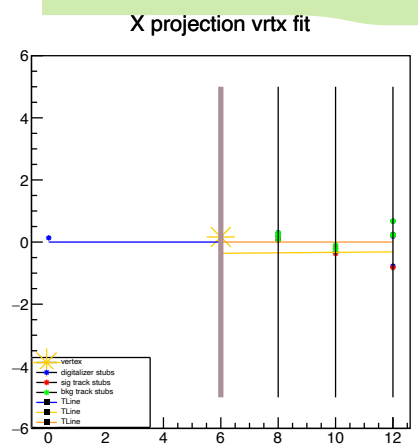
Example of one event with multiple tracks:

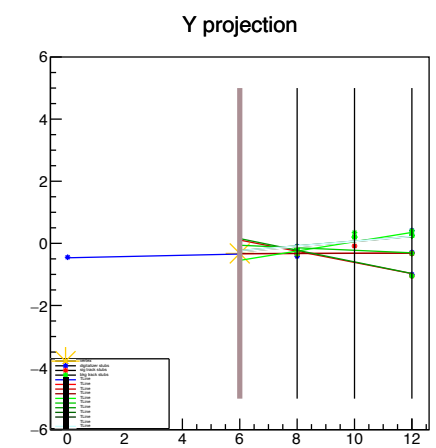
- Left column: X-Y projection of the **reconstructed tracks**
- Right column: X-Y projection of the **selected elastic candidates tracks** after the:

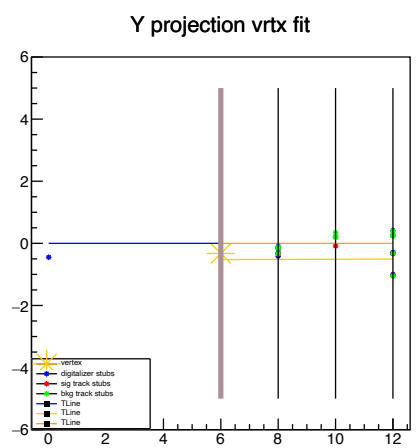
Kinematical fit vrtx ←

Adaptive fit vrtx →









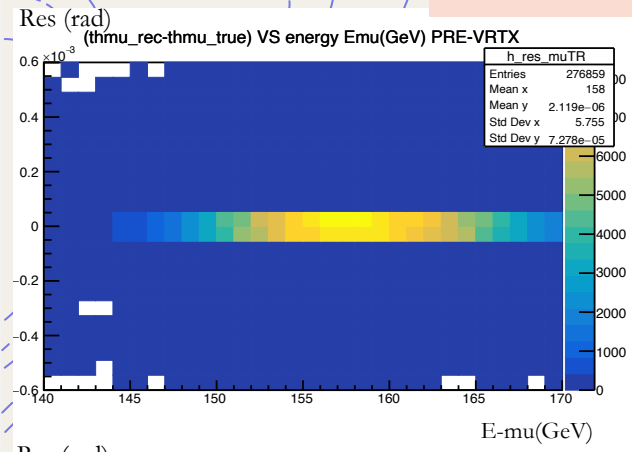
Residual (theta_rec-theta_gen) VS E_mu → NB residual of Polar angles wrt Z axis

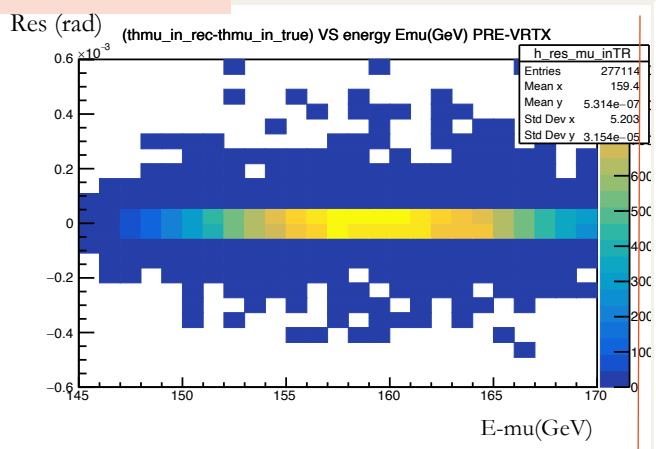
TILT

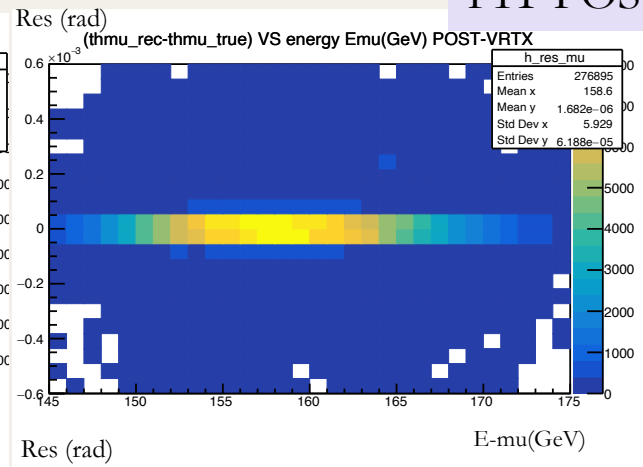
FIT PRE VERTEX

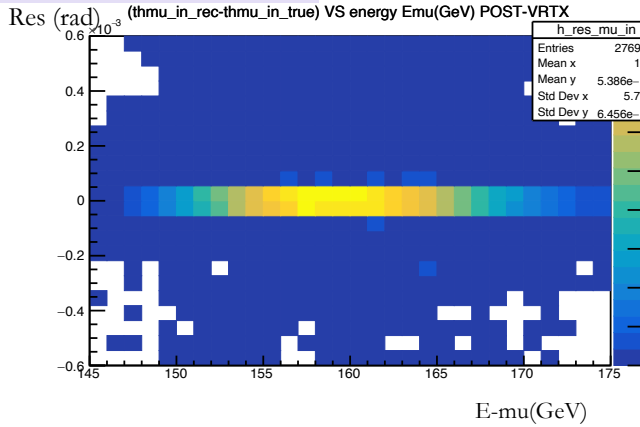
muon

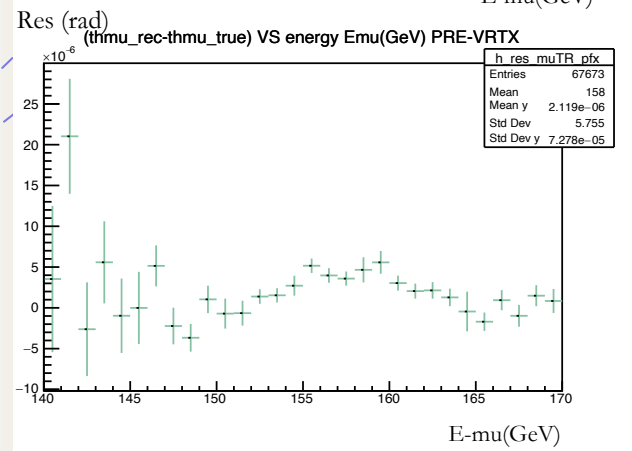
FIT POST VERTEX

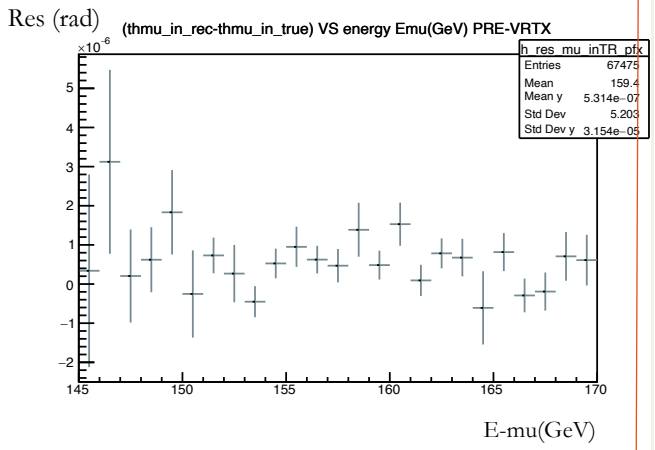


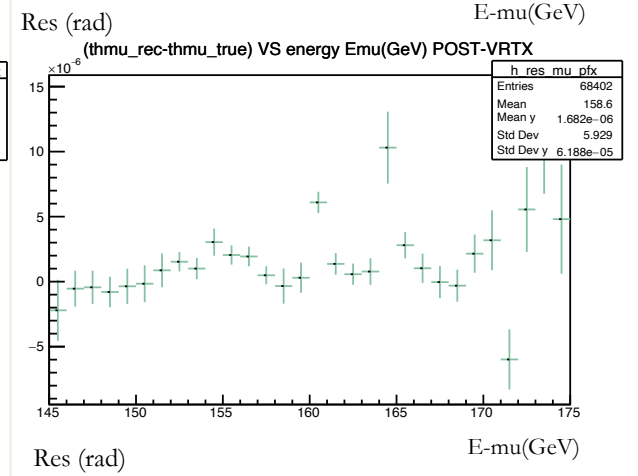


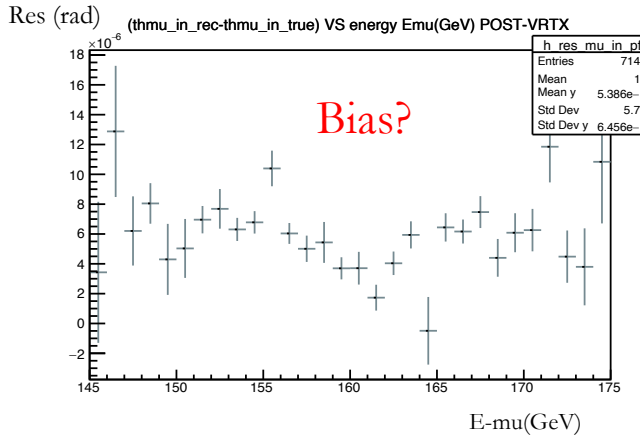


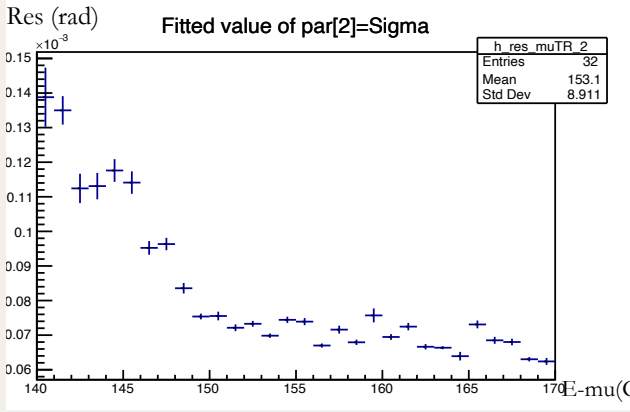


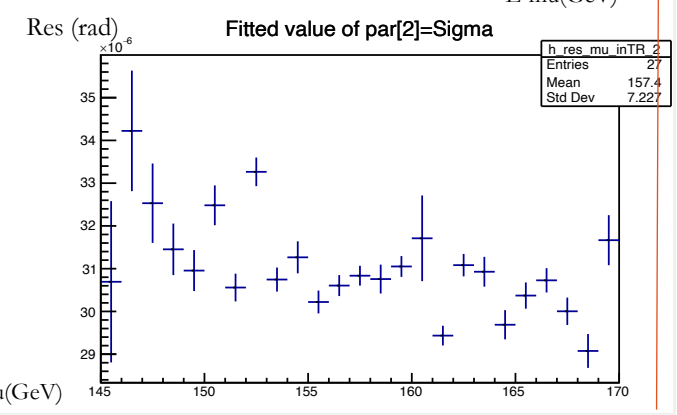


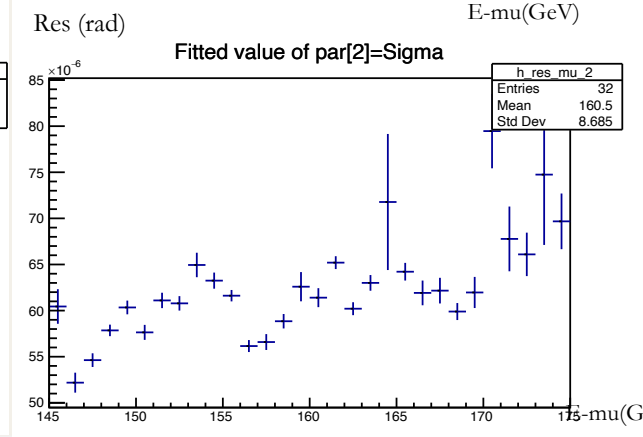


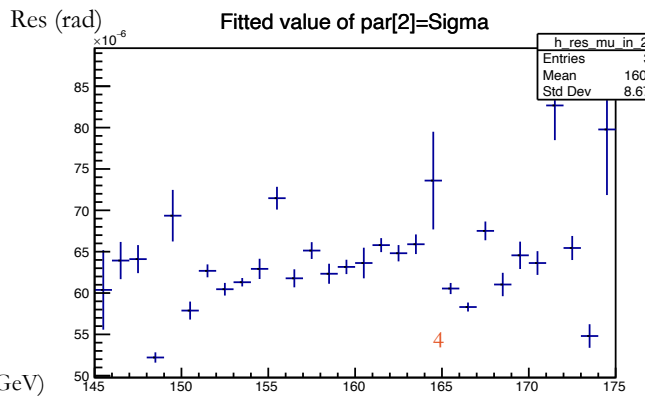












PROBLEM

- Why the **resolution** of the incoming and outgoing muon is so different? That difference is **absent** considering two stations without tilt (next slides)
- **Vertexing** *equalizes* the situation (improving outgoing and worsening incoming) both pre and post vertexing
- The problem needs to be understood as it is urgent, but not easy issue!

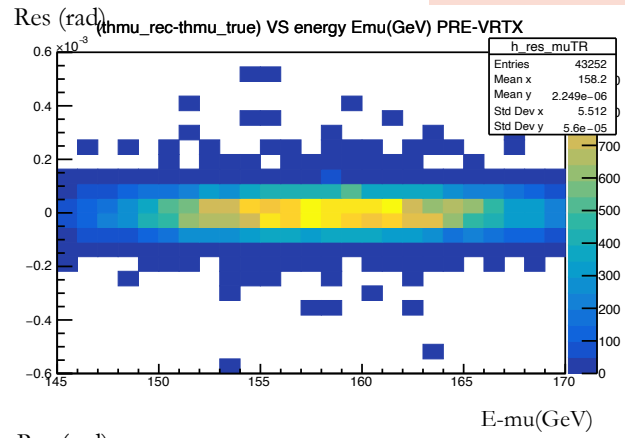
Residual (theta_rec-theta_gen) VS E_mu → NB residual of Polar angles wrt Z axis

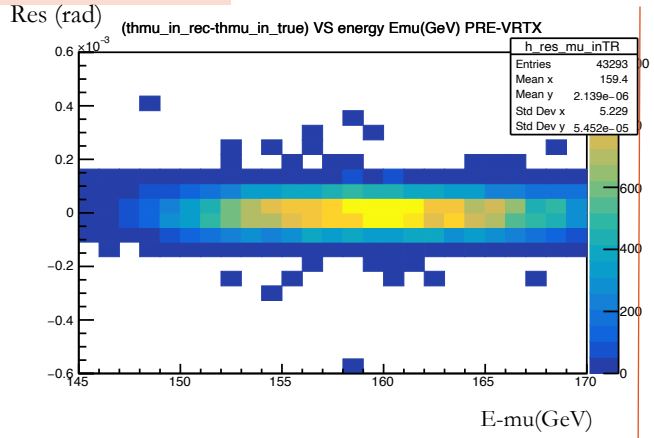
NO TILT

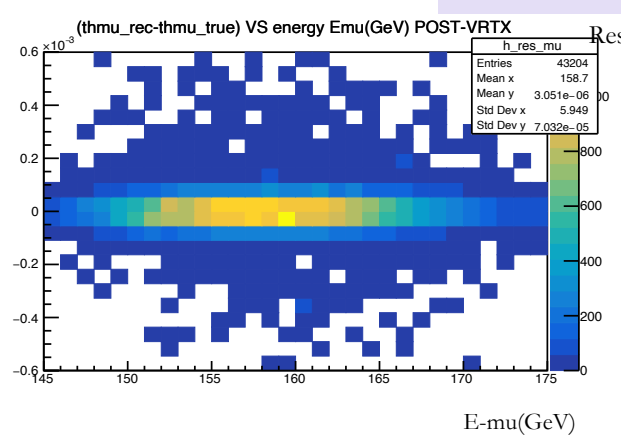
FIT PRE VERTEX

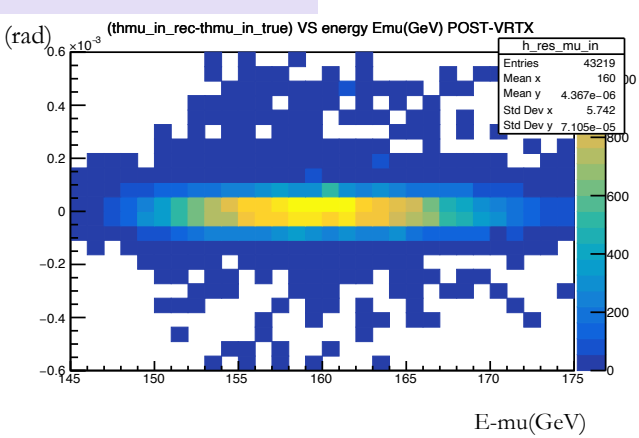
muon

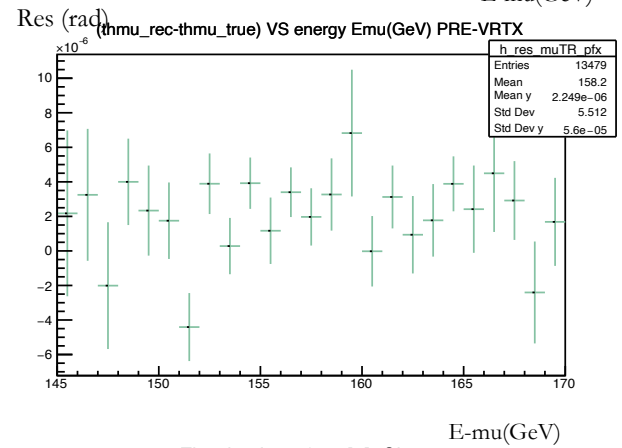
FIT POST VERTEX

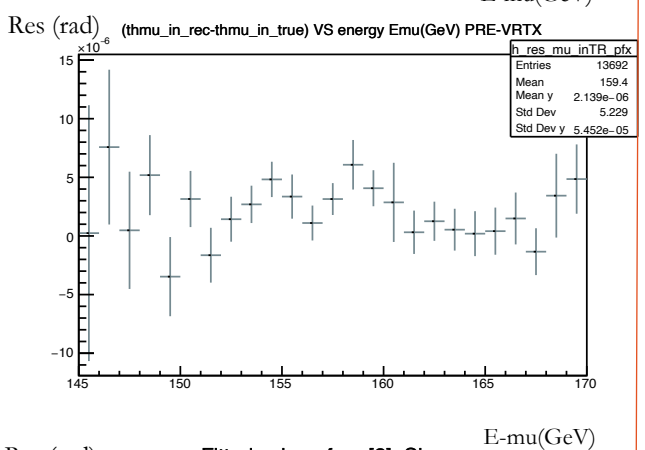


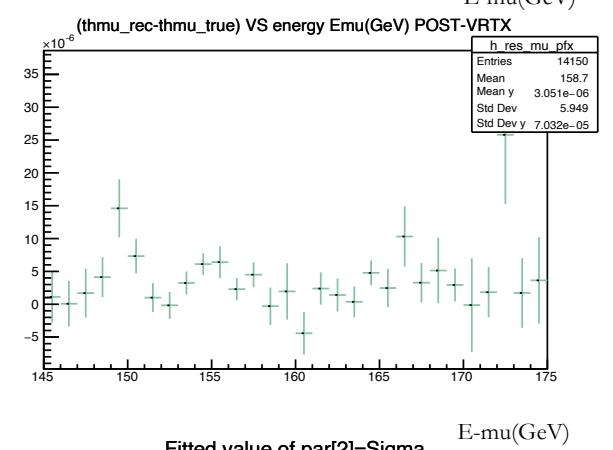


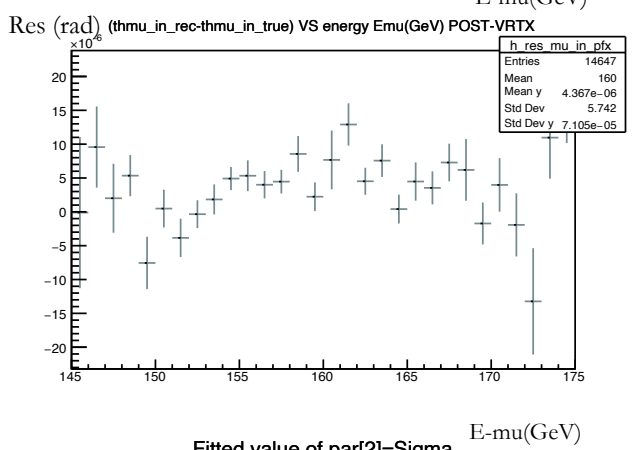


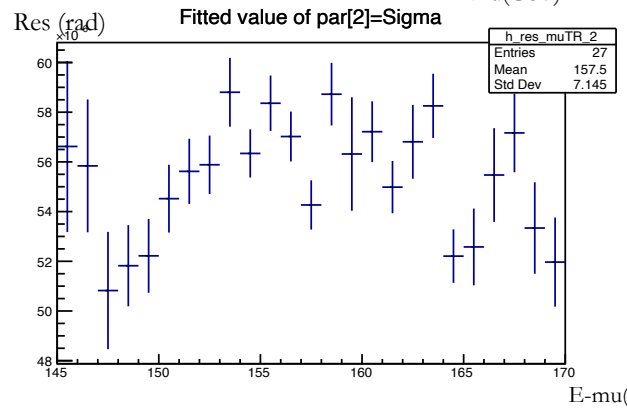


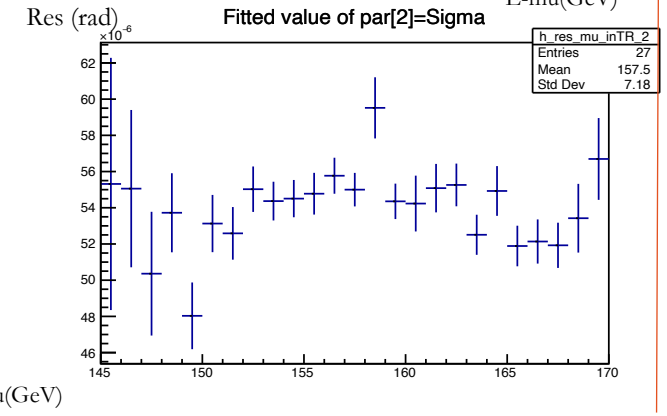


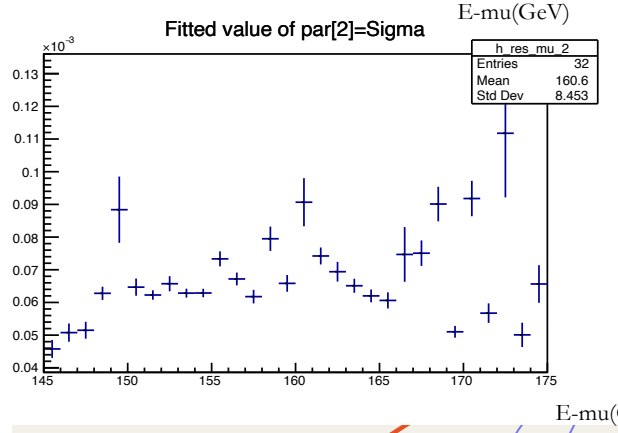


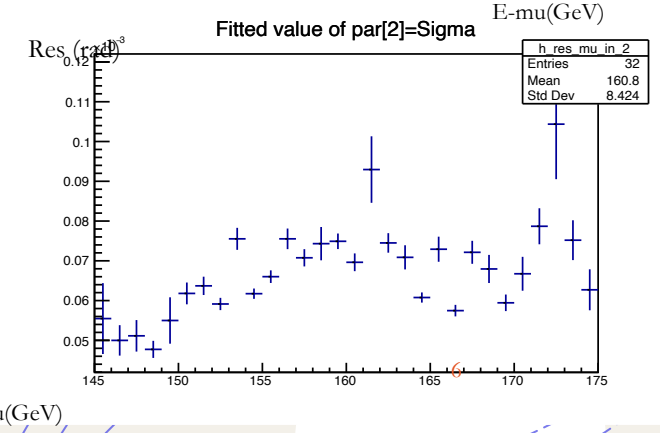












TILT

NO TILT

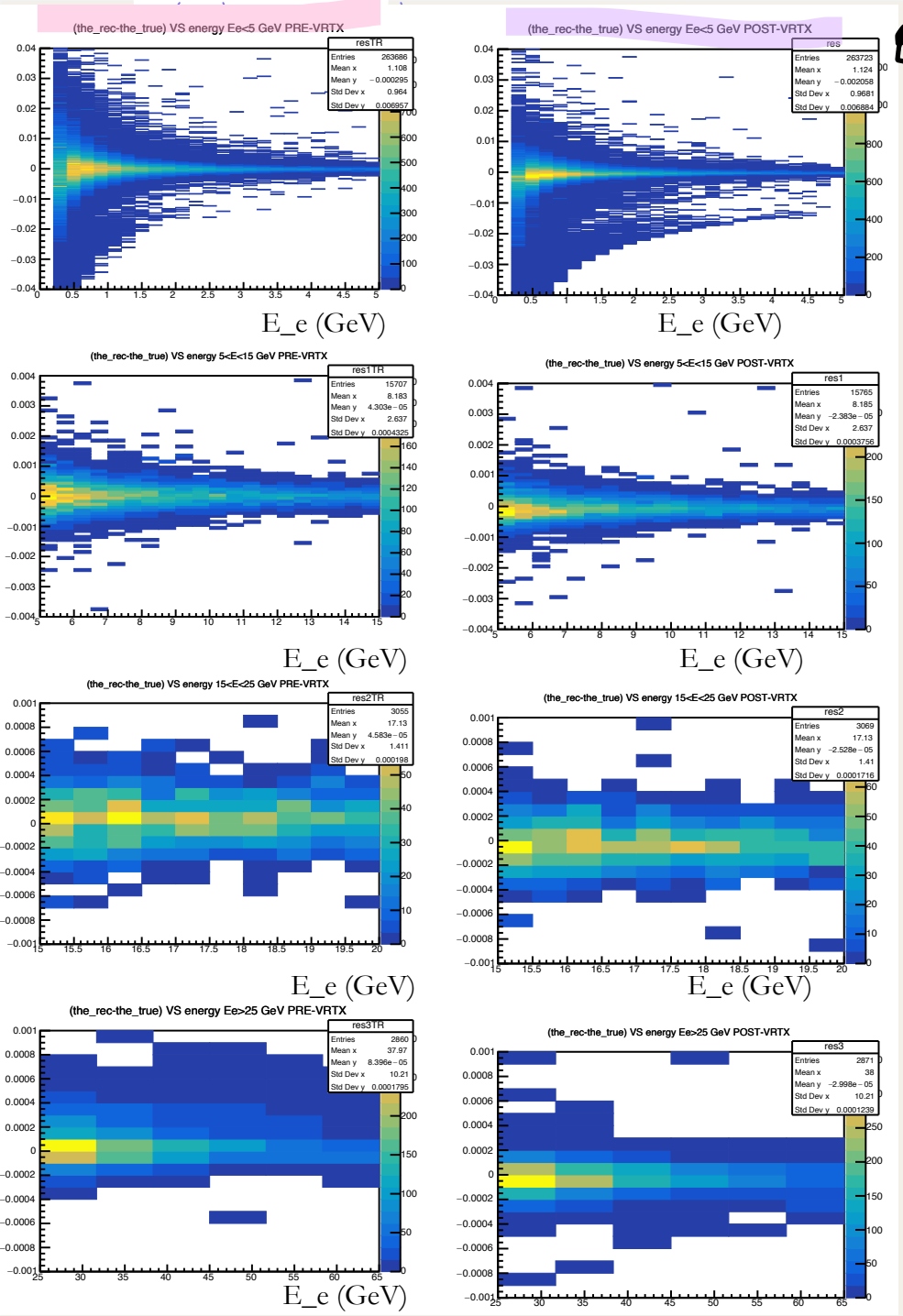
Plots for the electron

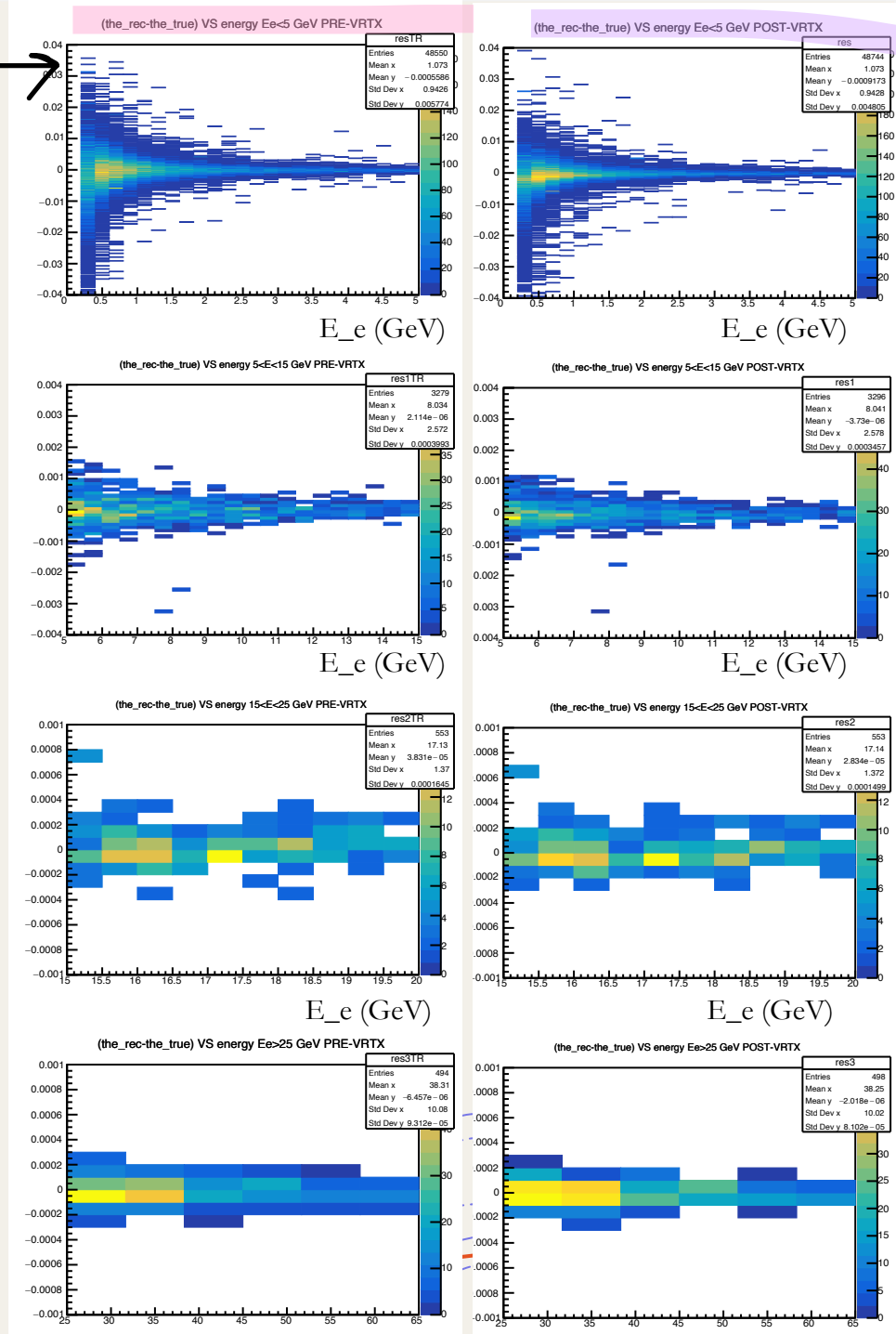
Residual (theta_rec-theta_gen) VS E_e

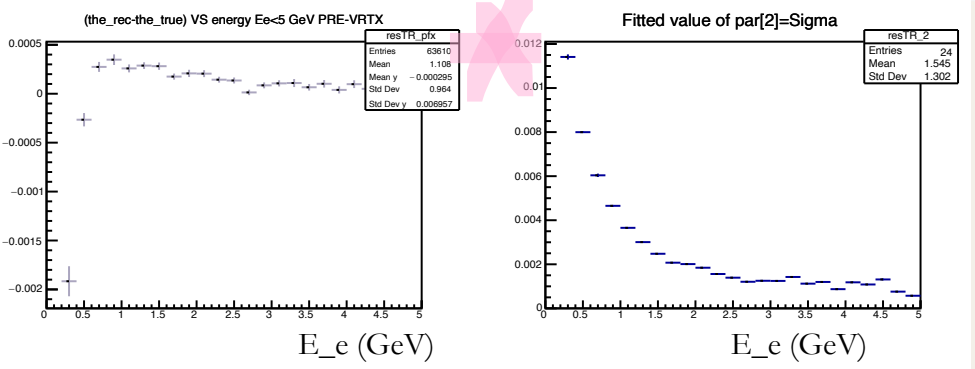
NB residual of **Polar angles** wrt Z axis

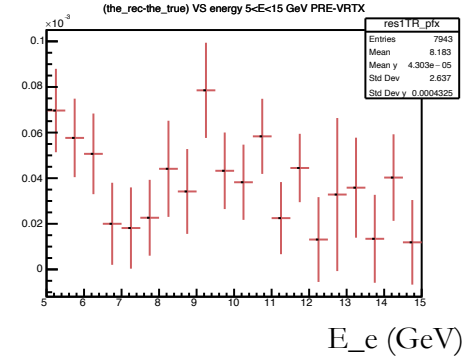
FIT PRE VERTEX on the left

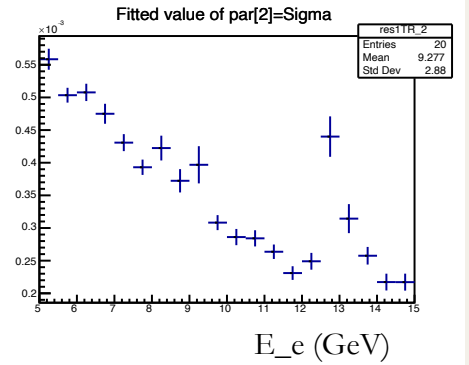
FIT POST VERTEX on the right

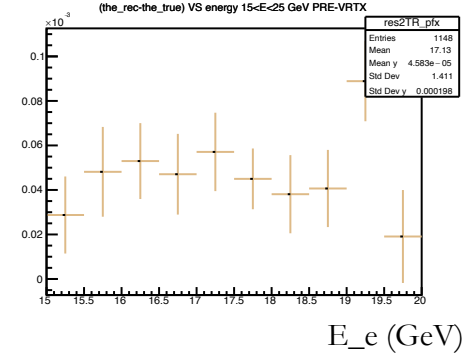


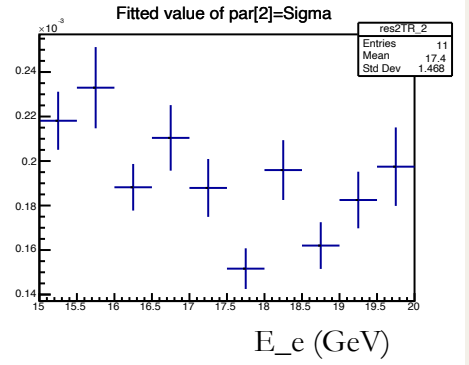


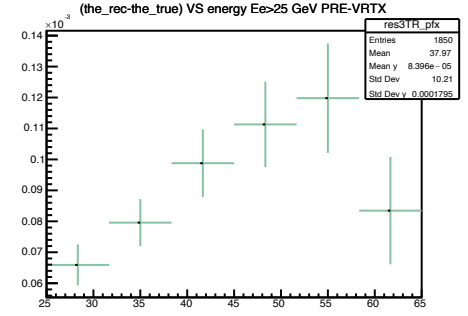


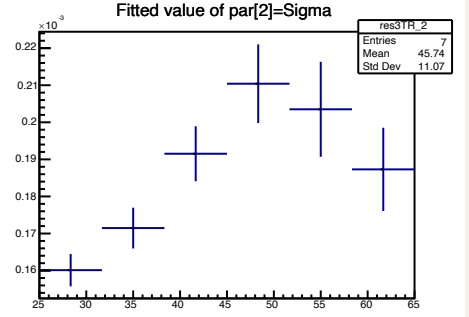


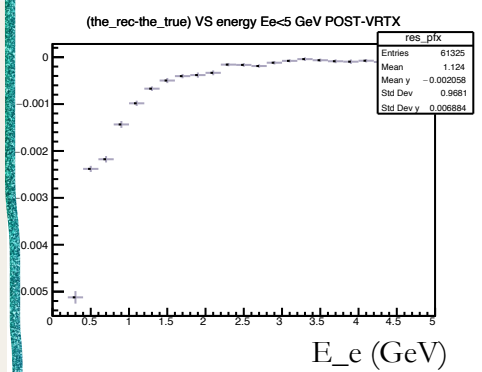


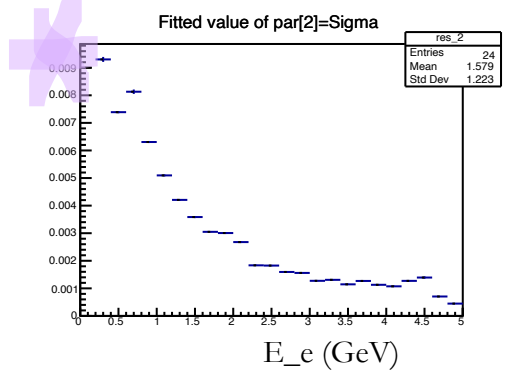


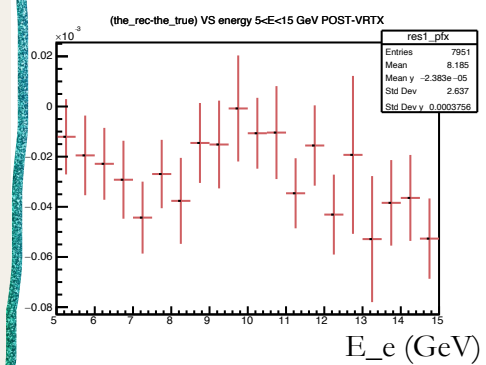


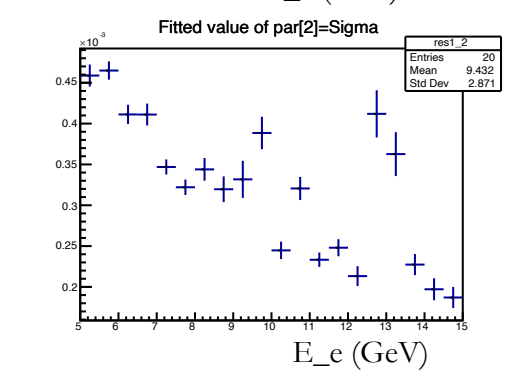


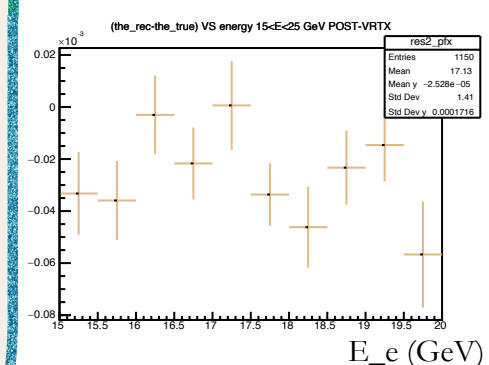


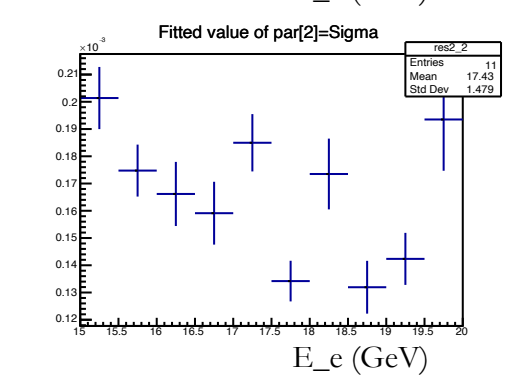


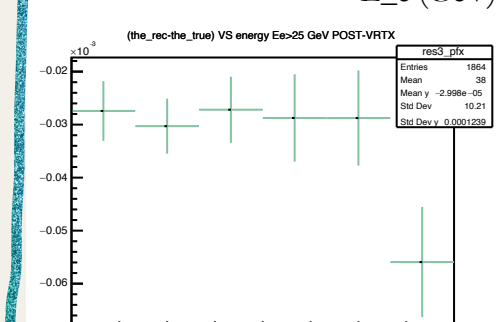


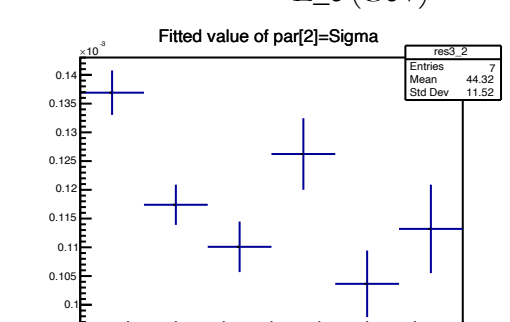










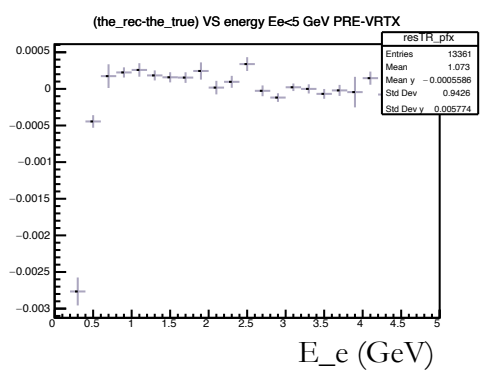


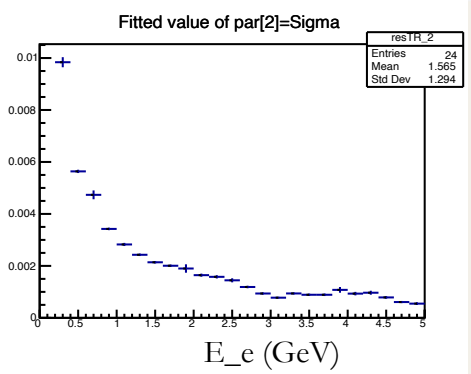
TILT

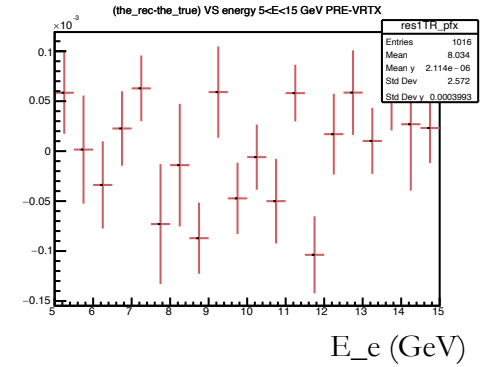
FIT PRE VERTEX
on the left

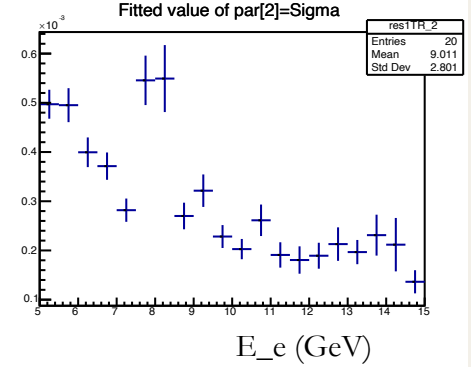
FIT POST VERTEX
on the right

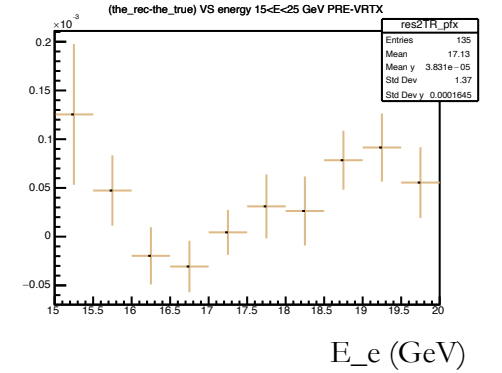
Improves a little bit with vertexing because it accounts for **MCS**

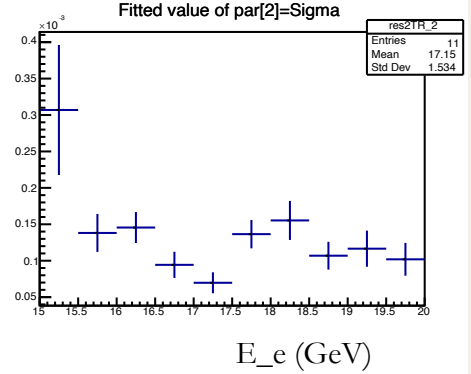


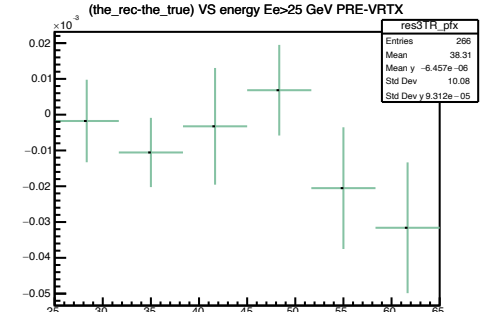


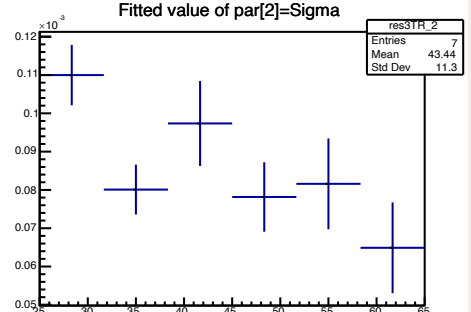


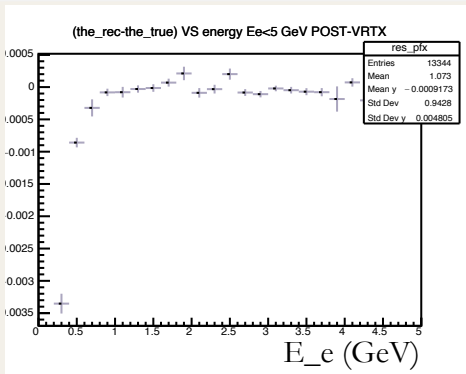


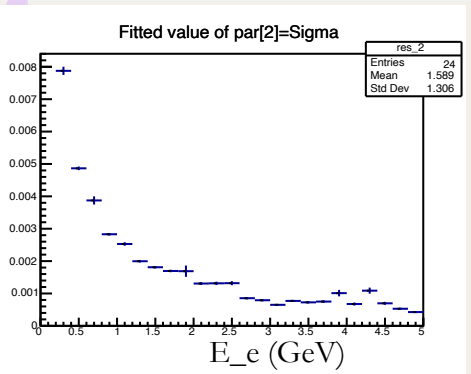


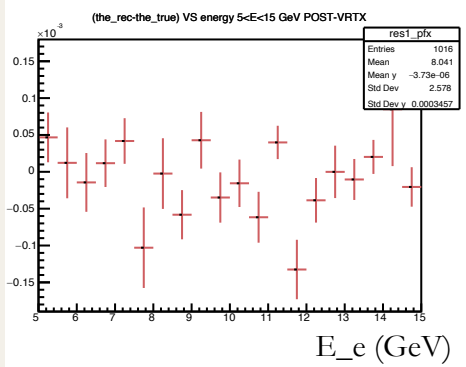


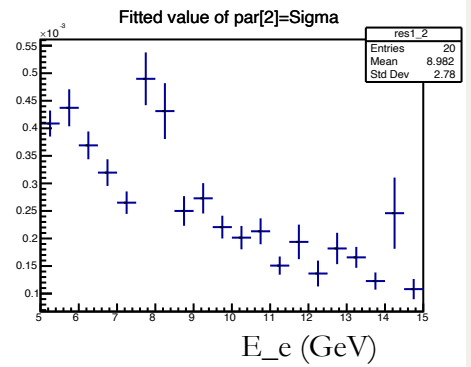


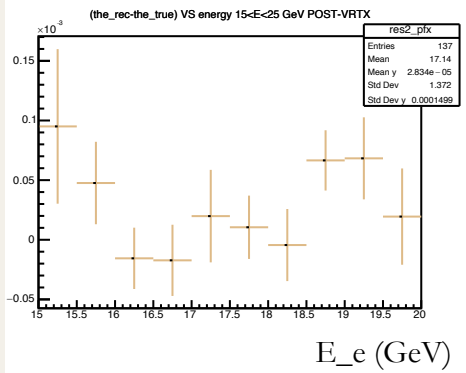


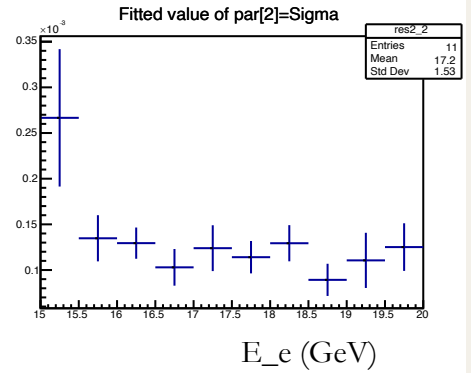


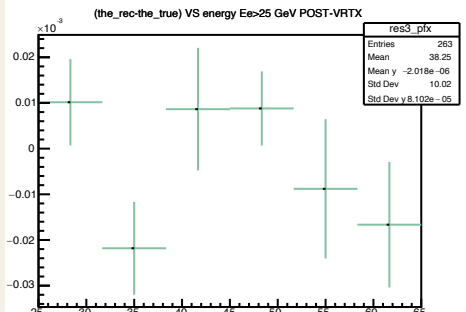


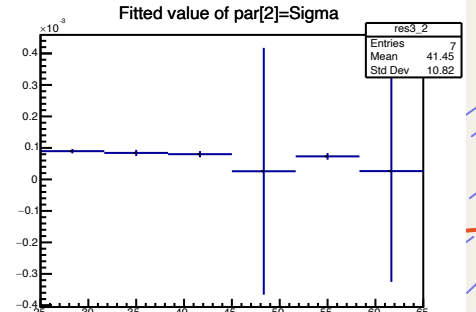








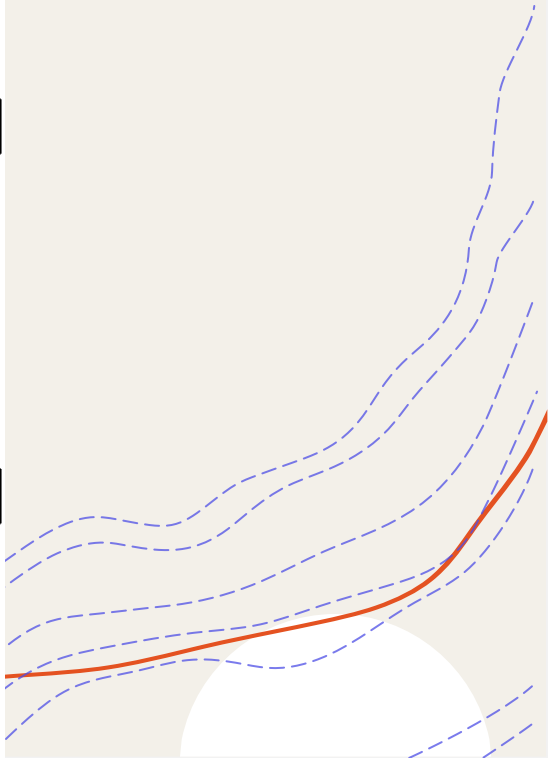


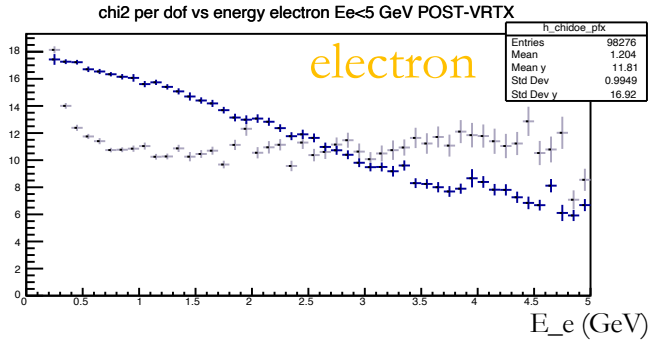


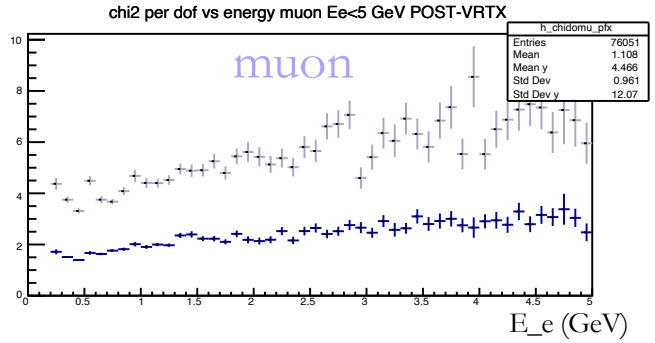
NO TILT

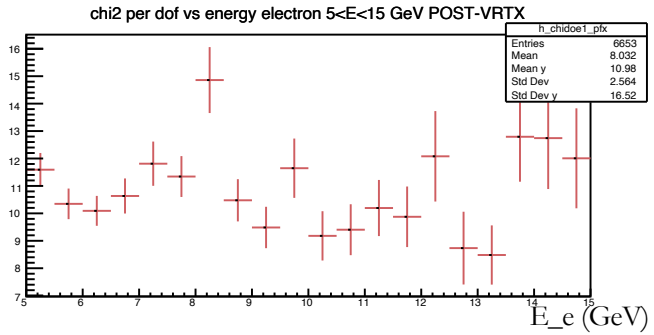
FIT PRE VERTEX
on the left

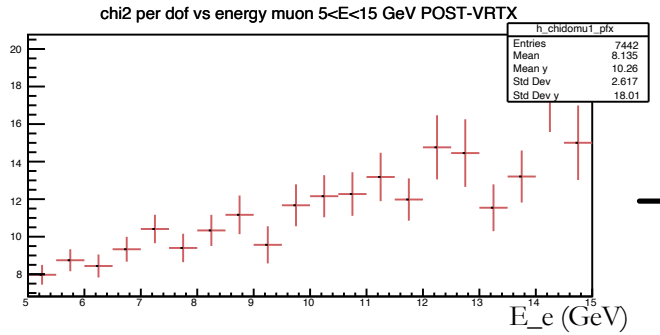
FIT POST VERTEX
on the right

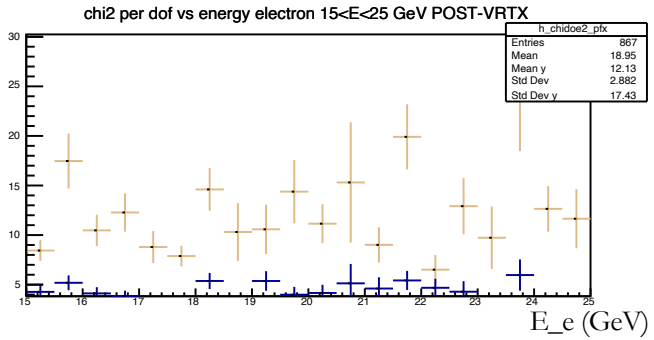


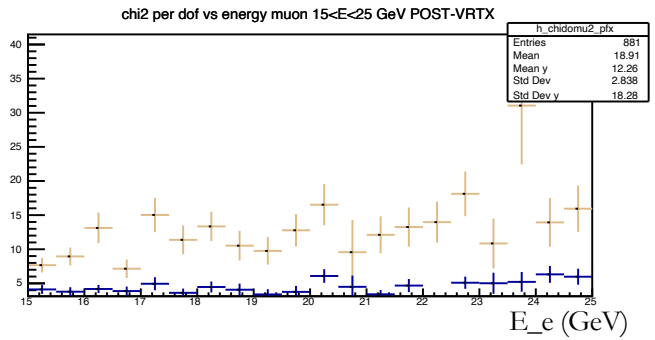


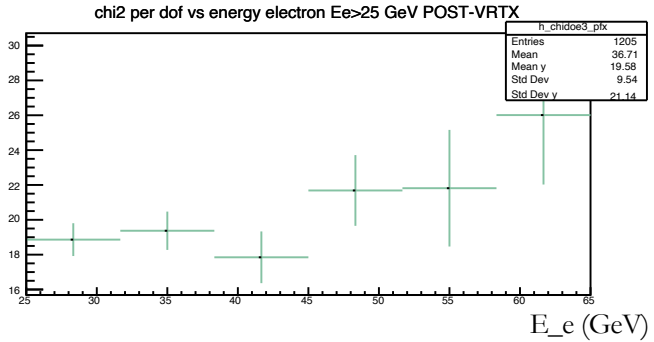


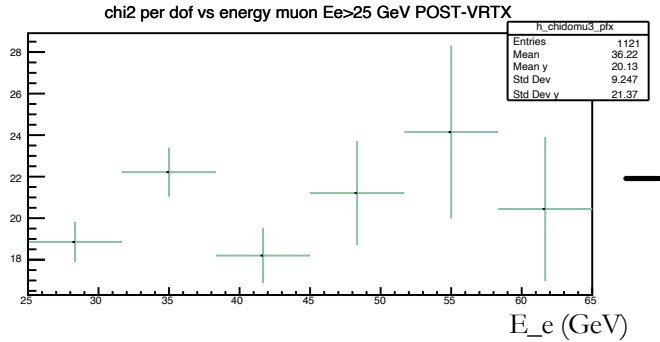












TILT

Mean Chi2/ndof of *electron* and *muon* tracks before and after vertexing as a function of electron energy

Sorry for these two plots, I've made the wrong drawing decision so chi2 before fit vertexing in blue is not visible (this is because it is very low wrt to the one after)

Pair production background

+Started studying **biased** production of e+e- pairs in the target, first attempt: analysis of the Pair Production candidates;

+Multiplicity, quality of the tracks..

SOME PRELIMINARY NUMBERS

Because of some problems

Probably because of cuts/thresholds on Geant4 generation

Number of PP events generated on 100k events:
79.0%

Percentage of PP with outgoing muon+electron or positron:
18.5%

Percentage of PP with outgoing muon+electron+positron:
4.3%

Percentage of PP not in the previous classes:
77.2%

- Cases with wultiplicity = 1,4,5,6 etc..
- Cases where multiplicity is 2/3 **but** the candidates are not linked to muon + electron or positron **or** muon+electron+positron

PROBLEM

+I say preliminary because there's a problem with the bias mechanism

interaction ID = 0 → Muon of the beam

interaction ID = 44 → Muon after PP interaction

+What I *expect* **in reconstruction**:

first station → muon with $intID = 0$

second station → muon with $intID = 44$

+What I *find*:

first station → muon with $intID = 0$

second station → both muon $intID = 0$ and $intID = 44$

Strange behaviour because biasing suppose to suppress the muon beam at the target when the interaction happens!

PROBLEM

It needs to be fixed, understanding if:

+Problem of biasing mechanism (not suppressing the muon from beam)

+Problem in linking

Dealing with linking it would be useful to have a quality/purity variable for *linking* (how many hits of the track associated to a given particle really belong to that MC particle)